SUPPLEMENT

TO THE

ENCYCLOPÆDIA,

OR

DICTIONARY

OF

ARTS, SCIENCES,

AND

MISCELLANEOUS LITERATURE.

IN THREE VOLUMES.

Illustrated with Copperplates.

NON IGNORO QUÆ BONA SINT, FIERI MELIORA POSSE DOCTRINA, ET QUÆ NON OPTIMA,
ALIQUO MODO ACUI TAMEN, ET CORRIGI POSSE.—*CICERO.*

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SUPPLEMENT

TO THE

ENCYCLOPÆDIA.

CRITICAL PHILOSOPHY.

1 Origin of the ſcience. CRITICAL PHILOSOPHY, is the appellation given to a ſyſtem of ſcience, of which the founder is *Immanuel Kant*, regius profeſſor of logic and metaphyſics in the univerſity of Koenigſberg. Of this ſyſtem, which is very generally admired in Germany, we promiſed, in our Proſpectus, to gratify our ſpeculative readers with a ſhort view; and that promiſe we are enabled to fulfil, by the kind communication of an illuſtrious foreigner, who, after acting a conſpicuous part on the theatre of the world, and ſtriving in vain to ſtem the torrent of democratic innovation, is now living an exile from his wretched country, and cultivating the ſciences and the arts of peace.

2 Obſcurity of its language. "To explain (ſays he) the philoſophy of Kant in all its details, would require a long and a painful ſtudy, without producing any real advantage to the reader. The language of the author is equally obſcure, and his reaſonings equally ſubtle, with thoſe of the commentators of Ariſtotle in the 15th century."

The truth of this aſſertion will be denied by none, who have endeavoured to make themſelves maſters of the works of *Willich* and *Nitſch* on the critical philoſophy; and the ſource of this obſcurity ſeems to be ſufficiently obvious. Beſides employing a vaſt number of words of his own invention, derived from the Greek language, Kant uſes expreſſions, which have long been familiar to metaphyſicians, in a ſenſe different from that in which they are generally received; and hence a large portion of time is requiſite to enable the moſt ſagacious mind to aſcertain with preciſion the import of his phraſeology.

The difficulty of comprehending this philoſophy has contributed, we believe, more than any thing elſe, to bring it into vogue, and to raiſe the fame of its author. Men are aſhamed, after ſo laborious and fatiguing a ſtudy, to acknowledge that all their labour has been thrown away; and vanity prompts almoſt every man to raiſe the importance of that branch of ſcience which is underſtood but by a few, and in which he is conſcious that his own attainments have been great. "We acknowledge, however, that in the ſyſtem of Kant there is diſplayed much genius, combination, and ſyſtematic arrangement; but this only affords one of the many reaſons which it preſents, for our regretting that the author has not directed his mind to more uſeful reſearches, and that he has waſted the ſtrength of his genius in rendering uncertain the moſt comfortable truths, and in giving the appearance of novelty to opinions for the moſt part taught long before his day.

The following analyſis, we believe, will ſufficiently enable any one, at all converſant with metaphyſical ſcience, to form a judgment of this celebrated ſyſtem; and our correſpondent, on whoſe word the reader may rely, aſſures us, that in detailing the principles of Kant, he has taken ſpecial care to exhibit them with the utmoſt poſſible exactneſs, having ſeveral times preferred the obſcurity of the author's reaſonings and language, to the danger of a falſe, though more perſpicuous, interpretation.

3 Diviſion of human knowledge. "Kant divides all our knowledge into that which is *a priori*, and that which is *a poſteriori*. Knowledge *a priori* is conferred upon us by our nature. Knowledge *a poſteriori* is derived from our ſenſations, or from experience; and is by our author denominated *empyric*. One would at firſt be induced, by this account of the origin of human knowledge, to believe that Kant intended to revive the ſyſtem of *innate ideas*; but we very quickly diſcover that ſuch is not his ſyſtem. He conſiders all our knowledge as acquired. He maintains, that experience is the *occaſional cauſe* or *productrice* of all our knowledge; and that without it we could not have a ſingle idea. Our ideas *a priori*, he ſays, are produced *with* experience, and could not be produced *without* it; but they are not produced *by* it, or do not proceed *from* it. They exiſt in the mind; they are the *forms* of the mind. They are diſtinguiſhed from other ideas by two marks, which are eaſily diſcerned; *i. e.* they appear *univerſal* and *neceſſary*; or, in other words, they admit of no exception, and their *converſe* is impoſſible. Ideas which we derive from experience have no ſuch characters. We can ſuppoſe, that what we have ſeen, or felt, or heard once, we may ſee, or feel, or hear again; but we do not perceive any impoſſibility in its being otherwiſe. For inſtance, a houſe is on fire in my view: I am certain of this fact; but it affords me no *general* or *neceſſary* knowledge. It is altogether *a poſteriori*; the materials are furniſhed by the individual impreſſion which I have received; and that impreſſion might have been very different.

"But if I take twice two ſmall balls, and learn to call twice two *four*, I ſhall be immediately convinced, that any two bodies whatever, when added to any two other bodies will conſtantly make the ſum of bodies *four*. Experience has indeed afforded me the *opportu-*

nity of acquiring this knowledge; but it has not given it to me; for how could experience prove to me that this truth ſhall never vary? Experience muſt always be *limited*; and therefore cannot teach us that which is *neceſſary* and *univerſal*. It is not experience which diſcovers to us, that we ſhall always have the ſurface of the whole pyramid by multiplying its baſe by the third part of his height; or that two parallel lines, extended *in infinitum*, ſhall never meet.

“ All the truths of pure mathematics are, in the language of Kant, *a priori*. Thus, that a ſtraight line is the ſhorteſt of all poſſible lines between two fixed points; that the three angles of a triangle are always equal to two right angles; that we have the ſame ſum, whether we add 5 to 7 or 7 to 5; and that we have the ſame remainder when we ſubtract 5 from 10 as when we ſubtract 10 from 15—are ſo many propoſitions, which are true *a priori*.

4 Pure knowledge *a priori*.

“ Pure *knowledge a priori*, is that which is abſolutely without any mixture of experience. *Two and two men* make *four men*, is a truth, of which the knowledge is *a priori*; but it is not PURE knowledge, becauſe the truth is particular. The ideas of *ſubſtance*, and of *cauſe* and *effect*, are *a priori*; and when they are ſeparated from the objects to which they refer (we ſuppoſe from this or that *particular* object), they form, in the language of Kant, *void ideas* (A). It is our knowledge *a priori*, *i. e.* that knowledge which precedes experience as to its origin, which renders experience poſſible (B). Our faculty of knowledge has an effect on our ideas of ſenſation analogous to that of a veſſel, which gives its own form to the liquor with which it is filled. Thus, in all our knowledge *a poſteriori*, there is ſomething *a priori* derived from our faculty of knowledge. All the operations of our minds; all the impreſſions which our external and internal ſenſes receive and retain, are brought into effect by the *conditions*, the *forms*, which exiſt in us by the pure ideas *a priori*, which alone render all our other knowledge certain.

5 Time and ſpace.

“ *Time* and *ſpace* are the two eſſential forms of the mind: the former for impreſſions received by the internal ſenſe; the ſecond for thoſe received by our external ſenſes. Time is neceſſary in all the *immediate* (perhaps *intuitive*) perceptions of objects; and ſpace in all *external* perceptions.

6 Extenſion.

“ *Extenſion* is nothing real but as the form of our ſenſations. If extenſion were known to us only by experience, it would then be poſſible to conceive that there might be ſenſible objects without ſpace.

7 Impenetrability, &c.

“ It is by means of the form *ſpace* that we are enabled, *a priori*, to attribute to external objects *impenetrability*, *diviſibility*, *mobility*, &c.; and it is by means of the form *time* that we attribute to any thing *duration*, *ſucceſſion*, *ſimultaneity*, *permanence*, &c.

8 Origin of arithmetic and geometry.

“ *Arithmetic* is derived from the form of our internal ſenſe, and *geometry* from that of our external.

9 Unifying power of the mind.

“ Our underſtanding collects the ideas received by the impreſſions made on our organs of ſenſe, confers on theſe ideas *unity* by a particular *force* (we ſuppoſe energy) *a priori*; and thereby forms the repreſentation of each object. Thus, a man is ſucceſſively ſtruck with the impreſſions of all the parts which form a particular garden. His underſtanding unites theſe impreſſions, or the ideas reſulting from them; and in the unity produced by that unifying act, it acquires the idea of the garden. If the objects which produce the impreſſions afford alſo the *matter* of the ideas (C), then the ideas are *empyric*; but if the objects only unfold the *forms of the thought*, the ideas are *a priori*. The act of the underſtanding which unites the perceptions of the various parts of an object into the perception of one whole, is the ſame with that which unites the attribute with its ſubject.

10 Analytic judgments.

“ Judgments are divided into two ſpecies; *analytic* and *ſynthetic*. An analytic judgment is that in which the attribute is the mere developement of the ſubject, and is found by the ſimple analyſis of the perception; as *bodies are extended*; *a triangle has three ſides*.

11 Synthetic judgments.

“ A ſynthetical judgment is that where the attribute is connected with the ſubject by a cauſe (or baſis) taken from the faculty of knowledge, which renders this connection neceſſary: as, *a body is heavy*; *wood is combuſtible*; *the three angles of a triangle are equal to two right angles*. There are ſyntheſes *a priori* and *a poſteriori*; and the former being formed by experience, we have the ſure means of avoiding deception.

“ It is a problem, however, of the utmoſt importance, to diſcover how ſynthetic judgments *a priori* are poſſible. How comes it, for example, that we can affirm that all the radii of a circle are equal, and that two parallel lines will never meet? It is by ſtudying the *forms* of our mind that we diſcover the poſſibility of making theſe affirmations. In all objects there are things which muſt neceſſarily be THOUGHT (be ſupplied by thought); as, for example, that there is *a ſubſtance*, an *accident*, a *cauſe*, and certain *effects*.

12 Forms of the underſtanding.

“ The *forms* of the underſtanding are, *quantity*, *quality*, *relation*, *modality*.

“ Quantity, Kant diſtinguiſhes into *general*, *particular*, and *individual*; quality, into *affirmation*, *negation*, *infinite*; relation, into *categoric*, *hypothetic*, and *disjunctive*; and modality, into *problematic*, *certain*, and *neceſſary*. He adds alſo to theſe properties of the four principal forms of the underſtanding, a table of *categories*, or fundamental ideas *a priori*.

13 Categories.

“ Quantity, gives *unity*, *plurality*, *totality*. Quality, gives *reality*, *negation*, *limitation*. Relation, gives *inherence*, *ſubſtance*, *cauſe*, *dependence*, *community*, *reciprocity*. Modality, gives *poſſibility*, *impoſſibility*, *exiſtence*, *nothing*, *neceſſity*,

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(A) In the language of Locke *abſtract ideas*.

(B) In our correſpondent's manuſcript, this ſentence runs thus: “ It is our knowledge *a priori*, or that knowledge which *entirely precedes experience* as to its origin, which experience renders poſſible;” but here muſt be ſome miſtake, either by the tranſlator or by the amanuenſis. Kant's philoſophy is abundantly obſcure and paradoxical; but it ſurely never entered into his head to repreſent the effect as prior in its origin to the very cauſe which alone renders it poſſible. The context, too, ſeems to us to agree better with the meaning of the ſentence as we have printed it in the text.

(C) This is wonderful jargon; but the reader will reflect that it is not ours.

neceſſity, accident. Theſe categories can only be applied to experience. When, in the conſideration of an object, we abſtract all that regards ſenſation, there remain only the pure ideas of the underſtanding, or the *categories*, by which a *thing* is conceived as a *thing*.

"Pure reaſon is the faculty of tracing our knowledge *a priori*, to ſubject it to principles, to trace it from its neceſſary conditions, till it be entirely without condition, and in complete unity. This pure reaſon has certain fundamental rules, after which the neceſſary connection of our ideas is taken for the determination of the objects in themſelves;—an illuſion which we cannot avoid, even when we are acquainted with it. We can conclude from what we know to what we do not know; and we give an *objective* reality to theſe concluſions from *an appearance* which leads us on.

14 Critique of pure reaſon. "The writings of Kant are multifarious; but it is in his work entitled the *Critique of Pure Reaſon* that he has chiefly expounded his ſyſtem. This work is a treatiſe on a pretended ſcience, of which Kant's ſcholars conſider him as the founder, and which has for its objects the *natural forces*, the *limits of our reaſon*, as the ſource of our pure knowledge *a priori*, the *principles of all truth*. Kant does not propoſe to give even an expoſition of theſe branches of knowledge, but merely to examine their origin; not to extend them, but to prevent the bad uſe of them, and to guard us againſt error. He denominates this ſcience *tranſcendental criticiſm*; becauſe he calls all knowledge, of which the object is not furniſhed by the ſenſes, and which concerns the kind and origin of our ideas, *tranſcendental knowledge*. The Criticiſm of Pure Reaſon, which gives only the fundamental ideas and maxims *a priori*, without explaining the ideas which are derived from them, can lead (ſays Kant) to a complete ſyſtem of pure knowledge, which ought to be denominated *tranſcendental philoſophy*, of which it (the *Criticiſm*, &c.) preſents the *architectonic* plan, *i.e.* the plan regular and well diſpoſed.

"The work entitled *The Critique of Pure Reaſon*, is divided into ſeveral parts or ſections, under the ridiculous titles of *Æſthetic tranſcendental*; of *tranſcendental logic*; of *the pure ideas of the underſtanding*; of *the tranſcendental judgment*; of *the paralogiſm of pure reaſon*; of *the ideal tranſcendental*; of *the criticiſm of ſpeculative theologies*; of *the diſcipline of pure reaſon*, &c.

15 We cannot know objects as they are in themſelves. "But to proceed with our abſtract of the ſyſtem. We know objects only by the manner in which they affect us; and as the impreſſions which they make upon us are only certain *apparitions* or phenomena, it is impoſſible for us to know what an *object is in itſelf*. In conſequence of this aſſertion, ſome have ſuppoſed that Kant is an *idealiſt* like Berkeley and ſo many others, who have thought that ſenſations are only *appearances*, and that there is no truth but in our reaſon; but ſuch is not the opinion of Kant (D). According to him, our underſtanding, when it conſiders the apparitions or phenomena, acknowledges the *exiſtence* of the objects in themſelves, inaſmuch as they ſerve for the baſes of thoſe apparitions; though we know nothing of their *reality*, and though we can have no certitude but in experience.

"When we apply the *forms* of our underſtanding, ſuch as *unity*, *totality*, *ſubſtance*, *caſuality*, *exiſtence*, to certain ideas which have no object in *ſpace* and time, we make a fallacious and arbitrary application. All theſe forms can bear only on ſenſible objects, and not on the *world of things in itſelf*, of which we can THINK, but which we CAN NEVER KNOW. Beyond things ſenſible we can only have *opinions* or a *belief* of our reaſon.

16 Objective and ſubjective truths. "The motives to conſider a propoſition as true, are either *objective*, *i. e.* taken from an *external* object, ſo that each man ſhall be obliged to acknowledge them; and then there is a truth *evident* and ſuſceptible of *demonſtration*, and it may be ſaid that we are *convinced*; or the motives are *ſubjective*, *i. e.* they exiſt only in the mind of him who judges, and he is *perſuaded*.

"TRUTH, then, conſiſts in the agreement of our *notions* with the *objects*, in ſuch a manner as that all men are obliged to form the ſame judgment; BELIEF conſiſts in holding a thing for true in a *ſubjective manner*, in conſequence of a perſuaſion which is entirely perſonal, and has not its baſis in an object ſubmitted to experience.

17 Belief. "There is a *belief of doctrine*, of which Kant gives, as an example, this aſſertion—'there are inhabitants in the planets.' We muſt acknowledge (he adds) that the ordinary mode of teaching the exiſtence of God belongs to *the belief of doctrine*, and that it is the ſame with *the immortality of the ſoul*. *The belief of doctrine* (he continues) has in itſelf ſomething *ſtaggering*; but it is not the ſame with *moral belief*. In moral belief there is ſomething *neceſſary*; it is (ſays he), that I ſhould obey the law of morality in all its parts. The end is ſtrongly eſtabliſhed; and I can perceive only one condition, by means of which this end may be in accord with all the other ends, *i. e.* that *there is a God*. I am certain that no man knows any other condition which can conduct to the ſame unity of end under the moral law; which law is a law of my reaſon. 18 Proof of the exiſtence of God, &c. I will conſequently believe certainly the *exiſtence of God*, and a *future life*; becauſe this perſuaſion renders immoveable my moral principles—principles which I cannot reject without rendering myſelf contemptible in my own eyes. I wiſh for happineſs, but I do not wiſh for it without morality; and as it depends on *nature*, I cannot wiſh it with this condition, except by believing that nature depends on a Being who cauſes this connection between morality and happineſs. This ſuppoſition is founded on the *want* (or *neceſſity*) of my reaſon, and not on my duty.

"We have, however, no *certainty* (ſays Kant) in our knowledge of God, becauſe certainty cannot exiſt except when it is founded on an object of experience. The philoſopher acknowledges, that *pure reaſon* is too weak to prove the exiſtence of a being beyond the reach of our ſenſes. The neceſſity of believing in God is therefore only *ſubjective*, although neceſſary and general for all thoſe beings who conform to their duty. This is not *knowledge*, but only a *belief* of reaſon, which

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(D) We muſt requeſt the reader to obſerve that this is the language of our correſpondent. We have ſhewn elſewhere, that Berkeley did not deny the reality of ſenſations: and we hope to ſhew by and bye, that Kant is as much an *idealiſt* as he was, if this be a fair view of the Critical Philoſophy.

ſupplies the place of a knowledge which is impoſſible (E).

“ The proofs of natural theology (ſays our philoſopher) taken from the order and beauty of the univerſe, &c. are proofs only in *appearance*. They reſolve themſelves into a bias of our reaſon to *ſuppoſe* an Infinite Intelligence as the author of all that is poſſible; but from this bias it does not follow that there really is ſuch an Author. To ſay, that whatever exiſts muſt have a cauſe, is indeed a maxim *a priori;* but it is a maxim applicable only to experience, for one knows not how to ſubject to the laws of our perceptions that which is abſolutely independent of them. It is as if we were to ſay, that whatever exiſts in experience muſt have an experience; but the world, taken as a whole, is without experience as well as its cauſe. It is much better to draw the proof of the exiſtence of God from morality, than to weaken it by ſuch reaſoning. This proof is relative. It is impoſſible to *know* that God exiſts; but we can comprehend how it is poſſible to act morally on the *ſuppoſition* of the exiſtence (although incomprehenſible) of an intelligent Creator—an exiſtence which PRACTICAL REASON forces THEORETICAL *reaſon* to adopt. This proof not only *perſuades*, but even acts on the CONVICTION, in proportion as the motives of our actions are conformable to the law of morality.

“ Religion ought to be the *means* of virtue and not its object. Man has not in himſelf the idea of religion as he has that of virtue. The latter has its principle in the mind; it exiſts in itſelf, and not as the means of happineſs; and it may be taught without the idea of a God, for the pure law of morality is *a priori*.

19 Morality.

“ He who does good by inclination does not act *morally*. The converſe of the principle of morality is to make perſonal happineſs the baſis (F) of the will. There are compaſſionate minds which feel an internal pleaſure in communicating joy around them, and who thus enjoy the ſatisfaction of others; but their actions, however juſt, however good, have no moral merit, and may be compared to other inclinations; to that of honour (for example), which, whilſt it meets with that which is juſt and uſeful, is worthy of praiſe and encouragement, but not of any high degree of eſteem. According to Kant, we ought not even to *do good*, either for the pleaſure we feel in doing it, or in order to be happy, or to render others happy; for any one of theſe additions (perhaps motives) would be *empyric*, and injure the purity of our morals. A reaſonable being ought to deſire to be exempted from all *inclinations*, and never to do his duty but for his duty's ſake.

“ We ought to act after the maxims derived *a priori* from the faculty of knowledge, which carry with them the idea of neceſſity, and are independent of all experience; after the maxims which, it is to be wiſhed, could be erected into GENERAL LAWS for all beings endowed with reaſon.”

20 Futility of this ſyſtem

If this be a correct view of the object and the reſults of the critical philoſophy, and the character of him from whom we received it permits us not to doubt of its being nearly correct, we confeſs ourſelves unable to diſcover any motive which ſhould induce our countrymen, in their reſearches after truth, to prefer the dark lantern of Kant to the luminous torch of Bacon. The metaphyſical reader will perceive, that, in this abſtract, there is little which is new except the phraſeology; and that what is new is either unintelligible or untenable.

21 Of which the fundamental principles are not new.

The diſtinction between knowledge *a priori* and knowledge *a poſteriori*, is as old as ſpeculation itſelf; and the mode in which Kant illuſtrates that diſtinction differs not from the illuſtrations of Ariſtotle on the ſame ſubject. The Stagyrite talked of *general forms*, or *formal cauſes*, in the mind, as well as the profeſſor at Koenigſberg: and he or his diſciples (for we quote from memory) compared them to the form of the ſtatue in the rough block of marble. As that form is brought into the view of the ſpectator by the chiſſel of the ſtatuary, ſo, ſaid the peripatetics, are the general *forms* in the mind brought into the view of conſciouſneſs by ſenſation and experience.

Such was the doctrine of Ariſtotle and his diſciples, and ſuch ſeems to be the doctrine of Kant and his followers; but it is either a falſe doctrine, or, if it be true, a doctrine fooliſhly expreſſed. A block of marble is capable of being cut into any form that the ſtatuary pleaſes; into the form of a man, a horſe, an ox, an aſs, a fiſh, or a ſerpent. Not one of theſe forms therefore can be inherent in it, or eſſential to it, in oppoſition to the reſt; and a general form, including all the animals under it, is inconceivable and impoſſible. In like manner, the human mind is capable of having the ideas of a circle, a triangle, a ſquare, of black, white, red, of ſour, ſweet, bitter, of the odour of a roſe, and the ſtench of a dunghill, of proportion, of muſical ſounds, and of a thouſand other things. None of theſe ideas therefore can be eſſential to the mind in oppoſition to the reſt; and every man, who is not an abſolute ſtranger to the operations of his own intellect, knows well that he cannot think of a thouſand things at once; or, to uſe the language of philoſophers, have in his mind a general idea, comprehending under it a thouſand things ſo diſcordant as colours and ſounds, figures, and ſmells. If therefore Kant means to affirm, with Plato, that, previous to all experience, there are *actually* in the mind *general forms*, or *general ideas*, to which ſenſation, or experience, gives an opportunity of coming into view, he affirms what all men of reflection know to be falſe. If he means only to affirm, what ſeems to have been the meaning of Ariſtotle, that particular ſenſations give occaſion

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(E) We have here again taken the liberty to alter the language of our correſpondent. He makes Kant ſay, “ It is not this knowledge, but a *belief* of reaſon, &c.;” but this is ſurely not the author's meaning. From the context, it is apparent that Kant means to ſay, that we have not, and cannot have, what can be properly called a *knowledge* of the exiſtence of God, but only ſuch a belief of his exiſtence as ſupplies the place of this impoſſible knowledge.

(F) This is a very abſurd phraſe. We ſuppoſe Kant's meaning to be, that the principles of him whoſe actions and volitions are influenced by the proſpect of perſonal happineſs, are the reverſe of the pure principles of morality.

occaſion to the intellect to form general ideas, he expreſſes himſelf indeed very ſtrangely; but his doctrine on this ſubject differs not eſſentially from that of Locke and Reid, and many other eminent metaphyſicians of modern times. Of abſtraction and general ideas we have given our own opinion elſewhere (See METAPHYSICS, *Encycl.* Part I. Chap. iv.), and ſhall not here reſume the ſubject.

22 Improper uſe of terms; But when Kant ſays that his ideas *a priori* are *univerſal*, and *neceſſary*, and that their converſe is *impoſſible*, he ſeems by the word *idea* to mean what more accurate writers expreſs by the term *propoſition*. There are indeed two kinds of propoſitions, of which both may be true, though the one kind expreſſes neceſſary and univerſal truths, and the other ſuch truths as are contingent and particular. (See METAPHYSICS, *Encycl.* Part I. Chapter vii.) Propoſitions directly contrary to thoſe which expreſs particular and contingent truths may be eaſily conceived; whilſt ſuch as are contrary to neceſſary and univerſal truths are inconceivable and impoſſible; but we doubt whether *any idea*, in the proper ſenſe of the word, has a *contrary* or, as he expreſſes it, a *converſe*. *Nothing* is not contrary to *ſubſtance*, nor *black* contrary to *white*, nor *ſour* contrary to *ſweet*, nor an *inch* contrary to an *ell*. Nothing is the negation of ſubſtance, and black the negation of white; ſour is different from ſweet, and an inch is leſs than an ell; but between theſe different ideas we perceive no contradiction.

That Kant uſes the term *idea* inſtead of *propoſition*, or ſome word of ſimilar import, is farther evident from his inſtances of *the houſe on fire*, and the manner in which we learn that any two bodies added to any two other bodies will conſtantly make the ſum of *four bodies*. If it be his will to uſe the terms *a priori* and *a poſteriori* in the ſenſe in which other metaphyſicians uſe the terms *neceſſary* and *contingent*, we can make no other objection to his diſtinction between theſe two propoſitions, but that it is expreſſed in very improper language. The houſe might certainly be *on fire* or *not* on fire; but twice two bodies *muſt* always make the ſum of four bodies, and cannot poſſibly make any other ſum.

The truth of this laſt propoſition (he ſays) we cannot have learned from *experience*, becauſe experience, being always limited, cannot poſſibly teach us what is *neceſſary* and *univerſal*. But this is egregious trifling. The experience employed here is not limited. A child unqueſtionably learns the import of the terms of numeration, as he learns the import of all other terms, by experience. By putting two little balls to two little balls, he learns to call the ſum *four* balls. After two or three leſſons of this kind with different bodies, his own reflection ſuggeſts to him, that the ſum four has no dependance upon the ſhape or conſiſtence of the bodies, but merely upon the *individuality* of each or their numerical difference; and individuality, or numerical difference, is as completely exemplified in two bodies of any kind as in two thouſand.

23 With its conſequences. All the truths of pure mathematics (ſays Kant) are *a priori*. If he means that they are all *neceſſary*, and that the contrary of any one of them is *inconceivable*, he affirms nothing but what is true, and has been known to all mathematicians theſe two thouſand years. But, if he means that they are *innate* truths, not diſcovered by induction or ideal meaſurement, his meaning is demonſtrably falſe. (See INDUCTION in this *Supplement*.) When he ſays, that it is not *experience* which diſcovers to us that we ſhall always have the ſurface of the pyramid, by multiplying its baſe by the third part of its height, he is right, if by experience he means the actual meaſurement of all poſſible pyramids; but ſurely he cannot mean that the truth of this meaſurement is innate in the mind, for it is in fact not a true but a falſe meaſurement (G). The baſe of a pyramid multiplied by the third part of its height gives, not the ſurface, but the ſolid contents of the pyramid; and he who underſtands the propoſition on which this truth is immediately built, knows perfectly that Euclid proved it by a ſeries of ideal meaſurements of thoſe particulars in which all pyramids neceſſarily agree.

Kant ſeems often to confound ſenſation with experience; and if by experience he means *ſenſation*, when he ſays that *pure knowledge, a priori*, is that which is abſolutely without any mixture of experience, he talks nonſenſe; for the moſt ſpiritual notions which men can form are derived from the operations of the mind on ideas of ſenſation. To the reſt of the paragraph, reſpecting pure knowledge, we have hardly any objection to make. Locke, the great enemy of innate ideas, taught, before Kant was born, that our knowledge depends upon our organization and the faculties of our minds, as much as upon impreſſions made on the ſenſes *ab extra*; that if our organs of ſenſe were different from what they are, the taſte of ſugar might be bitter, and that of wormwood ſweet; and that if we had not memory, and could not modify and arrange our ideas, all progreſs in knowledge would be impoſſible.

24 Groundleſs or falſe aſſertion. When our author talks of *time* and *ſpace* as the two eſſential *forms* of the mind, we are not ſure that we underſtand him. We have ſhewn elſewhere, that a conſcious intelligence may be conceived which has no ideas either of ſpace or of time (ſee METAPHYSICS, *Encycl.* n° 182, &c. and 209, &c); and he who can affirm, that if extenſion were known to us only by *experience*, it would be poſſible to conceive ſenſible objects *without ſpace*, has never attended to the force of what philoſophers call *the aſſociation of ideas in the mind*. But what is here meant by ſenſible objects? Are they objects of touch, taſte, or ſmell? Objects of touch cannot indeed be conceived without ſpace; but what extent of ſpace is ſuggeſted by the taſte of ſugar or the odour of a roſe?

(G) This may look like cavilling, as the blunder may be either Kant's or our correſpondent's, though neither of them can be ſuppoſed ignorant of the method of meaſuring the ſurface of a pyramid. We aſſure the reader, however, that we do not mean to cavil. We admit that both Kant and our correſpondent know perfectly well how to meaſure the ſurface of a pyramid; but had that knowledge been *innate* in their minds, we cannot conceive the poſſibility of their falling into the blunder. The blunder, therefore, though the offſpring of mere inadvertence, ſeems to be a complete confutation of the doctrine.

When Kant talks of the *form* ſpace enabling us to attribute to external objects *impenetrability*, *mobility*, &c. he talks at random; and another man may, with as much propriety, and perhaps more truth, affirm the converſe of his propoſitions, and ſay, that it is the impenetrability and mobility, &c. of external objects that enable us to form the idea called *ſpace*, and the ſucceſſion of ſome objects, compared with the permanence of others, that enables us to form the notion or mode called *time*.

25
Bad logic.

On the two or three next paragraphs it is not worth while to detain the reader with many remarks. They abound with the ſame uncouth and obſcure phraſeology, and the ſame idle diſtinctions between ideas *a priori* and *a poſteriori*. In n° 11. he affirms, that the three following propoſitions *(a body is heavy, wood is combuſtible,* and *the three angles of a triangle are equal to two right angles)* are all neceſſary judgments. In one ſenſe this affirmation is true, and in another it is falſe. We cannot, without ſpeaking unintelligibly, give the name *body* to any ſubſtance which is not heavy; and we are not acquainted with any kind of *wood* which is not combuſtible; but ſurely it is not impoſſible to conceive a ſubſtance extended and diviſible, and yet *not* heavy, to which the name *body* might be given without abſurdity, or to conceive wood as incombuſtible as the mineral called *aſbeſtos*. That the three angles, however, of a plane triangle can be either more or leſs than equal to two right angles, is obviouſly impoſſible, and muſt be perceived to be ſo by every intelligence from the Supreme down to the human. The three propoſitions, therefore, are not of the ſame kind, and ſhould not have been claſſed under the ſame genus of *neceſſary* ſynthetic judgments.

In the critique of pure reaſon, Kant ſeems to teach that all demonſtrative ſcience muſt proceed from general principles to particular truths. Hence his *forms* of the underſtanding, and his *categories*, which, according to one of his pupils,* " lie in our underſtanding as pure notions *a priori*, or the foundation of all our knowledge. They are *neceſſary forms*, *radical* notions, of which all our knowledge *muſt* be compounded." But this is directly contrary to the progreſs of the human mind, which, as we have ſhewn in the article INDUCTION, already referred to, proceeds, in the acquiſition of every kind of knowledge, from particular truths to general principles. This *tranſcendental philoſophy* of Kant's, therefore, inverts the order of nature, and is as little calculated to promote the progreſs of ſcience as the ſyllogiſtic ſyſtem of Ariſtotle, which was likewiſe built on *categories* or *general forms*. His *tranſcendental æſthetic*, which, according to Dr Willich, is the knowledge *a priori* of the *rules of ſenſation*, ſeems to be a contradictory expreſſion, as it implies that a man may know the laws of ſenſation, without paying the ſmalleſt attention to the organs of ſenſe.

That we know objects only by the manner in which they affect us, and not as they are in themſelves, is a truth admitted, we believe, by all philoſophers, and certainly by Locke and Reid; but when Kant ſays that we know nothing of the *reality* of the objects which affect our ſenſes, he ſeems to be ſingularly paradoxical. Berkeley himſelf, the moſt ingenious idealiſt perhaps that ever wrote, contends ſtrenuouſly for the exiſtence of a *cauſe* of our ſenſations diſtinct from our own minds; and becauſe he thinks inert matter a cauſe inadequate to this effect, he concludes, that every ſenſation of which we are conſcious is a proof of the immediate agency of the Deity. But Kant, as we ſhall perceive by and bye, makes the exiſtence of God and of matter equally problematical. Indeed he ſays expreſsly, that beyond things ſenſible we can only have *opinions* or *belief*; but things ſenſible, as every one knows, are nothing more than the *qualities* of objects.

26
Tendency of the ſyſtem towards atheiſm.

It ſhould ſeem that the greater number of wonders which Kant has found in our primitive knowledge and in the faculties of our mind, the greater number of proofs ought he to have found of the exiſtence and attributes of one Firſt Cauſe: but ſo far is this from being the caſe, that we have ſeen him reſting the evidence of this moſt important of all truths, either upon the *moral ſenſe*, which our paſſions and appetites ſo eaſily alter, or upon the intuitive perception of *abſtract moral rectitude*; a perception which thouſands, as virtuous and as profound as he, have conſidered as impoſſible. Our philoſopher's proof of a God is nothing more than his perſuaſion that happineſs is connected with virtue by a Being upon whom nature depends; and he ſays expreſsly, that this proof carries conviction to the mind in proportion as the motives of a man's actions are conformable to the law of morality. This being the caſe, the reader cannot be much ſurpriſed, when he is informed that ſeveral of Kant's diſciples on the continent have avowed themſelves Atheiſts or Spinoziſts. We have elſewhere (ſee ILLUMINATI, n° 37.) mentioned one of thoſe gentlemen who was lately diſmiſſed from his profeſſorial chair in the univerſity of Jena, for making GOD nothing more than an *abſtract idea*, derived from our relations with the moral world. His ſucceſſor, a Kantiſt likewiſe, when it was told in his preſence, that, during one of the maſſacres in Paris, David the Painter ſat with his pencil in his hand, enjoying the ſufferings of the unfortunate wretches, and trying to paint the expreſſions of their agonies, exclaimed—" What force of character! What ſublimity of ſoul!" That this wretch muſt be an Atheiſt, likewiſe, follows of courſe from Kant's principles; for it is not conceivable that he perceives any connection between happineſs and virtue.

That Kant is an athieſt himſelf, we have not learned, though his doctrine leads thus naturally to atheiſm, and though in his work called TUGEND LEHRE, page 180, he makes the following ſtrange obſervation upon oaths: " As it would be abſurd to ſwear that God exiſts, it is ſtill a queſtion to be determined, whether an oath would be poſſible and obligatory if one were to make it thus—*I ſwear on the ſuppoſition that God exiſts.* It is extremely probable (ſays he), that all *ſincere* oaths, taken with *reflection*, have been taken in no other ſenſe!"

It is not our intention to plunge deeper into this mire of atheiſm, or to enter into a formal confutation of the deteſtable doctrines which have been dragged from its bottom. Enough has been ſaid elſewhere to convince the *theoretical* reaſon of the ſound minds of our countrymen of the exiſtence of one omnipotent, infinitely wiſe, and perfectly good Being, the author and upholder of all things (See *Encycl.* METAPHYSICS, Part III. Chap. vi. and THEOLOGY, Part I. Sect. 1.). It may not, however, be altogether uſeleſs to point out

* *Dr Willich.*

to the reader how completely Kant confutes himſelf, even in the ſhort abſtract that we have given of his ſyſtem.

27 Kant confutes himſelf.

Among his *categories*, or fundamental ideas, which are *neceſſarily* formed in the mind, he expreſsly reckons *cauſe* and *effect*: but in various articles of this work, it has been proved beyond the poſſibility of contradiction, that no *ſenſible* object is the *true metaphyſical cauſe* of any one event in nature; and indeed Kant himſelf is at much pains to ſhew that his *categories* or ideas *a priori* are not ideas of ſenſation. There muſt, therefore, upon his own principles, be cauſes which are *not* the objects of *ſenſe* or *experience*; and by tracing theſe cauſes backward, if there be a ſucceſſion of them, we muſt arrive at one ſelf-exiſtent cauſe, by a demonſtration as complete as that by which Euclid proves the equality of the three angles of a plane triangle to two right angles. We have no other evidence for the truth of geometrical axioms than the laws of human thought, which compel us to perceive the impoſſibility of ſuch propoſitions being falſe. According to our philoſopher, we have the very ſame evidence for the reality of cauſes and effects which are not the objects of ſenſe. The conſequence is obvious.

28 His morality is extravagant.

Kant's *political* opinions are ſaid to be tolerably moderate, though he betrays, what we muſt think, an abſurd confidence in the *unlimited perfectibility* of the human mind. On his morality our valued correſpondent has beſtowed a much larger ſhare of his approbation than we can allow it of ours. Kant ſeems to contend, that the actions of men ſhould be directed to no end whatever; for he expreſsly condemns, as an end of action, the purſuit either of our own happineſs or of the happineſs of others, whether temporal or eternal; but actions performed for no purpoſe are ſurely indications of the very eſſence of folly. Such actions are indeed impoſſible to beings endowed with reaſon, paſſions, and appetites; for if there be that beauty in abſtract virtue, for which Kant and the Stoics contend, it cannot be but that the virtuous man muſt feel an internal pleaſure when he performs a virtuous action, or reflects upon his paſt conduct. He who makes his temporal intereſt the ſole rule of his conduct, has indeed no pretenſions to the character of a virtuous man; but as the morality of the goſpel has always appeared to us ſufficiently pure and diſintereſted, we think a man may, without deviating into vice, have reſpect unto "the recompence of future reward."

Phoſphorus.

PHOSPHORUS (See CHEMISTRY-*Index*, *Supplement*.) has lately been employed as a medicine by Alphonſus Leroi, profeſſor at the Medical School at Paris. Its effects, in a variety of caſes, are thus deſcribed in the *Bulletin de la Société Philomatique*, 1798.

1. Phoſphorus adminiſtered internally in conſumptive diſeaſes appears to give a certain degree of activity to life, and to revive the patients, without raiſing their pulſe in the ſame proportion. The author relates ſeveral inſtances that occurred to him in the courſe of his practice; one of which is as follows: Being called to attend a woman, at the point of death, who was quite worn out by a conſumptive diſorder, with which ſhe had been afflicted for three years, in compliance with the earneſt deſire of her huſband, who requeſted him to give her ſome medicine, he compoſed one of a portion of ſyrup diluted with water, in which a few ſticks of phoſphorus had been kept. Next day the woman found herſelf much better. She was revived for a few days; and did not die till about a fortnight after.

2. He himſelf, as he acknowledges, was ſo imprudent as to take two or three grains of ſolid phoſphorus combined only with treacle, and experienced the moſt dreadful ſymptoms. At firſt he felt a burning heat in the whole region of the ſtomach. That organ ſeemed to be filled with gas which eſcaped by the mouth. Being dreadfully tormented, he tried to vomit, but in vain; and found relief only by drinking cold water from time to time. His uneaſy ſenſations were at length allayed; but next morning he ſeemed to be endowed with an aſtoniſhing muſcular force, and to be urged with an almoſt irreſiſtible impulſe to try its energy. The effect of this medicine at length ceaſed, adds the author, *à la ſuite d'un priapiſme violent*.

3. In many caſes the author employed, and ſtill employs, phoſphorus internally, with great benefit, to reſtore and revive young perſons exhauſted by exceſſes. He divides the phoſphorus into very ſmall particles, by ſhaking it in a glaſs filled with boiling water. He continues to ſhake the bottle, plunging it into cold water, and thus obtains a kind of precipitate of phoſphorus, exceedingly fine, which he bruiſes ſlowly with a little oil and ſugar, or afterwards employs as liquid electuary, by diluting the whole in the yolk of an egg. By means of this medicine he has effected aſtoniſhing cures, and reſtored the ſtrength of his patients in a very ſhort time.

4. In malignant fevers the uſe of phoſphorus internally, to check the progreſs of gangrene, has ſucceeded beyond expectation. The author relates ſeveral inſtances.

5. Pelletier told him, that having left, through negligence, ſome phoſphorus in a copper baſon, that metal was oxydated, and remained ſuſpended in the water. Having thoughtleſsly thrown out the water in a ſmall court in which ducks were kept, theſe animals drank of it, and all died. *Mais le male* (ſays the author) *couvrit toutes ſes femelles juſque au dernier inſtant de ſa vie.* An obſervation which accords with the effect experienced by the author.

6. The author relates a fact which proves the aſtoniſhing diviſibility of phoſphorus. Having adminiſtered to a patient ſome pills, in the compoſition of which there was not more than a quarter of a grain of phoſphorus, and having had occaſion afterwards to open the body, he found all the internal parts luminous; and even the hands of the perſon who had performed the operation, though waſhed and well dried, retained a phoſphoric ſplendor for a long time after.

7. The phoſphoric acid, employed as lemonade, has been ſerviceable to the author in the cure of a great number of diſeaſes.

8. Leroi aſſures us that he oxydated iron with phoſphorus,

Phoſphorus ‖ Photometer.

phorus, and obtained, by the common means, a white oxyd, almoſt irreducible, which he thinks may be employed with advantage in the arts, and particularly in painting with oil, and in enamel, inſtead of the white oxyd of lead. This white oxyd of iron occaſioned violent retchings to the author, who ventured to place a very ſmall particle of it on his tongue. He does not heſitate, therefore, to conſider this oxyd as a terrible poiſon. He was not able to reduce it but by fixed alkali and the glaſs of phoſphorus.

9. The author aſſerts that, by means of phoſphorus, he decompoſed and ſeparated from their baſes the ſulphuric, muriatic, and nitric acids; that by help of the phoſphoric acid he tranſmuted earths; and that with calcareous earth he can make, at pleaſure, conſiderable quantities of magneſia. He declares, that to his labours on phoſphorus he is indebted for proceſſes by which he effects the diſſipation *(opère la fuite)* of rubies, the fuſion of emeralds, and the vitrification of mercury.

We agree with the editor of the reſpectable Miſcellany,* from which we have immediately taken this article, that practitioners will do well to uſe their wonted caution in the application of ſo powerful a remedy. Indeed we conſider it as ſo very *hazardous* a remedy, that we had reſolved to make no mention of it, till we found it tranſcribed into various journals, both foreign and domeſtic, and thence began to ſuſpect that we might be accuſed of culpable negligence, were we to paſs unnoticed what had attracted the attention of ſo many of our fellow-labourers in the field of ſcience.

Phosphorus, in aſtronomy, is the morning ſtar, or the planet Venus, when ſhe riſes before the ſun. The Latins call it *Lucifer*, the French *Etoile de berger*, and the Greeks *Phoſphorus*.

PHOTOMETER, an apparatus for meaſuring the intenſity of light, and likewiſe the tranſparency of the medium through which it paſſes. Inſtruments for this purpoſe have been invented by Count Rumford, M. de Sauſſure, that eminent mathematician and philoſopher Mr John Leſlie, and others. We ſhall content ourſelves with deſcribing in this place the photometer of Count Rumford, and the inſtrument to which Sauſſure gives the name of *diaphanometer*. Mr Leſlie's is indeed the ſimpleſt inſtrument of the kind of which we have anywhere met with a deſcription; but it meaſures only the momentary intenſities of light: and he who wiſhes to be informed of its conſtruction, will find that information in the third volume of Nicholſon's Philoſophical Journal.

Count Rumford, when making the experiments which we have noticed in the article Lamp *(Supplement)*, was led, ſtep by ſtep, to the conſtruction of a very accurate *photometer*, in which the ſhadows, inſtead of being thrown upon a paper ſpread out upon the wainſcot, or ſide of the room, are projected upon the inſide of the back part of a wooden box, $7\frac{1}{2}$ inches wide, $10\frac{1}{2}$ inches long, and $3\frac{1}{2}$ inches deep, in the clear. The light is admitted into it through two horizontal tubes in the front, placed ſo as to form an angle of 60°; their axes meeting at the centre of the field of the inſtrument. In the middle of the front of the box, between theſe two tubes, is an opening thro' which is viewed the field of the photometer (See fig. 1.). This field is formed of a piece of white paper, which is not faſtened immediately upon the inſide of the back of the box, but is paſted upon a ſmall pane of very fine ground glaſs; and this glaſs, thus covered, is let down into a groove, made to receive it, in the back of the box. The whole inſide of the box, except the field of the inſtrument, is painted of a deep black dead colour. To the under part of the box is fitted a ball and ſocket, by which it is attached to a ſtand which ſupports it; and the top or lid of it is fitted with hinges, in order that the box may be laid quite open, as often as it is neceſſary to alter any part of the machinery it contains.

Plate XLI.

Photometer.

The Count had found it very inconvenient to compare two ſhadows projected by the ſame cylinder, as theſe were either neceſſarily too far from each other to be compared with certainty, or, when they were nearer, were in part hid from the eye by the cylinder. To remedy this inconvenience, he now makes uſe of two cylinders, which are placed perpendicularly in the bottom of the box juſt deſcribed, in a line parallel to the back part of it, diſtant from this back $2\frac{2}{10}$ inches, and from each other 3 inches, meaſuring from the centres of the cylinders; when the two lights made uſe of in the experiment are properly placed, theſe two cylinders project four ſhadows upon the white paper upon the inſide of the back part of the box, or the *field* of the inſtrument; two of which ſhadows are in contact, preciſely in the middle of that field, and it is theſe two alone that are to be attended to. To prevent the attention being diſtracted by the preſence of unneceſſary objects, the two outſide ſhadows are made to diſappear; which is done by rendering the field of the inſtrument ſo narrow, that they fall without it, upon a blackened ſurface, upon which they are not viſible. If the cylinders be each $\frac{4}{10}$ of an inch in diameter, and $2\frac{2}{10}$ inches in height, it will be quite ſufficient that the field be $2\frac{7}{10}$ inches wide; and as an unneceſſary height of the field is not only uſeleſs, but diſadvantageous, as a large ſurface of white paper not covered by the ſhadows produces too ſtrong a glare of light, the field ought not to be more than $\frac{1}{10}$ of an inch higher than the tops of the cylinders. That its dimenſions, however, may be occaſionally augmented, the covered glaſs ſhould be made $5\frac{1}{2}$ inches long, and as wide as the box is deep, viz. $3\frac{1}{2}$ inches; ſince the field of the inſtrument can be reduced to its proper ſize by a ſcreen of black paſteboard, interpoſed before the anterior ſurface of this covered glaſs, and reſting immediately upon it. A hole in this paſteboard, in the form of an oblong ſquare, $1\frac{7}{10}$ inch wide, and two inches high, determines the dimenſions, and forms the boundaries of the field. This ſcreen ſhould be large enough to cover the whole inſide of the back of the box, and it may be fixed in its place by means of grooves in the ſides of the box, into which it may be made to enter. The poſition of the opening above-mentioned is determined by the height of the cylinders; the top of it being $\frac{1}{10}$ of an inch higher than the tops of the cylinders; and as the height of it is only two inches, while the height of the cylinders is $2\frac{1}{10}$ inches, it is evident that the ſhadows of the lower parts of the cylinders do not enter the field. No inconvenience ariſes from that circumſtance; on the contrary, ſeveral advantages are derived from that arrangement.

That the lights may be placed with facility and preciſion,

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* Philoſophical Magazine, vol. ii.

ciſion, a fine black line is drawn through the middle of the field, from the top to the bottom of it, and another (horizontal) line at right angles to it, at the height of the top of the cylinders. When the tops of the ſhadows touch this laſt mentioned line, the lights are at a proper height; and farther, when the two ſhadows are in contact with each other in the middle of the field, the lights are then in their proper directions.

We have ſaid that the cylinders, by which the ſhadows are projected, are placed perpendicularly in the bottom of the box; but as the diameters of the ſhadows of theſe cylinders vary in ſome degree, in proportion as the lights are broader or narrower, and as they are brought nearer to or removed farther from the photometer, in order to be able in all caſes to bring theſe ſhadows to be of the ſame diameter, which is very advantageous, in order to judge with greater facility and certainty when they are of the ſame denſity, the Count renders the cylinders moveable about their axes, and adds to each a vertical wing $\frac{11}{20}$ of an inch wide, $\frac{1}{10}$ of an inch thick, and of equal height with the cylinder itſelf, and firmly fixed to it from the top to the bottom. This wing commonly lies in the middle of the ſhadow of the cylinder, and as long as it remains in that ſituation it has no effect whatever; but when it is neceſſary that the diameter of one of the ſhadows be increaſed, the correſponding cylinder is moved about its axis, till the wing juſt deſcribed, emerging out of the ſhadow, and intercepting a portion of light, brings the ſhadow projected upon the field of the inſtrument to be of the width or diameter required. In this operation it is always neceſſary to turn the cylinder outwards, or in ſuch a manner that the augmentation of the width of the ſhadow may take place on that ſide of it which is oppoſite to the ſhadow correſponding to the other light. The neceſſity for that precaution will appear evident to any one who has a juſt idea of the inſtrument in queſtion, and of the manner of making uſe of it. They are turned likewiſe without opening the box, by taking hold of the ends of their axes, which project below its bottom.

As it is abſolutely neceſſary that the cylinders ſhould conſtantly remain preciſely perpendicular to the bottom of the box, or parallel to each other, it will be beſt to conſtruct them of braſs; and, inſtead of fixing them immediately to the bottom of the box (which, being of wood, may warp), to fix them to a ſtrong thick piece of well-hammered plate braſs; which plate of braſs may be afterwards faſtened to the bottom of the box by means of one ſtrong ſcrew. In this manner two of the Count's beſt inſtruments are conſtructed; and, in order to ſecure the cylinders ſtill more firmly in their vertical poſitions, they are furniſhed with broad flat rings, or projections, where they reſt upon the braſs plate; which rings are $\frac{1}{10}$ of an inch thick, and equal in diameter to the projection of the wing of the cylinder, to the bottom of which they afford a firm ſupport. Theſe cylinders are likewiſe forcibly puſhed, or rather pulled, againſt the braſs plate upon which they reſt, by means of compreſſed ſpiral ſprings placed between the under ſide of that plate and the lower ends of the cylinders. Of whatever material the cylinders be conſtructed, and whatever be their forms or dimenſions, it is abſolutely neceſſary that they, as well as every other part of the photometer, except the field, ſhould be well painted of a deep black dead colour.

In order to move the lights to and from the photometer with greater eaſe and preciſion, the obſerver ſhould provide two long and narrow, but very ſtrong and ſteady, tables; in the middle of each of which there is a ſtraight groove, in which a ſliding carriage, upon which the light is placed, is drawn along by means of a cord which is faſtened to it before and behind, and which, paſſing over pulleys at each end of the table, goes round a cylinder; which cylinder is furniſhed with a winch, and is ſo placed, near the end of the table adjoining the photometer, that the obſerver can turn it about, without taking his eye from the field of the inſtrument.

Many advantages are derived from this arrangement: Firſt, the obſerver can move the lights as he finds neceſſary, without the help of an aſſiſtant, and even without removing his eye from the ſhadows; ſecondly, each light is always preciſely in the line of direction in which it ought to be, in order that the ſhadows may be in contact in the middle of the vertical plane of the photometer; and, thirdly, the ſliding motion of the lights being perfectly ſoft and gentle, that motion produces little or no effect upon the lights themſelves, either to increaſe or diminiſh their brilliancy.

Theſe tables muſt be placed at an angle of 60 degrees from each other, and in ſuch a ſituation, with reſpect to the photometer, that lines drawn through their middles, in the direction of their lengths, meet in a point exactly under the middle of the vertical plane or field of the photometer, and from that point the diſtances of the lights are meaſured; the ſides of the tables being divided into Engliſh inches, and a vernier, ſhewing tenths of inches, being fixed to each of the ſliding carriages upon which the lights are placed, and which are ſo contrived that they may be raiſed or lowered at pleaſure; ſo that the lights may be always in a horizontal line with the tops of the cylinders of the photometer.

In order that the two long and narrow tables or platforms, juſt deſcribed, may remain immoveable in their proper poſitions, they are both firmly fixed to the ſtand which ſupports the photometer; and, in order that the motion of the carriages which carry the lights may be as ſoft and gentle as poſſible, they are made to ſlide upon parallel braſs wires, 9 inches aſunder, about $\frac{1}{10}$ of an inch in diameter, and well poliſhed, which are ſtretched out upon the tables from one end to the other.

The ſtructure of the apparatus will be clearly underſtood by a bare inſpection of Plate XLI. where fig. 1. is a plan of the inſide of the box, and the adjoining parts of the photometer. Fig. 2. Plan of the two tables belonging to the photometer. Fig. 3. The box of the photometer on its ſtand. Fig. 4. Elevation of the photometer, with one of the tables and carriages.

Having ſufficiently explained all the eſſential parts of this photometer, it remains for us to give ſome account of the precautions neceſſary to be obſerved in uſing it. And, firſt, with reſpect to the diſtance at which lights, whoſe intenſities are to be compared, ſhould be placed from the field of the inſtrument, the ingenious and accurate inventor found, that when the weakeſt of the lights in queſtion is about as ſtrong as a common

common wax-candle, that light may moſt advantageouſly be placed from 30 to 36 inches from the centre of the field; and when it is weaker or ſtronger, proportionally nearer or farther off. When the lights are too near, the ſhadows will not be well defined; and when they are too far off, they will be too weak.

It will greatly facilitate the calculations neceſſary in drawing concluſions from experiments of this kind, if ſome ſteady light, of a proper degree of ſtrength for that purpoſe, be aſſumed as a ſtandard by which all others may be compared. Our author found a good Argand's lamp much preferable for this purpoſe to any other lamp or candle whatever. As it appears, he ſays, from a number of experiments, that the quantity of light emitted by a lamp, which burns in the ſame manner with a clear flame, and *without ſmoke*, is in all caſes as the quantity of oil conſumed, there is much reaſon to ſuppoſe, that, if the Argand's lamp be ſo adjuſted as always to conſume a given quantity of oil in a given time, it may then be depended on as a juſt ſtandard of light.

In order to abridge the calculations neceſſary in theſe inquiries, it will always be advantageous to place the ſtandard-lamp at the diſtance of 100 inches from the photometer, and to aſſume the intenſity of its light at its ſource equal to unity; in this caſe (calling this ſtandard light A, the intenſity of the light at its ſource $= x = 1$, and the diſtance of the lamp from the field of the photometer $= m = 100$), the intenſity of the illumination at the field of the photometer $(= \frac{x}{m^2})$ (See Lamp, p. 323. vol. 2. in this *Suppl.*) will be expreſſed by the fraction $\frac{1}{100^2} = \frac{1}{10000}$; and the relative intenſity of any other light which is compared with it, may be found by the following proportion: Calling this light B, putting $y =$ its intenſity at its ſource, and $n =$ its diſtance from the field of the photometer expreſſed in Engliſh inches, as it is $\frac{y}{n^2} = \frac{x}{m^2}$, as was ſhewn in the article Lamp referred to; or inſtead of $\frac{x}{m^2}$, writing its value $= \frac{1}{10000}$, it will be $\frac{y}{n^2} = \frac{1}{10000}$; and conſequently y is to 1 as n^2 is to 10000; or the intenſity of the light B at its ſource, is to the intenſity of the ſtandard light A at its ſource, as the ſquare of the diſtance of the light B from the middle of the field of the inſtrument, expreſſed in inches, is to 10000; and hence it is $y = \frac{n^2}{10000}$.

Or, if the light of the ſun, or that of the moon, be compared with the light of a given lamp or candle C, the reſult of ſuch compariſon may beſt be expreſſed in words, by ſaying, that the light of the celeſtial luminary in queſtion, *at the ſurface of the earth*, or, which is the ſame thing, at the field of the photometer, is equal to the light of the given lamp or candle, *at the diſtance found by the experiment*; or, putting $a =$ the intenſity of the light of this lamp C at its ſource, and $p =$ its diſtance, in inches, from the field, when the ſhadows correſponding to this light, and that correſponding to the celeſtial luminary in queſtion, are found to be of equal denſities and putting $z =$ the intenſity of the rays of the luminary at the ſurface of the earth, the reſult of the experiment may be expreſſed thus, $z = \frac{a}{p^2}$; or the real value of a being determined by a particular experiment, made expreſsly for that purpoſe with the ſtandard-lamp that value may be written inſtead of it. When the ſtandard-lamp itſelf is made uſe of, inſtead of the lamp C, then the value of A will be 1.

The Count's firſt attempts with his photometer were to determine how far it might be poſſible to aſcertain by direct experiments, the certainty of the aſſumed law of the diminution of the intenſity of the light emitted by luminous bodies; namely, that the intenſity of the light is everywhere as the ſquares of the diſtances from the luminous body inverſely. As it is obvious that this law can hold good only when the light is propagated through perfectly tranſparent ſpaces, ſo that its intenſity is weakened merely by the divergency of its rays, he inſtituted a ſet of experiments to aſcertain the tranſparency of the air and other mediums.

With this view, two equal wax-candles, well trimmed, and which were found, by a previous experiment, to burn with exactly the ſame degree of brightneſs, were placed *together*, on one ſide, before the photometer, and their united light was counterbalanced by the light of an Argand's lamp, well trimmed, and burning very equally, placed on the other ſide over againſt them. The lamp was placed at the diſtance of 100 inches from the field of the photometer, and it was found that the two burning candles (which were placed as near together as poſſible, without their flames affecting each other by the currents of air they produced) were juſt able to counterbalance the light of the lamp at the field of the photometer, when they were placed at the diſtance of 60,8 inches from that field. One of the candles being now taken away and extinguiſhed, the other was brought nearer to the field of the inſtrument, till its light was found to be juſt able, ſingly, to counterbalance the light of the lamp; and this was found to happen when it had arrived at the diſtance of 43,4 inches. In this experiment, as the candles burnt with equal brightneſs, it is evident that the intenſities of their united and ſingle lights were as 2 to 1, and in that proportion ought, according to the aſſumed theory, the ſquares of the diſtances, 60,8 and 43,4, to be; and, in fact, $\overline{60,8}^2 = 3696,64$ is to $\overline{43,4}^2 = 1883,56$ as 2 is to 1 very nearly.

Again, in another experiment, the diſtances were,

With two candles = 54 inches. Square = 2916
With one candle = 38,6 - - = 1489,96

Upon another trial,

With two candles = 54,6 inches. Square = 2981,16
With one candle = 39,7 - - = 1576,09

And, in the fourth experiment,

With two candles = 58,4 inches. Square = 3410,56
With one candle = 42,2 - - = 1780,84

And, taking the mean of the reſults of theſe four experiments,

		Squares of the Diſtances		
		With two Candles.		With one Candle.
In the Experiment	N° 1.	3696,64	—	1883,56
	N° 2.	2916	—	1489,96
	N° 3.	2981,16	—	1576,09
	N° 4.	3410,56	—	1780,84
		4) 13004,36		4) 6730,45
	Means	3251,09	and	1682,61

which again are very nearly as 2 to 1.

With regard to theſe experiments, it may be obſerved, that were the reſiſtance of the air to light, or the diminution of the light from the imperfect tranſparency of air, ſenſible within the limits of the inconſiderable diſtances at which the candles were placed from the photometer, in that caſe the diſtance of the two equal lights united ought to be, to the diſtance of one of them ſingle, in a ratio leſs than that of the ſquare root of 2 to the ſquare root of 1. For if the intenſity of a light emitted by a luminous body, *in a ſpace void of all reſiſtance*, be diminiſhed in the proportion of the ſquares of the diſtances, it muſt of neceſſity be diminiſhed in a ſtill higher ratio when the light paſſes thro' a reſiſting medium, or one which is not perfectly tranſparent; and from the difference of thoſe ratios, namely, that of the ſquares of the diſtances, and that other higher ratio found by the experiment, the reſiſtance of the medium might be aſcertained. This he took much pains to do with reſpect to air, but did not ſucceed; the tranſparency of air being ſo great, that the diminution which light ſuffers in paſſing through a few inches, or even through ſeveral feet of it, is not ſenſible.

Having found, upon repeated trials, that the light of a lamp, properly trimmed, is incomparably more equal than that of a candle, whoſe wick, continually growing longer, renders its light extremely fluctuating, he ſubſtituted lamps to candles in theſe experiments, and made ſuch other variations in the manner of conducting them as he thought bid fair to lead to a diſcovery of the reſiſtance of the air to light, were it poſſible to render that reſiſtance ſenſible within the confined limits of his machinery. But the reſults of them, ſo far from affording means for aſcertaining the reſiſtance of the air to light, do not even indicate any reſiſtance at all; on the contrary, it might almoſt be inferred, from ſome of them, that the intenſity of the light emitted by a luminous body in air is diminiſhed in a ratio *leſs* than that of the ſquares of the diſtances; but as ſuch a concluſion would involve an evident abſurdity, namely, that light moving in air, its abſolute quantity, inſtead of being diminiſhed, actually goes on to *increaſe*, that concluſion can by no means be admitted.

Why not? Theories muſt give place to facts; and if this fact can be fairly aſcertained, inſtead of rejecting the concluſion, we ought certainly to rectify our notions of light, the nature of which we believe no man fully comprehends. Who can take it upon him to ſay, that the ſubſtance of light is not latent in the atmoſphere, as heat or caloric is now acknowledged to be latent, and that the agency of the former is not called forth by the paſſage of a ray through a portion of air as the agency of the latter is known to be excited by the combination of oxygen with any combuſtible ſubſtance? See Chemistry, n° 293, *Suppl.*

The ingenious author's experiments all conſpired to ſhew that the reſiſtance of the air to light is too inconſiderable to be perceptible, and that the aſſumed law of the diminution of the intenſity of light may be depended upon with ſafety. He admits, however, that means may be found for rendering the air's reſiſtance to light apparent; and he ſeems to have thought of the very means which occurred for this purpoſe to M. de Sauſſure.

That eminent philoſopher, wiſhing to aſcertain the tranſparency of the atmoſphere, by meaſuring the diſtances at which determined objects ceaſe to be viſible, perceived at once that his end would be attained, if he ſhould find objects of which the diſappearance might be accurately determined. Accordingly, after many trials, he found that the moment of diſappearance can be obſerved with much greater accuracy when a black object is placed on a white ground, than when a white object is placed on a black ground; that the accuracy was ſtill greater when the obſervation was made in the ſun than in the ſhade; and that even a ſtill greater degree of accuracy was obtained, when the white ſpace ſurrounding a black circle, was itſelf ſurrounded by a circle or ground of a dark colour. This laſt circumſtance was particularly remarkable, and an obſervation quite new.

If a circle totally black, of about two lines in diameter, be faſtened on the middle of a large ſheet of paper or paſteboard, and if this paper or paſteboard be placed in ſuch a manner as to be expoſed fully to the light of the ſun, if you then approach it at the diſtance of three or four feet, and afterwards gradually recede from it, keeping your eye conſtantly directed towards the black circle, it will appear always to decreaſe in ſize the farther you retire from it, and at the diſtance of 33 or 34 feet will have the appearance of a point. If you continue ſtill to recede, you will ſee it again enlarge itſelf; and it will ſeem to form a kind of cloud, the darkneſs of which decreaſes more and more according as the circumference becomes enlarged. The cloud will appear ſtill to increaſe in ſize the farther you remove from it; but at length it will totally diſappear. The moment of the diſappearance, however, cannot be accurately aſcertained; and the more experiments were repeated the more were the reſults different.

M. de Sauſſure, having reflected for a long time on the means of remedying this inconveniency, ſaw clearly, that, as long as this cloud took place, no accuracy could be obtained; and he diſcovered that it appeared in conſequence of the contraſt formed by the white parts which were at the greateſt diſtance from the black circle. He thence concluded, that if the ground was left white near this circle, and the parts of the paſteboard at the greateſt diſtance from it were covered with a dark colour, the cloud would no longer be viſible, or at leaſt almoſt totally diſappear.

This conjecture was confirmed by experiment. M. de Sauſſure left a white ſpace around the black circle equal in breadth to its diameter, by placing a circle of black paper a line in diameter on the middle of a white circle three lines in diameter, ſo that the black circle was only ſurrounded by a white ring a line in breadth.

Photometer.

Piano Forte.

The whole was paſted upon a green ground. A green colour was choſen, becauſe it was dark enough to make the cloud diſappear, and the eaſieſt to be procured.

The black circle, ſurrounded in this manner with white on a green ground, diſappeared at a much leſs diſtance than when it was on a white ground of a large ſize.

If a perfectly black circle, a line in diameter, be paſted on the middle of a white ground expoſed to the open light, it may be obſerved at the diſtance of from 44 to 45 feet; but if this circle be ſurrounded by a white ring a line in breadth, while the reſt of the ground is green, all ſight of it is loſt at the diſtance of only $15\frac{1}{2}$ feet.

According to theſe principles M. de Sauſſure delineated ſeveral black circles, the diameters of which increaſed in a geometrical progreſſion, the exponent of which was $\frac{3}{2}$. His ſmalleſt circle was $\frac{1}{5}$ or 0·2 of a line in diameter; the ſecond 0·3; the third, 0·45; and ſo on to the ſixteenth, which was 87·527, or about 7 inches $3\frac{1}{2}$ lines. Each of theſe circles was ſurrounded by a white ring, the breadth of which was equal to the diameter of the circle, and the whole was paſted on a green ground.

M. de Sauſſure, for his experiments, ſelected a ſtraight road or plain of about 1200 or 1500 feet in circumference, which towards the north was bounded by trees or an aſcent. Thoſe who repeat them, however, muſt pay attention to the following remarks: When a perſon retires backwards, keeping his eye conſtantly fixed on the paſteboard, the eye becomes fatigued, and ſoon ceaſes to perceive the circle; as ſoon therefore as it ceaſes to be diſtinguiſhable, you muſt ſuffer your eyes to reſt; not, however, by ſhutting them, for they would when again opened be dazzled by the light, but by turning them gradually to ſome leſs illuminated object in the horizon. When you have done this for about half a minute, and again directed your eyes to the paſteboard, the circle will be again viſible, and you muſt continue to recede till it diſappear once more. You muſt then let your eyes reſt a ſecond time in order to look at the circle again, and continue in this manner till the circle becomes actually inviſible.

If you wiſh to find an accurate expreſſion for the want of tranſparency, you muſt employ a number of circles, the diameters of which increaſe according to a certain progreſſion; and a compariſon of the diſtances at which they diſappear will give the law according to which the tranſparency of the atmoſphere decreaſes at different diſtances. If you wiſh to compare the tranſparency of the atmoſphere on two days, or in two different places, two circles will be ſufficient for the experiment.

According to theſe principles, M. de Sauſſure cauſed to be prepared a piece of white linen cloth eight feet ſquare. In the middle of this ſquare he ſewed a perfect circle, two feet in diameter, of beautiful black wool; around this circle he left a white ring two feet in breadth, and the reſt of the ſquare was covered with pale green. In the like manner, and of the ſame materials, he prepared another ſquare; which was, however equal to only $\frac{1}{144}$ of the ſize of the former, ſo that each ſide of it was 8 inches; the black circle in the middle was two inches in diameter, and the white ſpace around the circle was 2 inches alſo.

If two ſquares of this kind be ſuſpended vertically and parallel to each other, ſo that they may be both illuminated in an equal degree by the ſun; and if the atmoſphere, at the moment when the experiment is made, be perfectly tranſparent, the circle of the large ſquare which is twelve times the ſize of the other, muſt be ſeen at twelve times the diſtance. In M. de Sauſſure's experiments the ſmall circle diſappeared at the diſtance of 314 feet, and the large one at the diſtance of 3588 feet, whereas it ſhould have diſappeared at the diſtance of 3768. The atmoſphere, therefore, was not perfectly tranſparent. This aroſe from the thin vapours which at that time were floating in it. M. de Sauſſure, as we have obſerved, calls his inſtrument a *diaphanometer*; but as it anſwers one of the purpoſes of a photometer, we truſt our readers will not conſider this account of it as a digreſſion.

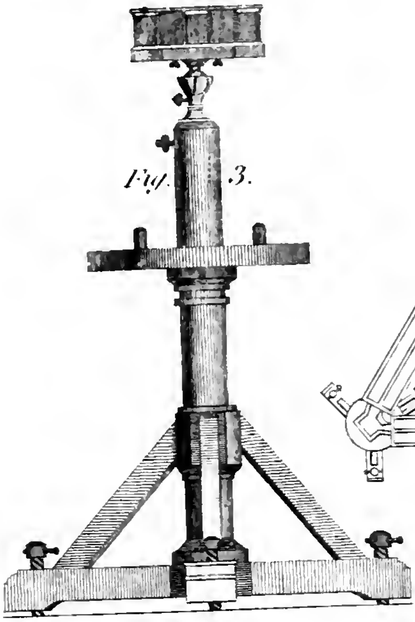
To return to Count Rumford. From a number of experiments made with his *photometer*, he found that, by paſſing through a pane of fine, clear, well poliſhed glaſs, ſuch as is commonly made uſe of in the conſtruction of looking-glaſſes, light loſes ,1973 of its whole quantity, *i. e.* of the quantity which impinged on the glaſs; that when light is made to paſs through two panes of ſuch glaſs ſtanding parallel, but not touching each other, the loſs is ,3184 of the whole; and that in paſſing through a very thin, clear, colourleſs pane of window glaſs, the loſs is only ,1263. Hence he infers that this apparatus might be very uſefully employed by the optician, to determine the degree of tranſparency of glaſs, and direct his choice in the proviſion of that important article of his trade. The loſs of light when reflected from the very beſt plain glaſs mirror, the author aſcertained, by five experiments, to be $\frac{1}{3}$d of the whole which fell upon the mirror.

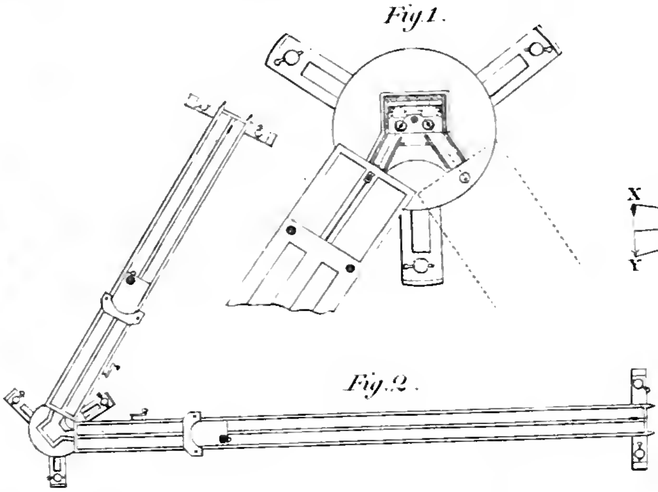
PIANKASHAWS, or *Pyankiſhas*, *Vermillions* and *Maſcontins*, are tribes of Indians in the N. W. Territory, who reſide on the Wabaſh and its branches, and Illinois river. Theſe with the *Kickapoos*, *Muſquitons* and *Ouiatanons*, could together furniſh about 1000 warriors, 20 years ago.—*Morſe*.

PIANKATUNK, a ſmall river of Virginia, which empties eaſtward into Cheſapeak Bay, oppoſite Gwin's Iſland. It is navigable 8 miles for ſmall craft.—*ib.*

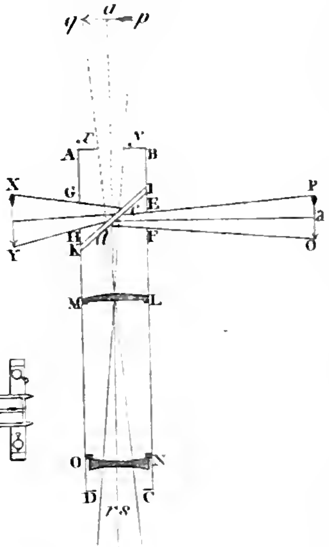
PIANO FORTE, otherwiſe called FORTE PIANO, a well known muſical inſtrument, of which we need make no apology for conſidering the peculiarities with ſome attention. If we look on muſic from no higher point of view than as the *laborum dulce lenimen*, the innocent, the ſoothing, the cheering ſweetener of toil, we muſt acknowledge that it is far from being the meaneſt of thoſe enjoyments with which the Bountiful Father of Men has embelliſhed this ſcene of our exiſtence. But there is a *ſcience* in muſic, independent of that artificial half mathematical doctrine which we have contrived to unite with it, and which really enables us to improve pure muſical pleaſure. Hence in the Engliſh univerſities degrees are conferred in muſic.

The voice is the original muſical inſtrument, and all others are but imitations. The voice of man obeys the impulſe of the heart with wonderful promptitude, and ſtill more wonderful accuracy. A very coarſe ear is hurt by an error in its tone, amounting to what is called a *comma*. A very limited voice can execute melodies extending to 12 notes, or an octave and a fifth. The motion of the glottis between theſe extremes does not amount

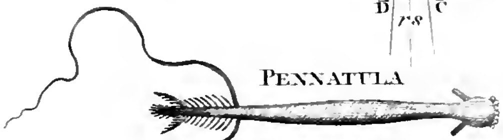


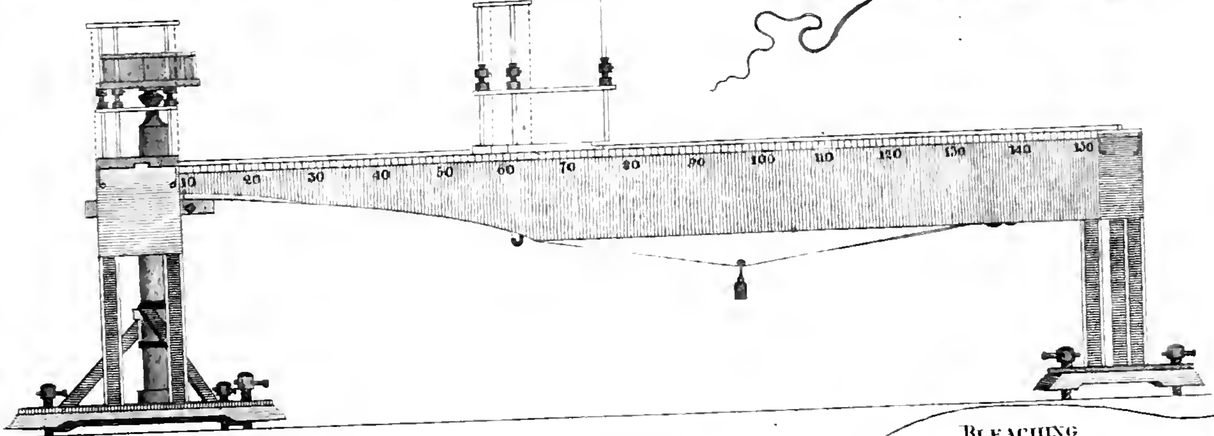


OPERA GLASS



PENNATULA





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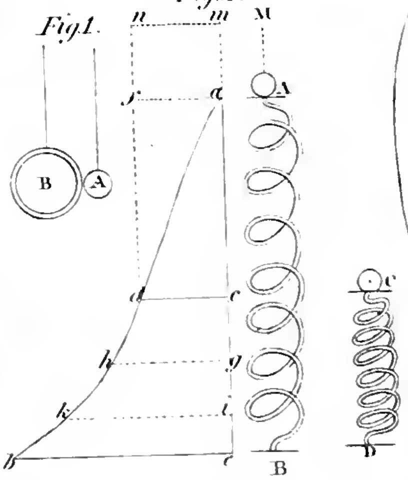
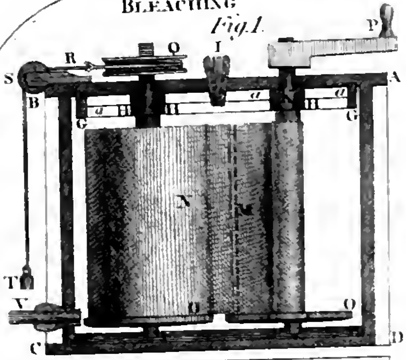
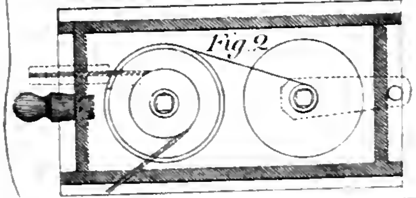
PERCUSSION



BLEACHING





amount to $\frac{1}{12}$th of an inch. This muſt therefore be divided, by the moſt ordinary finger, into more than a thouſand parts: and this muſt be done in an inſtant, and repeated with rapidity, without ever miſtaking one of theſe diviſions; and this is done everywhere, and without any ſeeming effort or thought. The mechaniſm of the human organ for effecting this with eaſe and preciſion is very remarkable, and ſeems to prove that the Author of our Being meant to give us this pleaſure.

When, in the cultivation of this fruit of our own ſoil, the moderns diſcovered the beauties of harmony or conſonance, and inſtruments of fixed ſounds were employed, by means of which theſe beauties could be exhibited in their utmoſt richneſs and variety; and particularly when the organ, that "magic world of ſound," was invented, the immenſe advantages of the ingenious ſpeculations of the ancient Greeks about the diviſion of the monochord were now perceived, and muſic became a deep intellectual ſtudy. It fell into the hands of men of letters, and, for a long while, counterpoint occupied all their attention. Inſtruments of fixed ſounds were now made, not only with pipes, but with ſtrings, bells, rings, and every thing that could make a noiſe in tune.

But all theſe inſtruments were far inferior to the voice, the ſpontaneous gift of Nature, in promptitude, and in the power of obeying every call of ſentiment, every degree, as well as every kind of emotion, with which the heart was agitated. The pleaſures of harmony, though great, were monotonous, and could not expreſs the momentary variations of ſentiment, which are as fleeting as the light and ſhade of a proſpect while the dappled clouds ſail acroſs the ſky. The violin, and a ſmall number of the ſimple wind inſtruments, were found to be the only ones which could fully expreſs thoſe momentary gradations of ſentiment that give muſic its pathos, and enable it to thrill the very ſoul.

Attempts were made to remove this defect of the harmonic inſtruments, and the SWELL was added to the organ. The effect was great, and encouraged the artiſts to attempt ſimilar improvements on other inſtruments of the ſame kind. This was firſt done in the ſame way as in the organ. The harpſicord was ſhut up, like the ſwell organ, and was opened by means of pedals when the performer wiſhed to enforce the ſound. But the effect was far inferior to that of the ſwell organ; for this was (at leaſt in all great organs) a real addition of another properly ſelected ſound. But the effect of the pedal on the harpſicord could not be miſtaken; it was juſt like opening the door of a room where muſic was performing. Other methods were tried with better effect. Uniſons were added to each note, which were brought on either by means of pedals or by another ſet of keys.

This method ſucceeded perfectly well, and the power of the harpſichord was greatly improved. But ſtill it was imperfect, becauſe it was only the more conſiderable changes of force which could be exhibited, and this only in one or two degrees. Other artiſts, therefore, attempted to conſtruct the inſtrument, ſo that the jacks (the moveable upright pieces which carry the quills) can be made to approach nearer to the wires, ſo that the quills ſhall give them a ſtronger twang. The mechaniſm was ſuch, that a very conſiderable motion of the pedal produced but a moſt minute motion of the quill; ſo that the performer was not reſtricted to the utmoſt preciſion in the degree of preſſure Some of thoſe inſtruments, when freſh from the hand of the artiſt, gave full ſatisfaction. But, though made in the moſt accurate manner, at an enormous expence, they very ſoon become unfit for the purpoſe The hundredth part of an inch, more or leſs, in the place of the quill, will make a great odds in the force of the ſound. Nor does the ſame change of diſtance produce an equal alteration of ſound on different quills. Other inſtrument makers have therefore tried baked or prepared leather (buffalo hide) in place of quills; and it is found much more uniform in the tone which it produces, and alſo remains longer in the ſame ſtate; but the tone is not ſo powerful, nor in general ſo much reliſhed.

But all theſe contrivances, both in the organ and harpſichord, were ſtill very deficient. Whatever change they could produce in the ſtrength of the ſound, was produced through the whole inſtrument, or at leaſt through two or three octaves. But the captivating expreſſion of muſic frequently reſults from the momentary ſwelling or ſoftening of a ſingle phraſe, or a ſingle note, in one of the parts. Hence ariſe the unrivalled powers of the harp, and the acknowledged ſuperiority of the theorbo, the lute, and even the guittar, over all keyed inſtruments, notwithſtanding their great limitations in harmony and in practicable melodies. Theſe inſtruments ſpeak, while the harpſichord only plays.

Many attempts have been made to enable the performer to produce, by the intervention of the key, all the gradations of ſtrength, and even the varieties of ſound, which the finger can bring forth by the different manner of pinching, bruſhing, or, as it were, careſſing the ſtring; but we have no diſtinct account of any attempt that has ſucceeded. Such a thing would quickly ſpread over Europe. The compiler of the article LUTHIER, in the *Encyclopedie Methodique*, ſays a great deal about a harpſichord fitted with prepared buffalo leather inſtead of crow quills; and aſſerts expreſsly, that, by the mere preſſure on the key, without the aſſiſtance of pedals or ſtops of any kind, the leather is made to act with greater or leſs force on the ſtring. But he gives no account by which we can comprehend how this is brought about; and indeed he writes in terms which ſhew plainly that he has not ſeen the inſtrument, and is merely puffing ſomething that he does not underſtand.

The attempt has been made with more ſucceſs on keyed inſtruments, when the ſtrings are not pinched, but are rubbed by a wheel or band, in the manner of the vielle (hurdygurdy), or ſtruck with a plectrum, like the dulcimer. The CELESTINA (deſcribed by Merſennus by the name of ARCHIVIOLA) is of this kind. A fine band of horſe hair or ſilk, filled with roſin, is extended under the ſtrings, and drawn ſmoothly along by a wheel. By a particular mechaniſm of the keys, this band is made to preſs or rub on any ſtring tranſverſely, as the ſtrings of a violin are touched by the bow. The preſſure on the key regulates the ſtrength of the tone. This inſtrument is not without conſiderable beauties, and will execute ſoft *cantabile* muſic in eaſy modulation, with great expreſſion and juſtneſs. But the artiſts have not yet been able to give it either clearneſs or brilliancy of tone, nor ſufficient force for concert muſic, nor

that

that promptitude of touch that is indiſpenſably neceſſary for figurative muſic or quick movements.

The ſame improvements have been made on the pulſatile inſtruments; and indeed they are here the moſt obvious and eaſy. When the key is employed merely as the means of cauſing a plectrum to give a blow to the ſtring, the performer will hardly fail to give that degree of force which he feels proper for his intended expreſſion. Accordingly, many inſtruments of this kind have been made in Germany, where the artiſts have long been eminent for mechanical knacks. But all their inſtruments of the dulcimer kind are feeble and ſpiritleſs, and none of them have been brought into general uſe if we except the CLAVICHORD. This is indeed an inſtrument of feeble, and not the moſt pleaſing ſound; but is well fitted for giving every momentary gradation of ſtrength by the preſſure of the finger. It is therefore a good inſtrument for forming the muſical taſte by chamber practice, and was much uſed by compoſitors in their ſtudies. It is alſo an ingenious, though ſeemingly an obvious and ſimple contrivance, and is capable of much more force, and even brilliancy of ſound, than has generally been given to it.

The conſtruction is ſhortly this. The inner end of the key is furniſhed with an upright piece, which terminates in an edge of braſs, ſomewhat like the end of a narrow blunt chiſſel, whoſe line of direction is athwart the ſtrings. When the key is preſſed down, this edge ſtrikes the ſtring, and forces it out of the ſtraight line in which it is ſtretched between its pins. Thus the ſtring is ſhaken or jogged into vibration, in the ſame manner as we obſerve a tight rope ſet a vibrating by a ſudden jerk given to any part of it. The ſtring, thus agitated, gives a ſound, which will continue for ſome little time if the key be held down. As the tone depends on the length of the vibrating ſtring, as well as on its tenſion, it is of importance that the ſtroke be made on the preciſe point of the ſtring which terminates the proper length. The ſtring does not give the note correſponding to its whole length, but that which is produced by the part between the edge and the pin. And becauſe the parts of the ſtring on each ſide of the edge are equally thrown into vibration, the ſhorter portion of it muſt be wrapped up in a liſt of cloth, to prevent it from diſturbing the ear by its ſonorous vibrations. This, however, greatly diminiſhes the ſweetneſs of the ſound given by the other part.

The clavichord gives a fretful waſpiſh kind of ſound, not at all ſuited to tender expreſſion. If the bridge (for the end of the key is really a bridge during the ſound) were placed at an exact third of the length of the ſtring, and if both parts were free, and if the ſtroke be of a proper ſtrength, the ſtring would ſound its twelfth with great ſweetneſs, and with much more force and brilliancy than it does by the preſent conſtruction, and the clavichord would be a charming inſtrument for a leſſon and for private ſtudy. We ſay this from experience of the power of one conſtructed under the direction of the great mathematician Euler, who was alſo an excellent judge of muſic and muſical compoſition. The tones of the upper part of that inſtrument had a ſort of pipe or vocal ſound, and were ſuperior in clearneſs and ſweetneſs to any ſtringed inſtrument we ever heard. But as this conſtruction required every ſtring to be one half longer than a harpſichord wire of the ſame pitch, and as this would have made the inſtrument of a moſt inconvenient ſize, the baſſes were made ſhorter, by placing the bridge at one-ſixth of the length and loading the ſhorter portion of the ſtring with wire twiſted round it. But although this was executed by a moſt dexterous artiſt, the tones were far inferior to thoſe of the trebles, and the inſtrument was like the junction of a very fine one and a very bad one, and made but hobbling muſic. This was probably owing to the impoſſibility of connecting the metal wire and its covering with ſufficient cloſeneſs and ſolidity. An upright clavichord, where the length would be no inconvenience, would be indeed a capital inſtrument for muſical ſtudy. It is worthy of remark, that Mr Euler tried other diviſions of the ſtring by the bridge. When it is ſtruck preciſely in the middle, it ſhould ſound its octave; when it is ſtruck at one-fourth, it ſhould give the double octave, &c. But the maker found that theſe diviſions gave very indifferent, and even uncertain tones; ſometimes not ſounding at all, and ſometimes ſounding beautifully. Our readers will find this well explained in a future article of this *Supplement*, (TRUMPET, *Marine*). They may pleaſe to reflect on the very different tone of the violin as it is bowed on different parts of the ſtring, and on the very different tones of the fore and back uniſons, and particularly of the Cornet ſtop of the harpſichord. The harpſichords of Rucker are noted for the grand fulneſs of their tone; thoſe of Haſſe of Dreſden for their mellow ſweetneſs, and thoſe of Kirkmann of London for their unequalled brilliancy. Theſe makers differed greatly in the placing of the quills.

But the Engliſh PIANO FORTE, by its ſuperior force of tone, its adequate ſweetneſs and the great variety of voice of which our artiſts have made it ſuſceptible, has withdrawn all farther attention from the clavichord, ſo that it is no longer probable that the learned contribution of the great Euler to public amuſement will be followed up. The Piano-forte correſponds to its name with great preciſion: For, without any other attention or effort than what ſentiment ſpontaneouſly dictates, and what we practiſe (without knowing it) on the harpſichord, where it is ineffectual, we make the Piano-forte give every gradation of ſtrength to the ſound of the ſtring, and give it every expreſſion that an inſtrument purely pulſatile, is capable of. It is alſo ſuſceptible of a very conſiderable variety of tone by the clothing of the mallets, which may be acute or obtuſe, hard or ſoft. And we ſee, by the effect of what are called the grand Piano-fortes, that they are fully equal to the harpſichord in fulneſs or body of tone. Nothing ſeems to be wanting to it but that ſliding, or (as the French call it) *careſſing* touch of the ſtring, by which a delicate finger, guided by fine taſte, cauſes the harp or lute to melt the heart, and excite its fineſt emotions. We truſt that the ingenuity of our Britiſh artiſts will accompliſh even this, and make this national inſtrument rival even the violin of Italy.

We call it a *national inſtrument*, not doubting but that this is a recommendation to a Britiſh heart, and becauſe we are very well aſſured that it is an Engliſh contrivance; the invention of a moſt excellent man and celebrated poet, Mr William Maſon. His Charactacus and Elfrida may convince any perſon who is a judge of muſic, that he had a mind exquiſitely ſenſible of all its charms; and we cannot be ſurpriſed that it was one of his chief delights. No man enjoyed the pleaſures of muſic with more rapture; and he uſed to ſay that his ſpeedieſt recruit from the fatigue of a long walk was to ſit down for a few minutes to the harpſichord. He had ſeen ſeveral of the German attempts to make keyed dulcimers, which were, in ſome meaſure, ſuſceptible of the *forte* and *piano*: But they were all on one principle, and required a particular touch of the finger, of difficult acquiſition, and which ſpoiled it for harpſicord practice. We have alſo ſeen of thoſe inſtruments, ſome of very old date, and others of modern improvement. Some had very agreeable tones; but all were deficient in delicacy and juſtneſs. The performer was by no means certain of producing the very ſtrength of ſound that he intended. And, as Mr Maſon obſerved, they all required an artificial peculiarity of fingering; without which, either the intended ſtrength of tone was not brought out, or the tone was deſtroyed by repeated rattling of the mallet on the wire.

Mr Maſon removed all thoſe imperfections, by detaching the mallet entirely from the key, and giving them a connection quite momentary. The ſketch in Plate XL. will give the reader a clear view of Mr Maſon's general principle by which the Engliſh piano forte is diſtinguiſhed from all others. The parts are repreſented in their ſtate of inaction. The key ABK turns, as uſual, on the round edge of the bar B, and a pin *b*, driven into the bar, keeps it in its place. The dot F repreſents a ſection of the ſtring. ED is the mallet, having a hinge of vellum, by which it is attached to the upper ſurface of the bar E. At the other end is the head D, of wood, covered with ſome folds of prepared leather. The mallet lies in the poſition repreſented in the figure, its lower end reſting on a cuſhion-bar K, which lies horizontally under the whole row of mallets. The key AR has a pin C tipt with a bit of the ſofteſt cork or buckſkin. This reaches to within $\frac{1}{20}$th of an inch of the ſhank of the mallet, but muſt not touch it. The diſtance E*e* is about $\frac{1}{3}$d or $\frac{1}{4}$th of the length of the ſhank. When the end A of the key is preſſed down on the ſtuffing (two or three thickneſſes of the moſt elaſtic woollen liſt) it raiſes the mallet, by means of the pin C, to the horizontal poſition E*d*, within $\frac{1}{8}$th or $\frac{1}{10}$th of an inch of the wire F; but it cannot be ſo much preſſed down as to make the mallet touch the wire. At the ſame time that the key raiſes the mallet by means of the pin C, it alſo lifts off the damper G (a bit of ſponge) from the wire. This damper is fixed on the end of a little wooden pin G*g*, connected with the lever *g*H, which has a vellum hinge at H. This motion of the damper is cauſed by the pin I, which is fixed into the key near to R. Theſe pieces are ſo adjuſted, that the firſt touch of the key lifts the damper, and, immediately after, the pin C acts on the ſhank of the mallet. As it acts ſo near to its centre of motion, it cauſes the head D to move briſkly through a conſiderable arch D *d*. Being made extremely moveable, and very light, it is thus *toſſed* beyond the horizontal poſition E*d*, and it ſtrikes the wire F, which is now at liberty to vibrate up and down, by the previous removal of the damper G. Having made its ſtroke, the mallet falls down again, and reſts on the ſoft ſubſtance on the pin C. It is of eſſential importance that this mallet be extremely light. Were it heavy, it would have ſo much force, after rebounding from the wire, that it would rebound again from the pin C, and again ſtrike the wire. For it will be recollected, that the key is, at this time, down, and the pin C raiſed as high as poſſible, ſo that there is very little room for this rebound. Leſſening the momentum of the mallet by making it very light, making the cuſhion on the top of the pin C very ſoft, and great preciſion in the ſhape and figure of all the parts, are the only ſecurities againſt the diſagreeable rattling which theſe rebounds would occaſion. In reſpect to the ſolidity and preciſion of workmanſhip, the Britiſh inſtruments are unrivalled, and vaſt numbers of them are ſent to all parts of the continent.

As the blow of ſo light a mallet cannot bring much ſound from a wire, it has always been found neceſſary to have two ſtrings for each note. Another circumſtance contributes to enfeeble the ſound. The mechaniſm neceſſary for producing it makes it almoſt impoſſible to give any conſiderable extent to the belly or ſound board of the inſtrument. There is ſeldom any more of it than what occupies the ſpace between the tuning pins and the bridge. This is the more to be regretted, becauſe the baſſes are commonly covered ſtrings, that they may be of a moderate length. The baſs notes are alſo of braſs, which has a conſiderably lower tone than a ſteel wire of the ſame diameter and tenſion. Yet even this ſubſtitution for ſteel in the baſs ſtrings is not enough. The higheſt of them are much too ſlack, and the loweſt ones muſt be loaded, to compenſate for want of length. This greatly diminiſhes the fulneſs, and ſtill more the mellowneſs and diſtinctneſs of the tone, and frequently makes the very loweſt notes hardly appreciable. This inequality of tone about the middle of the inſtrument is ſomewhat diminiſhed by conſtructing the inſtrument with two bridges; one for the ſteel, and the other for the braſs wires. But ſtill the baſs notes are very much inferior to the treble. It would ſurely be worth while to conſtruct ſome piano fortes, of full ſize, with naked baſſes. If theſe were made with all the other advantages of the grand piano forte, they would ſurpaſs all other inſtruments for the regulating power of their thorough baſs. We wiſh that the artiſts would alſo try to conſtruct them with the mechaniſm of mallets, &c. above the ſound board. This would allow to it the full extent of the inſtrument, and greatly improve the tone. It does not ſeem impoſſible, nor (we think) very difficult.

For directions how to tune this pleaſing inſtrument, ſee Temperament in this *Supplement*.

PIARA, on the coaſt of S. America, lies 13 or 14 leagues from Payta, in lat. 7 N. and is the firſt town of any note. A river which waſhes it, falls into the bay of Chiroper; but as it abounds with ſhoals, it is little frequented.—*Morſe*.

PIC, *River du*, empties into Lake Superior, in lat. 48 36 11, and long. 89 41 6. The Grand Portage is in lat. 48 41 6.—*ib.*

PIC DE L'ETOIL, *le*, or *Pic de l'Alverdi*, as it is named in Bouganville's map, a ſmall high iſland, ſhaped like a ſugar-loaf, lying a little to the northward, and in ſight of Aurora Iſland; diſcovered by the fore-named navigator in May, 1768.—*ib.*

PICA, a harbour on the coaſt of Peru, where there is high and ſteep land; 12 leagues N. of Lora river, and 5 ſouth of Tarapaca, or as it is called by Britiſh ſeamen, *Carapoucha*.—*ib.*

PICARA, a large province of S. America, in New-Granada; bounded on the E. by the Andes.—*ib.*

PICAWEE, Indian towns in the N. W. Territory, on Great Miami river, 75 miles from its mouth, where it is only 30 yards broad, although navigable for loaded batteaux 50 miles higher.—*ib.*

PICKERSGILL's *Cove*, is within Chriſtmas Sound, on the ſouth coaſt of Terra del Fuego, at the ſouthern extremity of S. America.—*ib.*

Pickersgill's *Iſland*, is off Cape Diſappointment, in S. Georgia, in the S. Atlantic Ocean. S. lat. 54 42. W. long. 36 58.—*ib.*

PICKERSVILLE, the chief town of Waſhington diſtrict, in S. Carolina.—*ib.*

PICOLATA, a fort on the river St John, in Eaſt-Florida, 27 miles from St Auguſtine, and 3 from Poopoa Fort.—*ib.*

PICOLET *Point*, on the north ſide of the iſland of St Domingo, forms the W. boundary of the bay which ſets up to Cape Francois. In time of war, ſhips have often been taken under the cannon of Picolet.—*ib.*

PICOSA, or *Piſana*, mountains on the coaſt of Peru, which ſerve to direct mariners. They are high hills within land, extending about 7 leagues, between Colanche river, and Solango Iſland; and lie ſouthward of the equator.—*ib.*

PICTOU, a ſmall iſle, river, bay, and ſettlement in the N. E. part of the province of Nova-Scotia, and on the ſouthern ſide of the Straits of Northumberland, at the ſouthern extremity of the Gulf of St Lawrence. The iſland lies in the narroweſt part of the ſtrait, a little way north-weſt of the mouth of the river of its name; 8 miles ſouth of Bear Cove in the iſland of St John's, and 58 eaſterly of the mouth of Bay Verte. The bay or harbour of this name ſeems to be of conſiderable extent. Eaſt river, which falls into Pictou harbour, ſupplies the country with coals, from the mines on its banks; the ſtreams of leſs note which empty into the bay, are St Mary's, Antigoniſh, Liverpool, Turket, Muſquideboit, and Siſſibou rivers. The ſettlement of Pictou is fertile, populous, and increaſing in importance. A good road is cut, cleared, and bridged to Halifax, 68 miles diſtant ſouth by weſt. This ſettlement is now called *Tinmouth.*—*ib.*

PIERCE's *Iſland.* The main channel of Piſcataqua river, in New-Hampſhire, lies between Pierce's and Seavey's Iſlands; on each of which batteries of cannon were planted, and entrenchments formed in 1775. The ſtream here is very contracted; the tide rapid; the water deep, and the ſhore bold and rocky on each ſide: ſo that in the ſevereſt winters the river is never frozen.—*ib.*

PIERE, an iſland in Illinois river, about 47 miles above the Piorias wintering-ground. A *fleche*, or arrow-ſtone is obtained by the Indians from a high hill on the weſtern ſide of the river, near the above iſland; with this ſtone the natives make their gun-flints, and point their arrows. Above this iſland are rich and fertile meadows, on the eaſtern ſide of the river, and continue ſeveral miles.—*ib.*

PIERMONT, a townſhip in Grafton county, New-Hampſhire, on the eaſt bank of Connecticut river, 6 miles ſouthward of Haverhill, and 5 northward of Orford. It was incorporated in 1764, and contains 426 inhabitants.—*ib.*

PIEROUAGAMIS, an Indian nation who inhabit the N. W. banks of Lake St John, in Lower Canada.—*ib.*

PIERRE, *St*, a ſmall deſert iſland near the coaſt of Newfoundland, which is only fit for curing and drying fiſh. N. lat. 46 27, W. long. 55 57. It was ceded to the French by the peace of 1763.—*ib.*

Pierre, *St*, the firſt town built in the iſland of Martinico in the Weſt-Indies, ſituated on a round bay on the weſt coaſt of the iſland, 5 leagues ſouth of Fort Royal. It is a port of entry, the reſidence of merchants, and the centre of buſineſs. It has been 4 times burnt down, yet it contains at preſent about 2,000 houſes. The anchorage ground is ſituated along the ſea-ſide on the ſtrand, but is very unhealthy. Another port of the town is ſeparated from it by a river, and the houſes are built on a low hill, which is called the fort, from a ſmall fortreſs which defends the road, which is commodious for loading and unloading ſhips, and is likewiſe eaſy of acceſs; but in the rainy ſeaſon the ſhipping take ſhelter at Fort Royal, the capital of the iſland.—*ib.*

Pierre, *St*, a river in Louiſiana which empties into the Miſſiſſippi, from weſt, about 10 miles below the Falls of St Anthony. It paſſes through a moſt delightful country, abounding with many of the neceſſaries of life, which grow ſpontaneouſly. Wild rice is found here in great abundance, trees bending under loads of fruit, ſuch as plums, grapes, and apples. The meadows are covered with hops, and many other vegetables; while the ground is ſtored with uſeful roots, as angelica, ſpikenard, and ground-nuts as large as hens eggs. On its eaſt ſide, about 20 miles from its mouth, is a coal mine.—*ib.*

PIGEON, the name of two ſouth-weſtern branches of French Broad river, in the State of Tenneſſee. The mouth of Little Pigeon is about 25 miles from the confluence of French Broad with Holſton river, and about 3 below the mouth of Nolachucky. Big Pigeon falls into the French Broad 9 miles above Little Pigeon river. They both riſe in the Great Iron Mountains.—*ib.*

Pigeon, a ſmall iſland, whoſe ſtrong fortifications command and ſecure ſafe and good anchorage in Port Royal Bay, in the iſland of Martinico, in the Weſt-Indies.—*ib.*

PIGMENTS, or Paints, are furniſhed by both the mineral and vegetable kingdoms. The former are the moſt durable, and are generally prepared from the Oxyds of metals (ſee Chemistry-*Index* in this *Suppl.* and *Colour-Making*, Encycl.); but Fourcroy thinks that chemiſtry furniſhes a method of fixing vegetable colours completely. From a number of experiments, which we need not detail, as they will be noticed in the article *Vegetable* Substances, he draws the following concluſions:

1. That oxygen, when combined with vegetable ſubſtances, changes their colour.

2. That different proportions of this principle produce different ſhades in coloured vegetable matter.

3. That theſe ſhades paſs, by a ſort of degradation, from the darkeſt colours to the lighteſt; and that the extreme point of the latter may be conſidered as a complete deprivation of colour.

4. That in many vegetable ſubſtances this degradation does not take place, as M. Berthollet has obſerved.

5. That many red, violet, purple, cheſnut, and blue vegetable

vegetable colours, are produced by different proportions of oxygen; but that none of theſe are completely ſaturated with this principle.

6. That the complete ſaturation here ſpoken of generally produces yellow colours, which are the leaſt changeable of all.

7. That vegetable ſubſtances coloured by oxygen, not only change their colour according to the proportion of oxygen they have imbibed, but that they alſo change their nature in the ſame proportion, and approach more to a reſinous ſtate as they become nearer to a yellow colour.

Laſtly, that the cauſe of the changeability of the red, brown, and violet colours, procured from vegetables, is ſuch as has been ſtated above; that there exiſts a method of fixing them, or rendering them permanent, by impregnating them with a certain quantity of oxygen, by means of the oxygenated muriatic acid; imitating, by this proceſs, the method purſued by nature, who never forms fixed and permanent colours, except in ſubſtances which have been long expoſed to the open air.

PIKELAND, a townſhip in Cheſter county, Pennſylvania.—*Morse.*

PILDRAS, *St*, on the E. ſhore of the Gulf of Campeachy, in the Gulf of Mexico. N. lat. 21 4, W. long. 90 35.—*ib.*

PILES-GROVE, a townſhip in Salem county, New-Jerſey.—*ib.*

PILGERRUH, or *Pilgrim's Reſt*, was a Moravian ſettlement of Chriſtian Indians, on the ſcite of a forſaken town of the Ottawas; on the bank of a river, 20 miles north-weſterly of Cayahoga, in the N. W. Territory, near Lake Erie, and 140 miles N. W. of Pittſburg.—*ib.*

PILGRIM's *Iſland*, on the S. eaſtern ſhore of St Lawrence river, and below the Iſland de Coudres.—*ib.*

PILLAR, *Cape*, at the W. end of the Straits of Magellan, 6 leagues N. of Cape Deſeada. S. lat. 52 45, W. long. 76 40.—*ib.*

PILOTO, or *Salinas del Piloto*, upright craggy rocks on the W. coaſt of Mexico, S. E. of Cape Corientes; where there is good anchorage, and ſhelter from N. W. and W. and S. W. winds. There are ſalt-pits near this place.—*ib.*

PILOT-TOWN, in Suſſex county, Delaware, lies near the mouth of Cool Spring Creek, which falls into Delaware Bay, near Lewiſtown, and 6 miles N. W. of Cape Henlopen.—*ib.*

PIMENT, *Port à*, a village on the S. W. coaſt of the S. peninſula of the iſland of St Domingo, 4½ leagues N. W. of Les Coteaux, between which are two coves affording anchorage; that neareſt Coteaux, is called Anſe a Damaſſin. Port Piment is nearly eight leagues E. by S. of Tiburon.—*ib.*

PINAS *Iſland*, on the coaſt of the Gulf of Honduras, is ſituated off *Trivigillo Bay.*—*ib.*

Pinas *Point*, the eaſtern point of Panama Bay. N. lat. 6 15, W. long. 80 30. The port of this name is on the ſame S. W. coaſt of the Iſthmus of Darien, near the point; 12 leagues N. by W. of Port Quemada, and 7 from Cape Garachina. The coaſt, all the way ſouthward, to Cape Corientes, abounds with pine trees; hence the name.—*ib.*

PINCHINA, one of the Cordilleras in S. America. M. Baugier found the cold of this mountain, immediately under the equator, to extend from 7 to 9 degrees under the freezing point every morning before ſun-riſe.—*ib.*

PINCKNEY, an iſland on the coaſt of South-Carolina.—*ib.*

Pinckney, a diſtrict of the upper country of S. Carolina, lying W. of Camden and Cheraw diſtricts; ſubdivided into the counties of York, Cheſter, Union, and Spartanburgh. It contains 25,870 white inhabitants; ſends to the State legiſlature, 9 repreſentatives, and 3 ſenators; and in conjunction with Waſhington, ſends one member to Congreſs. It was formerly part of Camden and Ninety-Six diſtricts. Chief town, Pinckneyville.—*ib.*

PINCKNEYVILLE, a poſt-town of S. Carolina, and capital of the above diſtrict, in Union county, on the S. W. ſide of Broad river, at the mouth of Pacolet. It contains a handſome court-houſe, a gaol, and a few compact houſes. It is 75 miles N. W. of Columbia, 56 from Lincolntown, in N. Carolina, and 716 from Philadelphia.—*ib.*

PINE, *Cape*, on the S. coaſt of the Iſland of Newfoundland, is about eight leagues weſtward of Cape Race. N. lat. 46 42, W. long. 53 20.—*ib.*

Pine *Creek*, in Northumberland county, Pennſylvania, a water of the W. branch of Suſquehannah river. Its mouth is about 12 miles weſtward of Lycoming Creek, and 40 N. W. of the town of Northumberland.—*ib.*

PINES, a ſmall iſland on the N. coaſt of Terra Firma, S. America, about 41 leagues E. of Porto Bello, and forms a good harbour, with two other ſmall iſlands, and the main land. N. lat. 9 12, W. long. 80 15. The *River of Pines* is 5 miles from the above named harbour, and 27 eaſterly of Allabrolies river. Its mouth has 6 feet water, but within there is 3 fathoms a conſiderable way up.—*ib.*

Pines, *Pinez* or *Pinas*, a ſmall uninhabited iſland, ſeparated from the S. W. part of the iſland of Cuba, in the Weſt-Indies, by a deep ſtrait. It is about 25 miles long, and 15 broad, and affords good paſturage. It is 6 leagues from the main, but the channel is impaſſable, by reaſon of ſhoals and rocks. N. lat. 21 30, W. long. 83 25.—*ib.*

PINTARD's *Sound*, on the N. W. coaſt of N. America, ſets up in an eaſtern direction, having in it many ſmall iſlands. Its mouth extends from Cape Scott, on the ſouthern ſide, in lat. 50 56, and long. 128 57 W. to Point Diſappointment, in lat. 52 5, and long. 128 50 W. It communicates with the Straits de Fuca; and thus the lands on both ſides of Nootka Sound, from Cape Scott to Berkley's Sound, (oppoſite Cape Flattery, on the eaſtern ſide of the Straits de Fuca) are called by Capt. Ingraham, Quadras Iſles.—*ib.*

PINTCHLUCO *River*, a large branch of the Chata Uche, the upper part of Appalachicola river.—*ib.*

PIORIAS *Fort and Village, Old*, in the N. W. Territory, on the weſtern ſhore of Illinois river, and at the ſouthern end of Illinois Lake; 210 miles from Miſſiſſippi river, and 30 below the Craws Meadows river. The ſummit on which the ſtockaded fort ſtood, commands a fine proſpect of the country to the eaſtward, and up the lake, to the point where the river comes in at the north end; to the weſtward are large meadows. In the lake (which is only a dilatation of the river, 19¼ miles in length, and 3 in breadth) is great plenty of fiſh, and in particular, ſturgeon and picannau. The country to the weſtward is low and very level, and full of ſwamps, ſome a mile wide, bordered with fine meadows, and in ſome places the high land comes to the river in points, or narrow necks. Here is abundance of cherry, plum, and other fruit trees. The Indians at the treaty of Greenville, in 1795, ceded to the United States a tract of 12 miles ſquare at this fort. N. lat. 40 53, W. long. 91 12 30.—*ib.*

Piorias *Wintering Ground*, a tract of land in the N. W. Territory, on the S. E. ſide of Illinois river, about 40 miles above, and N. E. of the Great Cave, on the Miſſiſſippi, oppoſite the mouth of the Miſſouri, and 27 below the iſland Pierre. About a quarter of a mile from the river, on the eaſtern ſide of it, is a meadow of many miles long, and 5 or 6 miles broad. In this meadow are many ſmall lakes, communicating with each other, and by which there are paſſages for ſmall boats or canoes; and one leads to the Illinois river.—*ib.*

Piorias, an Indian nation of the N. W. Territory, who with the Mitchigannias could furniſh 300 warriors, 20 years ago. They inhabit near the ſettlements in the Illinois country. A tribe of this name inhabit a village on the Miſſiſſippi, a mile above Fort Chartres. It could furniſh about the ſame period 170 warriors of the Piorias and Mitchigamias. They are idle and debauched.—*ib.*

PIRAUGY, a river of Brazil, S. America, S. S E. of Rio Grand, and Point Negro.—*ib.*

PISCA, a handſome town in the audience of Lima in Peru, with a good harbour and ſpacious road. The country round it is fertile, and it ſends to the neighbouring ſettlements quantities of fruit and wine. It formerly ſtood a quarter of a league farther to the ſouth, but being deſtroyed by an earthquake, in 1682, it was removed to its preſent ſituation, about half a mile from the ſea. It is 140 miles ſouth of Lima. S. lat. 14, W. long 73 35.—*ib.*

PISCADORES, or *Fiſhers*, two great rocks on the coaſt of Peru, in lat. 16 48 ſouth, near the broken gap between Attico and Ocona.—*ib.*

Piscadores, rocks above the town of Cailao, in Peru; 5 leagues N. N. W. of Callao Port. They are 6 in number; the largeſt is weſt of the port of Ancon de Rhodas, and 3 leagues ſouth-eaſt of Chaucai Port.—*ib.*

PISCATAQUA, the ancient name of lands in the Diſtrict of Maine, ſuppoſed to comprehend the lands known by the names of Kittery and Berwick.—*ib.*

PISCATAWAY, a townſhip of New-Jerſey, ſituated in Middleſex county, on Rariton river, 6 miles from its mouth. It has 2,261 inhabitants, including 218 ſlaves. It is 3½ miles N. E. of New-Brunſwick, and 14 ſouth-weſt of Elizabeth-Town.—*ib.*

Piscataway, a ſmall poſt-town of Prince George's county, Maryland; ſituated on the creek of its name which runs weſtward into Patowmac river, oppoſite Mount Vernon in Virginia, and 14 miles ſouth of the Federal City. The town is 16 miles ſouth-weſt of Upper Marlborough, 16 north of Port Tobacco, and 67 S. W. by S. of Baltimore.—*ib.*

PISCO, a noted harbour on the coaſt of Peru, in the province of Los Reyes, 6 leagues from the port of Chinca; Lorin Chinca lying half way between them. The road is ſafe and capacious enough to hold the navy of France. The town is inhabited by about 300 families, moſt of them meſtizoes, mulattoes, and negroes; the whites being much the ſmalleſt number. It has 3 churches, and a chapel for Indians; lies about half a mile from the ſea, and 123 miles ſouth of Lima. The ruins of the ancient town of Piſca are ſtill viſible, extending from the ſea ſhore to the New town. It was deſtroyed by an earthquake and inundation on Oct. 19, 1680. The ſea, at that time, retired half a league, and returned with ſuch fury, that it overflowed almoſt as much land beyond its bounds. S. lat. 13 36, W. long. 76 15.—*ib.*

PISS-POT, a bay on the ſouth ſhore of the ſtraits of Magellan, in the Long Reach, 8 leagues W. by N. of Cape Notch. S. lat. 53 14, W. long. 75 12—*ib.*

PISTOLET, a large bay at the northern end of Newfoundland, ſetting up from the Straits of Belliſle. Its weſtern ſide is formed by Cape Norman, and its eaſtern point by Burnt Cape; 3 leagues apart.—*ib.*

PITCAIRN'S *Iſland*, in the S. Pacific Ocean, is 6 or 7 miles in length and 2 in breadth. It has neither river nor harbour; but has ſome mountains which may be ſeen 15 leagues off to the S. E. All the S. ſide is lined with rocks. S. lat. 25 2, W. long. 133 21. The variation of the needle off this iſland, in 1767, was 2 46 E.—*ib.*

PITCH. See *Encycl.*—The beſt black pitch is made of the refuſe of roſin and turpentine, ſuch as will not paſs through the ſtraw filter, and the cuttings around the inciſion on the tree. Theſe materials are put into a boiler ſix or ſeven feet in circumference, and eight or ten high. Fuel is laid around the top, and the materials as they melt flow through a channel, cut in the fire-place into a tub half filled with water. It is at that time very red, and almoſt liquid. To give this a proper conſiſtence, it is put in a cauldron placed in a furnace, and boiled down in the ſame manner as roſin, but it requires much leſs precaution and double the time. It is then poured into moulds of earth, and forms the beſt kind of black pitch. See Rosin and Turpentine in this *Suppl.*

Bastard PITCH, is a mixture of colophony, black pitch, and tar. They are boiled down together, and put into barrels of pine wood, forming, when the ingredients are mixed in equal portions, a ſubſtance of a very liquid conſiſtence, called in France *bray gras*. If, on the contrary, it is deſired of a thicker conſiſtence, a greater proportion of colophony is added, and it is caſt in moulds. It is then called *baſtard pitch*.

PITON *Point, Great*, the S. W. point of the iſland of St Lucia, in the Weſt-Indies, and the moſt weſterly point of the iſland. It is on a kind of a peninſula, the northern part of which is called Point Chimatchin.—*Morse.*

PITT, a county of N. Carolina, in Newbern diſtrict, bounded N. E. by Beaufort, and S. W. by Glaſgow. It contains 8,275 inhabitants, including 2,367 ſlaves. Chief town, Greenville.—*ib.*

PITTQUOTTING, an Indian ſettlement in the N. W. Territory, at the mouth of Huron river, which empties into Lake Erie.—*ib.*

PITTSBOROUGH, or *Pittſburg*, the capital of Chatham county, N. Carolina, is ſituated on a riſing ground, and contains a court-houſe, gaol, and about 40 or 50 houſes. The country in its environs is rich and well cultivated; and is much reſorted to from the maritime parts of the State in the ſickly months. The Hickory Mountain is not far diſtant, and the air and water here are as pure as any in the world. It is 26 miles ſouth-weſt of Hillſborough, 36 weſt of Raleigh, 54 north-weſt of Fayetteville, and 505 from Philadelphia.—*ib.*

PITTSBURG, a poſt-town of Pennſylvania, the capital of Alleghany county, ſituated on a beautiful plain running to a point. The Alleghany, which is a beautiful clear ſtream, on the north, and the Monongahela, which is a muddy ſtream, on the ſouth, uniting below where Fort du Queſne ſtood, form the majeſtic Ohio; which is there a quarter of a mile wide; 1,188 miles from its confluence with the Miſſiſſippi, and 500 above Limeſtone, in Kentucky. This town was laid out on Penn's plan, in the year 1765, on the eaſtern bank of the Monongahela, about 200 yards from Fort du Queſne, which was taken from the French, by the Britiſh, in 1760, and who changed its name to Fort Pitt, in honour of the late Earl of Chatham. It contains between 250 and 300 houſes, a gaol, court-houſe, Preſbyterian church, a church for German Lutherans, an academy, two breweries, and a diſtillery. It has been lately fortified, and a party of troops ſtationed in it. By an enumeration made Dec. 1795, it appears that there were then 1,353 inhabitants in this borough; the number has conſiderably increaſed ſince. The hills on the Monongahela ſide are very high, extend down the Ohio, and abound with coals. Before the revolution, one of theſe coal-hills, it is ſaid, took fire and continued burning 8 years; when it was effectually extinguiſhed by part of the hill giving way and filling up the crater. On the back ſide of the town, from Grant's Hill, (ſo called from his army's being here cut to pieces by the Indians) there is a beautiful proſpect of the two rivers, waſting along their ſeparate ſtreams till they meet and join at the point of the town. On every ſide, hills covered with trees, appear to add ſimplicity and beauty to the ſcene. At the diſtance of 100 miles up the Alleghany is a ſmall creek, which, in ſome places, boils or bubbles forth, like the waters of Hell Gate, in New-York State, from which proceeds an oily ſubſtance, deemed by the people of this country, ſingularly beneficial, and an infallible cure for weakneſs in the ſtomach, for rheumatic pains, for ſore breaſts in women, bruiſes, &c. The oil is gathered by the country people and Indians, who boil it and bring it to Pittſburg for ſale; and there is ſcarcely a ſingle inhabitant who does not poſſeſs a bottle of it, and is able to recount its many virtues, and its many cures. The navigation of the Ohio, in a dry ſeaſon, is rather troubleſome from Pittſburg to the *Mingo Town*, about 75 miles; but from thence to the Miſſiſſippi there is always water enough for barges carrying from 100 to 200 tons burden, ſuch as are uſed on the river Thames, between London and Oxford, viz. from 100 to 120 feet keel, 16 to 18 feet in breadth, 4 feet in depth, and when loaded, drawing about 3 feet water. During the ſeaſon of the floods in the ſpring, veſſels of 100 or 200 tons burden may go from Pittſburg to the ſea with ſafety, in 16 or 17 days, although the diſtance is upwards of 2,000 miles. It is 178 miles W. by N. of Carliſle; 303 in the ſame direction from Philadelphia; 283 N. W. by N. of Alexandria, in Virginia; and 445 from Fort Waſhington, in the N. W. Territory. N. lat. 40 31 44, W. long. 80 8.—*ib.*

PITTSFIELD, a pleaſant poſt-town of Maſſachuſetts, ſituated on the weſt line of Berkſhire county, 6 miles N. of Lenox, 38 W. of Northampton, 140 W. of Boſton, and 40 N. E. of Albany. This townſhip, and thoſe N. and S. of it, on the banks of Houſatonic river, are in a rich vale, from one to ſeven miles wide. It was incorporated in 1761, and contains 1 992 inhabitants. The place of worſhip is a very handſome edifice, with a bell and cupola, from which there is a charming proſpect.—*ib.*

Pittsfield, a townſhip of New-Hampſhire, ſituated in Rockingham county. It was incorporated in 1782, and contains 888 inhabitants. It was taken from Chicheſter, on Suncook river, N. E. of Concord. —*ib.*

Pittsfield, the north eaſternmoſt townſhip of Rutland county, Vermont, containing 49 inhabitants. It has Chittenden townſhip on the S. W. and Philadelphia, in Addiſon county, on the N. W.—*ib.*

PITTSFORD, a townſhip of Vermont, in Rutland county.—*ib.*

PITT's *Grove*, a village in Salem county, New-Jerſey.—*ib.*

Pitt's *Iſland*, on the N. W. coaſt of N. America, lies near the main land, about half way from Dixon's Entrance to Prince William's Sound, and between Croſs Sound and Port Banks.—*ib.*

PITTSTOWN, a poſt-town of the Diſtrict of Maine, ſituated in Lincoln county, on Kennebeck river, 5 miles below Hallowell Hook, 22 N. by W. of Wiſcaſſet, 70 N. by E. of Portland, 187 N. by E. of Boſton, and 547 from Philadelphia. It contained, in 1790, 605 inhabitants. The weſtern part called *Cobiſey* or *Cobeſey*, has an Epiſcopal church, with an annual income of 28 guineas, given by Dr Gardiner for the ſupport of an Epiſcopal miniſter.—*ib.*

Pittstown, a poſt-town of New-Jerſey, in Hunterdon county, on the weſt head water of Rariton river, 10 miles E. by N. of Alexandria on Delaware river, 32 northerly of Trenton, and 58 N. N. E. of Philadelphia.—*ib.*

Pittstown, a townſhip of New-York, in Renſſelaer county. It is bounded ſoutherly by Renſſelaerwyck and Stephentown, and northerly by Schactekoke and Cambridge. In 1790 it contained 2,447 inhabitants, including 33 ſlaves; 419 of its inhabitants, in 1796, were electors.—*ib.*

PITTSYLVANIA, a county of Virginia, between the Blue Ridge, and the tide waters; bounded S. by the State of N. Carolina, and N. by Campbell county. It contains 11,252 inhabitants, including 5,933 ſlaves. —*ib.*

PIURA, the capital of a juriſdiction of the ſame name in Peru, and was the firſt Spaniſh ſettlement in that country; founded in 1531, by Don Franciſco Pizarro, who alſo built the firſt church in it. It contains about 1,500 inhabitants. The houſes are generally of one ſtory, built of unburnt bricks, or of a kind of cane, called quincas. The climate is hot and dry. S. lat. 5 11, W. long. 80 5.—*ib.*

PLACENTIA *Bay*, on the S. coaſt of Newfoundland Iſland, opens between Chapeau-Rouge Point weſtward, and Cape St Mary's on the E. 15½ leagues apart; lying between lat. 46 53 30, and 47 54 N. and between long. 54 1, and 55 21 30 W. It is very ſpacious, has ſeveral iſlands towards its head, and forms a good harbour for ſhips; and is frequented by ſuch veſſels as are bound either into the gulf or river of St Lawrence. The port-town which gives name to the bay is on the eaſtern ſhore; 67 leagues to the E. of the iſland of Cape Breton; 40 miles W. by S. of St John's, and in lat. 47 15 N. and long. 55 13 W. The harbour is ſo very capacious, that 150 ſail of ſhips may lie in ſecurity, and can fiſh as quietly as in any river. The entrance into it is by a narrow channel; which will admit but one ſhip at a time. Sixty ſail of ſhips can conveniently dry their fiſh on the Great Strand, which lies between 2 ſteep hills, and is about 3 miles long. One of the hills is ſeparated from the ſtrand, by a ſmall brook which runs out of the channel, and forms a ſort of lake, called the Little Bay, in which are caught great quantities of ſalmon. The inhabitants dry their fiſh on what is called the Little Strand. The French had formerly a fort called St Louis, ſituated on a ridge of dangerous rocks, which contracts the entrance into the harbour. This ridge muſt be left on the ſtarboard, going in.—*ib.*

PLAGUE (ſee MEDICINE-*Index*, Encycl.), is a diſeaſe which has been lately aſſerted by Dr Moſely to be not contagious. In ſupport of this opinion, he quotes many paſſages from medical writers, ancient and modern; but he ſeems to place the greateſt confidence (as is indeed natural) in his own obſervations on peſtilential fevers in the Weſt Indies, and on what is ſaid of the plague in Berthier's account of Buonaparte's expedition into Syria.

“At the time of our entry into Syria (ſays this Frenchman), all the towns were infected by the plague; a malady which ignorance and barbarity render ſo fatal in the Eaſt. Thoſe who are affected by it give themſelves up for dead: they are immediately abandoned by every body (A), and are left to die, when they might have been ſaved by medicine and attention.

“Citizen Degenettes, principal phyſician to the army, diſplayed a courage and character which entitle him to the national gratitude. When our ſoldiers were attacked by the leaſt fever, it was ſuppoſed that they had caught the plague, and theſe maladies were confounded. The fever hoſpitals were abandoned by the officers of health and their attendants. Citizen Degenettes repaired in perſon to the hoſpitals, viſited all the patients, felt the glandular ſwellings, dreſſed them, declared and maintained that the diſtemper was not the plague, but a malignant fever with glandular ſwellings, which might eaſily be cured by attention, and keeping the patient's mind eaſy.”

Degenette's views in making this diſtinction were highly commendable; but certainly, ſays Dr Moſeley, this fever was the plague. The phyſician, however, carried his courage ſo far, as to make two inciſions, and to inoculate the ſuppurated matter from one of theſe buboes above his breaſt and under his arm-pits, but was not affected with the malady. He thus eaſed the minds of the ſoldiers, the firſt ſtep to a cure; and, by his aſſiduity and conſtant attendance in the hoſpitals, a number of men attacked with the plague were cured. His example was followed by other officers of health.

The lives of a number of men Citizen Degenettes was thus inſtrumental of ſaving. He diſmiſſed thoſe who had been ill with the fever and buboes, without the leaſt contagion being communicated to the army.

“There are (ſays Dr Moſeley) annual or ſeaſonal diſorders, more or leſs ſevere, in all countries; but the plague, and other great depopulating epidemics, do not always obey the ſeaſons of the year. Like comets, their courſe is eccentric. They have their revolutions; but from whence they come, or whither they go after they have made their revolutions, no mortal can tell.

“To look for the cauſe of an epidemic in the preſent ſtate of the air, or weather, when it makes its appearance, is a very narrow contracted method of ſcrutiny. The cauſe of peſtilential epidemics cannot be confined, and local. It muſt lie in the atmoſphere, which ſurrounds, and is in contact with every part of us; and in which we are immerſed, as bodies in fluids.

“Theſe diſeaſes not appearing in villages and thinly inhabited places, and generally attacking only great towns and cities, may be, that the atmoſphere, which I conceive to be the univerſal propagator of peſtilence, wants a commixture, or union, with ſome compounded and peculiar air, ſuch as is generated in populous communities, to releaſe its impriſoned virulence, and give it force. Like the divided ſeminal principles of many plants, concealed in winds and rains until they find ſuitable materials and ſoil to unite their ſeparated atoms, they then aſſume viſible forms in their own proper vegetation.

“Diſeaſes originating in the atmoſphere ſeize ſome, and paſs by others; and act excluſively on bodies graduated to receive their impreſſions; otherwiſe whole nations would be deſtroyed. In ſome conſtitutions of the body the acceſs is eaſy, in ſome difficult, and in others impoſſible.

“The air of confined places may be ſo vitiated as to be unfit for the purpoſes of the healthy exiſtence of any perſon. Hence gaol, hoſpital, and ſhip fevers. But as theſe diſtempers are the offspring of a local cauſe, that local cauſe, and not the diſtempered people, communicate the diſeaſe.

“Plagues and peſtilences, the produce of the great atmoſphere, are conveyed in the ſame manner, by the body being in contact with the cauſe; and not by its being in contact with the effect. If peſtilences were propagated by contagion, from infected perſons, the infection muſt iſſue from their breath or excrements, or from the exhalations of the bodies of the diſeaſed. The infection, if it were not in the atmoſphere, would be

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(A) This can hardly be true. Every one knows that Mahometans are fataliſts in the ſtricteſt ſenſe of the word; and Mr Browne, whoſe knowledge of Syria and its inhabitants muſt be at leaſt equal to that of Berthier, aſſures us, that, far from abandoning his friend in the plague, “the Moſlem, awe-ſtruck, and reſigned to the unalterable decrees of fate, hangs over the couch of his expiring relative.”

be confined within very narrow limits; have a determinate ſphere of action; and none but phyſicians and attendants on the ſick would ſuffer; and theſe muſt ſuffer; and the cauſe and the effects would be palpable to our ſenſes. Upon this ground the precaution of quarantine would be rational. But who then would viſit and attend the ſick, or could live in hoſpitals, priſons, and lazarettos?"

From theſe reaſonings and facts, the author is convinced, that the bubo and carbuncle, of which we hear ſo much in Turkey, and read ſo much in our own hiſtory of plagues, ariſe from heating food and improper treatment; that they contain no infection; and conſequently that they are not the natural depoſit of the morbific virus ſeparated from the contagion.

He is equally confident that no peſtilential or pandemic fever was ever imported or exported; and hence he conſiders the fumigating of ſhip-letters, and ſhutting up the crews and paſſengers of veſſels, on their arrival from foreign places, ſeveral weeks, for fear they ſhould give diſeaſes to others which they have not themſelves, as an ignorant barbarous cuſtom. Whence was the importation of the plague at Naples in 1656; by which 20,000 people died in one day? Can any perſon, for a moment reflecting, believe, that the great plague of London in 1665, which imagination traced from the Levant to Holland, and from Holland to England, was cauſed by opening a bag of cotton in the city, or in Long Acre; or a package of hemp in St Giles's pariſh? Quarantine, always expenſive to commerce, and often ruinous to individuals, is a reflection on the good ſenſe of countries.

That Dr Moſeley is a man of learning, and a lively writer, is known to every one who has looked into his works, and is not himſelf a ſtranger to letters. On this account, and ſtill more on account of the opportunities which he has poſſeſſed of making accurate obſervations on various kinds of peſtilential diſeaſes, we have detailed at ſome length his notions of the plague; but as it does not appear that he ever *ſaw* the diſeaſe which is *known* by the name of *the plague*, juſtice requires that we give ſome account of it from a man who had the beſt poſſible opportunities of obtaining correct information on the ſubject.

"The facts that appear to be chiefly aſcertained relative to the plague (ſays Mr Browne), are, 1. That the infection is not received but by actual contact. In this particular, it would ſeem leſs formidable than ſeveral other diſorders. 2. That it is communicated by certain ſubſtances, by others not; as by a woollen cloth, or rope of hemp, but not by a piece of ivory, wood, or a rope made of the date tree; nor by any thing that has been completely immerſed in water. It would appear from the report of the Kahirines,* that no animal but man is affected with this diſorder; though, it is ſaid, a cat paſſing from an infected houſe has carried the contagion. 3. That perſons have often remained together in the ſame houſe, and entirely under the ſame circumſtances, of whom one has been attacked and died, and the others never felt the ſmalleſt inconvenience. 4. That a perſon may be affected any number of times. 5. That it is more fatal to the young than the old. 6. That no climate appears to be exempt from it; yet, 7. That the extremes of heat and cold both appear to be adverſe to it. In Conſtantinople it is often, but far from being always, terminated by the cold of winter, and in Kahira by the heat of ſummer; both circumſtances being, as may be conjectured, the effect of indiſpoſition for abſorption in the ſkin, unleſs it be ſuppoſed that in the latter caſe it may be attributed to the change the air undergoes from the increaſe of the Nile.

* The inhabitants of *Cairo*, which Mr Brown uniformly calls *Kahira*.

"The firſt ſymptoms are ſaid to be thirſt; 2. cephalalgia; 3. a ſtiff and uneaſy ſenſation, with redneſs and tumor about the eyes; 4. watering of the eyes; 5. White puſtules on the tongue. The more advanced ſymptoms of buboes, fœtor of the breath, &c. &c. are well known; and I have nothing authentic to add to them. Not uncommonly, all theſe have ſucceſſively ſhewn themſelves, yet the patient has recovered; in which caſe, where ſuppuration has had place, the ſkin always remains diſcoloured, commonly of a purple hue. Many who have been bleeded in an early ſtage of the diſorder, have recovered without any fatal ſymptoms; but whether from that or any other cauſe, does not appear certain (B). The ſame operation is reported to have been commonly fatal in a late ſtage. It is ſaid that embrocating the buboes continually with oil has ſometimes

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(B) Dr Moſeley, we think, has aſſigned a very ſufficient reaſon why bleeding ſhould generally prove effectual, if recourſe be had to it at the commencement of the diſeaſe. "In the common order of peſtilential fevers (ſays he), they commence with coldneſs and ſhivering; ſimply demonſtrating, that ſomething unuſual has been in contact with the ſkin, agonizing cutaneous ſenſibility. Sickneſs at the ſtomach, and an immoveable preſſure about the præcordia, follow. Theſe demonſtrate, that the blood cannot pervade the extremities of the body, and that the quantity which ought to dilate through the whole machine is confined to the larger organs, and is crowding and diſtending the heart and central veſſels.

"The reſtraining power of the remoter blood-veſſels being deſtroyed, the thinner parts of the blood eſcape their boundaries; hence ariſes yellowneſs in the ſkin in ſome climates; in others, the extravaſated groſſer parts of the blood ſtagnate, forming black lodgements, bubo, anthrax, and exanthemata.

"The object in theſe fevers is, to decide the conteſt between the ſolids and the fluids; and this appears to me to be only practicable, when ſpontaneous ſweats do not happily appear, or cannot be raiſed by a cooling regimen; and by draining the vital parts, by bleeding and purging, before the fluids have burſt their confines, and diſſolved their bond of union with the ſolids. The next ſtep is to regain the loſt energy of the ſurface of the body, by exciting perſpiration; and then of the whole ſyſtem, by tonics.

"When theſe things are not done in the firſt hours of attack, in peſtilential fevers, and the conflict is not *extinguiſhed* at once, attempting to extort ſweats from the body, by heating alexipharmics, will do miſchief; and bark, wine, ſtimulants, and cordials, may be called on, like undertakers, to perform an uſeleſs ceremony."

ſometimes wrought a cure; but this remedy is ſo difficult and dangerous for the operator, that it would appear experiments muſt yet be very defective."

They are not, perhaps, ſo defective as Mr Browne ſuppoſes. In the hoſpital of St Anthony at Smyrna, it has been the practice for many years paſt to rub over with warm olive oil the bodies of perſons infected by the plague; and that practice has been attended with wonderful ſucceſs. It was firſt ſuggeſted by Mr Baldwin the Engliſh conſul; and from him adopted by *P. Luigi di Pavia*, who for upwards of 27 years has expoſed himſelf to infection by his unremitting attendance on thoſe who are labouring under this dreadful diſtreſs. This excellent man, whoſe philanthropy equals that even of "Marſeilles' good biſhop," declares, that during the long period mentioned, he has found no remedy comparable to that of rubbing olive oil, with the ſtrongeſt friction, into the whole body of the infected perſon. When the body is thus rubbed, the pores being opened, imbibe the oil, and a profuſe perſpiration takes place, by which the poiſonous infection is again thrown out. This operation muſt be performed the firſt day of the infection; and if only a weak perſpiration enſues, it muſt be repeated till it is obſerved that every particle of infection is removed, and that the whole body of the patient is covered with a profuſe ſweat. Neither the patient's ſhirt nor bed-clothes muſt be changed till the perſpiration has entirely ceaſed. The operation muſt be performed in a very cloſe apartment; and at every ſeaſon of the year there muſt be kept in it a fire-pan, over which ſugar and juniper muſt be thrown from time to time, that the vapour which thence ariſes may promote the perſpiration. The whole body of the patient, the eyes alone excepted, muſt in this manner be anointed, or rather rubbed over with the greateſt care.

This practice of the pious monk is mentioned by Mr Howard in his work on Lazarettos; but a more ſatisfactory account of it is given by Count *Leopold von Berchtold*, who adds the following remarks by way of illuſtration: 1. The operation of rubbing in the oil muſt be performed by means of a ſponge, and ſo ſpeedily as not to laſt more than about three minutes. 2. The interval between the firſt and the ſecond rubbing, if a ſecond be neceſſary, muſt be determined by circumſtances, as the ſecond muſt not be performed till the firſt perſpiration is over, and this will depend on the conſtitution of the patient. If any ſweat remains upon the ſkin, it muſt be wiped off with a warm cloth before the ſecond rubbing takes place. This ſtrong friction with oil may be continued, for ſeveral days ſucceſſively, until a favourable change is remarked in the diſeaſe; after which the rubbing may be performed in a more gentle manner. The quantity of oil requiſite each time cannot be determined with accuracy; but, in general, a pound may be ſufficient. The pureſt and freſheſt oil is the beſt for this operation: it muſt not be hot, but only lukewarm. The breaſt and privities muſt be rubbed ſoftly. In a cold climate ſuch as ours, thoſe parts only into which the oil is rubbed muſt be expoſed naked. The other parts muſt be covered with warm clothing. In this manner each part of the body muſt be rubbed with oil in ſucceſſion, as quickly as poſſible, and be then inſtantly covered. If the patient has boils or buboes, they muſt be rubbed over gently with the oil till they can be brought to ſuppurate by means of emollient plaſters. The perſons who attend the patients to rub in the oil muſt take the precaution to rub themſelves over in the like manner, before they engage in the operation. They muſt, if poſſible, avoid the breath of the patient, and not be under any apprehenſions of catching the infection.

P. Luigi then ſays: "In order to prevent the patients from loſing their ſtrength, I preſcribed for them, during four or five days, ſoup made of vermicelli boiled in vinegar without ſalt. I gave them ſix or ſeven times a-day a ſmall ſpoonful of preſerved ſour cherries; preſerved not with honey, but with ſugar, as the former might have occaſioned a diarrhœa. When convinced that the patients were getting better, I uſually gave them the fifth morning a cup of good Mocha coffee, with a piece of toaſted biſcuit *(biſcotto)* prepared with ſugar; and I doubled the latter according to the ſtrength and improvement of my patients."

In the courſe of five years, during which friction with oil was employed in the hoſpital at Smyrna, of 250 perſons attacked by the plague the greater part were cured; and this would have been the caſe with the reſt had they not neglected the operation, or had it not been employed too late after their nervous ſyſtem had been weakened by the diſeaſe ſo as to render them incurable. Immenſe numbers of people have been preſerved from the effects of this malady by the above means; and of all thoſe who have anointed themſelves with oil, and rubbed it well into their bodies, not one has been attacked by the plague, even though they approached perſons already infected, provided they abſtained from heavy and indigeſtible food.

Thus we ſee, if this account may be depended on, that oil rubbed into the ſkin acts as a preventative, as well as a cure. When the operation is performed to prevent infection, and it is ſucceſsfully performed with that view at Smyrna, as often as the plague makes its appearance in the city, as it is not done for the purpoſe of promoting perſpiration, it is not requiſite that it ſhould be performed with the ſame ſpeed as when for curing the diſorder; nor is it neceſſary to abſtain from fleſh and to uſe ſoups; but it will be proper to uſe only fowls or veal for ten or twelve days, boiled or roaſted, without any addition or ſeaſoning *(condimento)*. In the laſt place, it will be neceſſary to guard againſt fat and indigeſtible food, and ſuch liquors as might put in motion or inflame the maſs of the blood.

This important diſcovery deſerves the ſerious conſideration of all medical men; for if olive oil has been found efficacious in curing or preſerving againſt one ſpecies of infection, it is not abſurd to ſuppoſe that the ſame or other kinds of oil might be productive of much benefit in other malignant infectious diſeaſes. We hope ſoon to hear of ſome trial being made with it in this country. Would it be of any ſervice in the yellow fever, ſo prevalent in the weſtern world? See the *Philoſophical Magazine*, Vol. II.

PLAIN *du Nord*, a town on the north ſide of the Iſland of St Domingo, ſituated at the ſouth-eaſt corner of Bay del'Acul, and on the road from Cape Francois to Port de Paix, nearly 5 leagues weſt by ſouth of the Cape, and 13 S. E. by E. of Port de Paix.—*Morſe.*

PLAINFIELD, a townſhip of Maſſachuſetts, county of Hampſhire. It was incorporated in 1785, and contains 458 inhabitants. It is 120 miles weſt by north of Boſton.—*ib.*

Plainfield, a townſhip in Northampton county, Pennſylvania.—*ib.*

Plainfield, a townſhip in the N. W. corner of Cheſhire county, New-Hampſhire, on the eaſt bank of Connecticut river, which ſeparates it from Hartland in Vermont. It was incorporated in 1761, and contains 1,024 inhabitants.—*ib.*

Plainfield, a townſhip in the S. E. part of Windham county, Connecticut, on the eaſt ſide of Quinabaug river, which divides it from Brooklyn and Canterbury. It is about 14 miles north-eaſt of Norwich, has two Preſbyterian churches, an academy, and was ſettled in 1689.—*ib.*

PLAISANCE, a town on the middle of the neck of the north peninſula of the iſland of St Domingo; 12 leagues S. W. of Cape Francois, and 7 north of Les Gonaves.—*ib.*

PLANETARY hours, are twelfth parts of the artificial day and night; being each double in length to the hour uſed in civil computation in Europe. They are ſtill uſed by the Jews as they were among their forefathers; and hence are called *Jewiſh* hours. The reaſon of their being called *planetary* hours, is, that, according to the aſtrologers, a new planet comes to predominate every hour, and that the day takes its denomination from that which predominates the firſt hour of it; as Monday from the moon, &c.

PLANTAIN *Garden River*, at the eaſt end of the iſland of Jamaica, and N. by W. of Point Morant. There is a kind of bay at its mouth; and on it, within land, is the town of Bath.—*Morſe.*

PLANTS, organiſed bodies, of which a full account has been given in the *Encycl.* under the title Botany. Plant, Sexes, *&c.* The eſtabliſhment of the ſexual ſyſtem in vegetables, and the acknowledged analogy between vegetable and animal bodies, has ſuggeſted a method of improving plants, as animals are confeſſedly improved, by what is called *croſſing the breed.* This thought occurred firſt, we believe, to Andrew Knight, Eſq; and in the Tranſactions of the Royal Society for 1779, we have an account of ſome very curious experiments made by him, with the view of aſcertaining whether the improvement which he had conceived be actually practicable. Thoſe were chiefly made on the garden pea, of which he had a kind growing in his yard; which having been long cultivated in the ſame ſoil, had ceaſed to be productive, and did not appear to recover the whole of its former vigour when removed to a ſoil of ſomewhat different quality. On this his firſt experiment in 1787 was made. Having opened a dozen of its immature bloſſoms, he deſtroyed the male parts, taking great care not to injure the female ones; and a few days afterwards, when the bloſſoms appeared mature, he introduced the farina of a very large and luxuriant grey pea into one half of the bloſſoms, leaving the other half as they were. The pods of each grew equally well; but he ſoon perceived that of thoſe into whoſe bloſſoms the farina had not been introduced, the ſeed remained nearly as they were before the bloſſom expanded, and in that ſtate they withered. Thoſe in the other pods attained maturity, but were not in any ſenſible degree different from thoſe afforded by other plants of the ſame variety; owing, he imagines, to the external covering of the ſeed (as he had found in other plants) being furniſhed entirely by the female. In the ſucceeding ſpring, the difference, however, became extremely obvious; for the plants from them aroſe with exceſſive luxuriance, and the colour of their leaves and ſtems clearly indicated that they had all exchanged their whiteneſs for the colour of the male parent: the ſeeds produced in autumn were dark grey. By introducing the farina of another white variety (or in ſome inſtances by ſimple culture), he found this colour was eaſily diſcharged, and a numerous variety of new kinds produced; many of which were in ſize and every other reſpect much ſuperior to the original white kind, and grew with exceſſive luxuriance, ſome of them attaining the height of more than twelve feet.

The diſſimilarity he obſerved in the offspring, afforded by different kinds of farina in theſe experiments, pointed out to him an eaſy method of aſcertaining whether ſuperfœtation (the exiſtence of which has been admitted among animals) could alſo take place in the vegetable world. For as the offspring of a white pea is always white, unleſs the farina of a coloured kind be introduced into the bloſſom, and as the colour of the grey one is always transferred to its offspring, though the female be white, it readily occurred to Mr Knight that if the farina of both were mingled or applied at the ſame moment, the offſpring of each could be eaſily diſtinguiſhed.

His firſt experiment was not altogether ſucceſsful; for the offspring of five pods (the whole which eſcaped the birds) received their colour from the coloured male. There was, however, a ſtrong reſemblance to the other male in the growth and character of more than one of the plants; and the ſeeds of ſeveral in the autumn very cloſely reſembled it in every thing but colour. In this experiment he uſed the farina of a white pea, which poſſeſſed the remarkable property of ſhrivelling exceſſively when ripe; and in the ſecond year he obtained white ſeeds from the grey ones above mentioned, perfectly ſimilar to it. He is therefore ſtrongly diſpoſed to believe that the ſeeds were here of common parentage; but doth not conceive himſelf to be in poſſeſſion of facts ſufficient to enable him to ſpeak with deciſion on this queſtion. We have no right to form a decided opinion on this part of the ſubject, having paid to it very little attention; but at preſent we are inclined to think differently from the author. We admit, indeed, that if the female afford the firſt organized atom, and the male act only as a ſtimulus, it is by no means impoſſible that the exploſion of two veſicles of farina, at the ſame moment (taken from different plants), may afford ſeeds of common parentage; but whether the female or the male affords the firſt organized atom, is the queſtion which to us appears not yet decided.

Another ſpecies however, of ſuperfœtation, in which one ſeed appears to have been the offspring of two males, has occurred to Mr Knight ſo often, as to remove, he ſays, all poſſibility of doubt as to its exiſtence. In 1797, the year after he had ſeen the reſult of the laſt mentioned experiment, having prepared a great many white bloſſoms, he introduced the farina of a white and that of a grey nearly at the ſame moment into each; and as in the laſt year the character of the coloured male had prevailed, he uſed its farina more ſparingly than that of the white one; and now almoſt

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every pod afforded plants of different colours. The majority, however, were white; but the characters of the two kinds were not ſufficiently diſtinct to allow him to judge with preciſion whether any of the ſeeds were produced of common parentage or not. In the year 1798 he was more fortunate; having prepared bloſſoms of the little early frame pea, he introduced its own farina and immediately afterwards that of a very large and late grey kind, and ſowed the ſeeds thus obtained in the end of ſummer. Many of them retained the colour and character of the ſmall early pea, not in the ſlighteſt degree altered, and bloſſomed before they were eighteen inches high; whilſt others (taken from the ſame pods), whoſe colour was changed, grew to the height of more than four feet, and were killed by the froſt before any bloſſoms appeared.

It is evident, that in theſe inſtances ſuperfœtation took place; and it is equally evident that the ſeeds were not all of common parentage. Should ſubſequent experience evince, that a ſingle plant may be the offſpring of two males, the analogy between animal and vegetable nature may induce ſome curious conjectures relative to the proceſs of generation in the animal world.—It certainly may; but either we do not perfectly underſtand the author's meaning, or this experiment is not concluſive. There were here ſeeds of different colours produced by the farina of different males, operating on the ſame female plant; and there are well atteſted inſtances of twin children being born of different colours, in conſequence of the coition of different males, a negro and a whiteman, with the ſame woman. Had Mr Knight diſcovered, not that the ſame pod, but that the ſame individual *pea*, was the offspring of two males, his diſcovery would indeed have led to ſome curious conjectures reſpecting animal generation. But to proceed with his experiments:

By introducing the farina of the largeſt and moſt luxuriant kinds into the bloſſoms of the moſt diminutive, and by reverſing this proceſs, he found that the powers of the male and female, in their effects on the offſpring, are exactly equal. The vigour of the growth, the ſize of the ſeeds produced, and the ſeaſon of maturity, were the ſame, though the one was a very early and the other a late variety. He had in this experiment a ſtriking inſtance of the ſtimulative effects of croſſing the breeds; for the ſmalleſt variety, whoſe height rarely exceeded two feet, was increaſed to ſix feet; whilſt the height of the large and luxuriant kind was very little diminiſhed. By this proceſs it is evident, that any number of new varieties may be obtained; and it is highly probable, that many of theſe will be found better calculated to correct the defects of different ſoils and ſituations than any we have at preſent.

The ſucceſs of Mr Knight's experiments on the pea induced him to make ſimilar experiments on wheat; but theſe did not anſwer his expectations. The varieties indeed which he obtained, eſcaped the blights of 1795 and 1796; but their qualities were not otherwiſe good, nor were they permanent. His experiments on the apple, the improvement of which was the firſt object of his attention, have, as far as he could judge from the cultivated appearance of trees which had not borne fruit when he wrote his memoir, been fully equal to his hopes. The plants which he obtained from his efforts to unite the good qualities of two kinds of apple, ſeem to poſſeſs the greateſt health and luxuriance of growth, as well as the moſt promiſing appearance in other reſpects. In ſome of theſe the character of the male appears to prevail; in others that of the female; and in others both appear blended, or neither is diſtinguiſhable. Theſe variations, which were often obſervable in the ſeeds taken from a ſingle apple, evidently ariſe from the want of permanence in the character of this fruit, when raiſed from ſeed. Many experiments of the ſame kind were tried on other plants; but it is ſufficient to ſay, that all tended to evince, that improved varieties of every fruit and of eſculent plants may be obtained by this proceſs, and that Nature intended that a ſexual intercourſe ſhould take place between neighbouring plants of the ſame ſpecies.

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PLANTS, Nutrition of. This is a ſubject on which a variety of opinions has been entertained by modern chemiſts. Haſſenfratz conſiders carbon as the ſubſtance which nouriſhes vegetables. Ingenhouz, in his work on the nutrition of plants, publiſhed in 1797, endeavours to prove, that if carbon has any influence in this reſpect, it can be only in the ſtate of carbonic acid, as that acid is abſorbed and decompoſed by vegetables: while the ligneous carbon, furniſhed by Nature, produces no effect on the expanſion of plants. Mr A. Young has endeavoured to demonſtrate the ſame thing by experiments. M. Raſn, a Daniſh chemiſt, deſirous of diſcovering the truth amidſt theſe contradictory opinions, made, for three years, a ſeries of experiments; from which he concludes, by the expanſion, ſize, and colour of the plants employed, that carbon, either vegetable or animal, has a decided influence in the nouriſhment of vegetables. What is new and particularly worthy of remark in theſe reſearches, is, that, according to M. Raſn, the carbonic acid produces exactly the ſame effect as charcoal of wood.

According to Mr Raſn, coal aſhes, on which the German and Engliſh farmers beſtow ſuch praiſe, deſtroy the plants if the ſoil contains an eighth part of that admixture. The leaves become faded, as if ſcorched, at the end of from fifteen to twenty days, and the plants themſelves die at the end of four or five weeks.

No ſeed germinates in oil. A ſingle grain of common ſalt, in 200 grains of water, is ſufficient to retard the vegetation of plants, and may even kill them if they are watered with that ſaline liquor.

Shavings of horn, next to infuſion animals, are the moſt favourable to vegetation: charcoal holds the third rank. For the truth of theſe opinions, ſee *Vegetable* SUBSTANCES in this *Suppl.*

PLASTOW, or *Plaiſtow*, a townſhip in the ſouth-eaſtern part of Rockingham county, New-Hampſhire, ſeparated from Haverhill in Maſſachuſetts, (of which it was formerly a part) by the ſouthern State line. It was incorporated in 1749, and contains 521 inhabitants; 12 or 14 miles ſouth-weſtward of Exeter, and 28 ſouth-weſt of Portſmouth.—*Morſe.*

PLATA *Cays*, or *Keys*, a large ſand-bank from 10 to 14 leagues north of the north coaſt of the iſland of St Domingo. It is nearly 10 leagues in length, at weſt by north, and from 2 to 6 miles in breadth. The eaſt end is nearly due north of Old Cape Francois.—*ib.*

PLATA, an iſland on the coaſt of Quito, in Peru, 4 or 5 leagues W. N. W. from Cape St Lorenzo, and in lat. 1 10 ſouth. It is four miles long and 1¼ broad; and

affords

affords little elſe than graſs and ſmall trees. The anchoring places are on the eaſt ſide near the middle of the iſland.—*ib.*

Plata, *River de la*, is one of the largeſt rivers on this globe, and falls into the S. Atlantic Ocean between Capes St Anthony ſouthward, and St Mary on the northward, which are about 150 miles apart. It acquires this name after the junction of the Parana and Paraguay; and ſeparates Brazil from the Deſert Coaſt. Its navigation, although very extenſive, is rather dangerous, on account of the number of ſandy iſlands and rocks in its channel, which are perhaps difficult to avoid, by reaſon of the currents and different ſets of the tide, which they produce. For theſe and other reaſons, ſhips ſeldom enter this river, unleſs urged by neceſſity; eſpecially as there are many bays, harbours, and ports on the coaſt where veſſels can find good and ſafe anchorage. The water is ſweet, clears the lungs, and is ſaid to be a ſpecific againſt rheums and defluxions; but is of a petrifying quality. Cape St Anthony is in lat. 36 32 ſouth, and long. 56 34 weſt. —*ib.*

Plata, a city of Peru, in S. America, in the province of Charcas, built in 1539. It ſtands on a ſmall plain, environed by eminences, which defend it from all winds. The air in ſummer is very mild; nor is there any conſiderable difference throughout the year, except in the winter months, viz. May, June, and July, when tempeſts of thunder and lightning and rain are frequent; but all the other parts of the year the air is ſerene. The houſes have delightful gardens planted with European fruit trees, but water is very ſcarce in the city. It has a large and elegant cathedral, adorned with paintings and gildings, a church for Indians, an hoſpital, and 2 nunneries; and contains about 14,000 inhabitants. Here are alſo an univerſity and two colleges, in which lectures on all the ſciences are read. In its vicinity are mines of ſilver in the mountain of Porco; which have been neglected ſince thoſe of Potoſi were diſcovered. It is ſeated on the river Chimdo, 500 miles S. E. of Cuſco. S. lat. 19 16, weſt long. 63 40. The juriſdiction of this name is 200 leagues in length, and 100 in breadth, extending on each ſide of the famous river La Plata. In winter the nights are cold, but the days moderately warm. The froſt is neither violent nor laſting, and the ſnows very inconſiderable.—*ib.*

PLATE, *Monte de*, a mountainous ſettlement near the centre of the iſland of St Domingo, towards its eaſtern extremity, 15 leagues north of the mouth of Macoriz river, and 16 to the north-eaſt of the city of St Domingo. It was formerly a flouriſhing place, and called a city; but the whole pariſh does not now contain above 600 ſouls. Two leagues to the N. E. of it is the wretched ſettlement of Boya, to which the cacique Henri retired, with the ſmall remnant of Indians, when the cruelties of the Spaniards, in the reign of Charles V. had driven him to a revolt. There does not now exiſt one pure deſcendant of their race.—*ib.*

Plate, *Point*, the north point of the entrance into Port Dauphin, on the E. coaſt of the Iſland of Cape Breton, or Sydney; and 3 leagues ſouth-weſt by ſouth of Cape Fumi, which is the ſouth-weſt boundary of the harbour of Achepe.—*ib.*

Plate, *Port de*, on the N. coaſt of the iſland of St Domingo, is overlooked by a white mountain, and lies 22 leagues W. of Old Cape Francois. It has 3 fathoms water at its entrance, but diminiſhes within; and is but an indifferent harbour. The bottom is in ſome parts ſharp rocks, capable of cutting the cables. A veſſel muſt, on entering, keep very cloſe to the point of the breaker, near the eaſtern fort; when in, ſhe anchors in the middle of the port. The canton of Port de Plate greatly abounds in mines of gold, ſilver and copper. There are alſo mines of plaſter. It is unhealthy, from the cuſtom which the inhabitants have of drinking the water of a ravin. It has a handſome church and about 2,500 inhabitants.—*ib.*

Plate *Forme, La*, a town on the S. ſide of the N. peninſula of St Domingo, 3 leagues W. of Point du Paradis, which is oppoſite the ſettlement of that name, a league from the ſea; 2½ leagues S. by E. of Bombarde, and 13 S. E. by S. of the Mole. N. lat. 19 36, W. long. from Paris, 75 40.—*ib.*

PLATFORM, a bay on the N. coaſt of the iſland of Jamaica, eaſtward of Dunklin's Cliff.—*ib.*

PLATINUM, or **Platina** (See Chemistry, *Suppl.* Part. I. Chap. iii. Sect. 3.), is a metal, of which every chemiſt regrets the difficulty of making it malleable. Of the different proceſſes adopted to accompliſh this end, we have reaſon to believe that of Mr Richard Knight the moſt ſucceſsful; and, with the ſpirit of a true philoſopher, he wiſhes to make that proceſs as generally known as poſſible. We ſhall give it in his own words:

"To a given quantity of crude platinum, I add (ſays he) 15 times its weight of nitro-muriatic acid (compoſed of equal parts of nitric and muriatic acids) in a tubulated glaſs retort, with a tubulated receiver adapted to it. It is then boiled, by means of an Argand's lamp, till the acid has aſſumed a deep ſaffron colour: it is then poured off; and if any platina remains undiſſolved, more acid is added, and it is again boiled until the whole is taken up. The liquor, being ſuffered to reſt till quite clear, is again decanted: a ſolution of ſal-ammoniac is then added, by little and little, till it no longer gives a cloudineſs. By this means the platina is thrown down in the form of a lemon coloured precipitate, which having ſubſided, the liquor is poured off, and the precipitate repeatedly waſhed with diſtilled water till it ceaſes to give an acid taſte (too much water is injurious, the precipitate being in a certain degree ſoluble in that liquid); the water is then poured off, and the precipitate evaporated to dryneſs."

Thus far our author's method, as he candidly obſerves himſelf, differs not from that which has been followed by many others; but the remainder of the proceſs is his own. "A ſtrong, hollow, inverted cone of crucible earth being procured, with a correſponding ſtopper to fit it, made of the ſame materials, the point of the latter is cut off about three-fourths from the baſe. The platina, now in the ſtate of a light yellow powder, is preſſed tight into the cone, and, a cover being fixed ſlightly on, it is placed in an air-furnace, and the fire raiſed gradually to a ſtrong white heat. (The furnace uſed by Mr Knight is portable, with a chamber for the fire only eight inches in diameter.) In the mean time the conical ſtopper, fixed in a pair of iron tongs ſuitable for the purpoſe, is brought to a red, or to a bright red heat. The cover being then removed from the cone, the tongs with the heated ſtopper is introduced through a hole in the cover of the furnace, and preſſed at firſt gently on the platina, at this time in a ſtate nearly as ſoft as dough, till it at length acquires a more ſolid conſiſtence. It is then repeatedly ſtruck with the ſtopper, as hard as the nature of the materials will admit, till it appears to receive no farther impreſſion. The cone is then removed from the furnace; and being ſtruck lightly with a hammer, the platina falls out in a metallic button, from which ſtate it may be drawn, by repeatedly heating and gently hammering, into a bar fit for flatting, drawing into wire, planiſhing, &c.

" Beſides the comparative facility of this proceſs, it has the farther advantage of rendering the platina much purer than when red hot iron is obliged to be had recourſe to; for platina, when of a white heat, has a ſtrong affinity for iron, and, with whatever care it may have been previouſly ſeparated from that metal, will be found to have taken up a portion of it, when it is employed of a red heat, to ſerve to unite the particles of the platina."

PLATONIC Bodies, ſee *Regular Bodies, Suppl.*

PLATTE, *La*, a ſmall river of Vermont which falls into Lake Champlain at Shelburne.—*Morſe.*

PLATTSBURGH is an extenſive townſhip in Clinton county, New-York, ſituated on the weſt margin of Lake Champlain, lying northerly of Willſborough, about 300 miles north of New-York city, and nearly that diſtance ſoutherly of Quebec in Canada. From the ſouth part of the town the mountains trend away wide from the lake, and leave a charming tract of excellent land, of a rich loam, well watered, and about an equal proportion ſuitable for meadow and for tillage. The land riſes in a gentle aſcent for ſeveral miles from the lake, of which every farm will have a delightful view. Several years ago, this townſhip, and the whole county indeed, which at preſent contains ſeveral thouſand inhabitants, was a wilderneſs; now they have a houſe for public worſhip, a court-houſe and gaol, the courts of common pleas and general ſeſſions of the peace ſit here twice in a year; they have artizans of almoſt every kind among them, and furniſh among themſelves all the materials for building, glaſs excepted. Polite circles may here be found, and the genteel traveller be entertained with the luxuries of a ſea-port, a tune on the harpſichord, and a philoſophical converſation. In 1790, it contained 458 inhabitants, including 13 ſlaves. In 1796 there were 142 of the inhabitants qualified electors.—*ib.*

PLAY *Green*, or *Puſcacogan*, in Upper Canada, lies near the north ſhore of Winnipeg Lake, in lat. 53 53, and long. 97 54.—*ib.*

PLEASANT *Point*, a north-eaſterly head-land in Merry Meeting Bay, Diſtrict of Maine, and in Lincoln county.—*ib.*

Pleasant *Point*, the eaſtern boundary of the mouth of Hawk's, or Sandwich river, in the harbour of Chebucto, on the ſouthern coaſt of Nova-Scotia.—*ib.*

Pleasant *River*, a ſmall village where is a poſt-office on the ſea-coaſt of Waſhington county, Diſtrict of Maine, and at the head of Narraguagus Bay; 16 miles N. E. of Goldſborough, and 32 W. by S. of Machias.—*ib.*

PLEIN *River*, the northern head-water of Illinois river. It interlocks with Chicago river, a water of Lake Michigan. Forty miles from its ſource is the place called Hid-Iſland; 26 miles farther it paſſes through Dupage Lake; and 5 miles below the lake, and ſouthward of Mount Juliet, it joins Theakiki river, which comes from the eaſtward. Thence the united ſtream aſſumes the name of Illinois. The land between theſe branches is rich, and intermixed with ſwamps and ponds.—*ib.*

PLUCKEMIN, a town or village of ſome trade, in Somerſet county, New-Jerſey, 28 miles north of Princeton, and about 18 S. W. of Brunſwick. It derived its ſingular name from an old Iriſhman, noted for his addreſs in *taking in* people.—*ib.*

PLUE, *Lac la*, or *Rainy Lake*, lies W. by N. of Lake Superior, and E. by S. of the Lake of the Woods, in Upper Canada. The Narrows are in N. lat.

	49°	3′	2″
Fort Lac la Plue	48	35	49
Iſland Portage	50	7	31
At the Barrier	50	7	51

Long. 95 8 30 W.—*ib.*

PLUMB *Iſland*, on the coaſt of Maſſachuſetts, is about 9 miles long, and about half a mile broad, extending from the entrance of Ipſwich river on the ſouth, nearly a north courſe to the mouth of Merrimack river, and is ſeparated from the main land by a narrow ſound, called Plumb Iſland river, which is fordable in ſeveral places at low water. It conſiſts for the moſt part of ſand, blown into ludicrous heaps, and crowned with buſhes bearing the beach plum. There is however, a valuable property of ſalt-marſh, and at the S. end of the iſland, are 2 or 3 good farms. On the N. end ſtand the light-houſes, and the remains of a wooden fort, built during the war, for the defence of the harbour. On the ſea ſhore of this iſland, and on Saliſbury beach, the Marine Society, and other gentlemen of Newbury-Port, have humanely erected ſeveral ſmall houſes, furniſhed with fuel and other conveniences, for the relief of mariners who may be ſhipwrecked on this coaſt. The N. end lies in lat. 43 4 N. and long. 70 47 W.—*ib.*

Plumb *Iſland*, on the N. E. coaſt of Long-Iſland, in the State of New-York, is annexed to Southhold in Suffolk county. It contains about 800 acres, and ſupports 7 families. It is fertile, and produces wheat, corn, butter, cheeſe, and wool. It is three-fourths of a mile from the eaſtern point of Southhold. This iſland, with the ſandy point of Gardner's Iſland, form the entrance of Gardner's Bay.—*ib.*

Plumb *Point*, *Great*, on the S. coaſt of the iſland of Jamaica, forms the S. E. limit of the peninſula of Port-Royal, which ſhelters the harbour of Kingſton. *Little Plumb Point* lies weſtward of the former, towards the town of Port-Royal, on the ſouth ſide of the peninſula.—*ib.*

PLUMSTEAD, a poſt-town of Pennſylvania, ſituated on the W. ſide of Delaware river, 36 miles N. of Philadelphia, and 13 S. by W. of Alexandria, in New-Jerſey.—*ib.*

PLUVIAMETER, a machine for meaſuring the quantity of rain that falls, otherwiſe called Ombrometer; which ſee, *Encycl.*

PLYMOUTH, a maritime county in the eaſtern part of the State of Maſſachuſetts, having Maſſachuſetts Bay to the N. E. Briſtol county S. W. Barnſtable county S. E. and Norfolk county N. W. It is ſubdivided into 15 townſhips, of which Plymouth is the chief; and contains 4,240 houſes, and 29,535 inhabitants. Within the counties of Plymouth and Briſtol, there are now in operation, 14 blaſt, and 6 air furnaces, 20 forges, 7 ſlitting and rolling mills, beſides a number of trip-hammer ſhops, and an almoſt incredible number of nail-ſhops, and others for common ſmithery. Theſe furnaces, ſupplied from the neighbouring mines, produce annually from 1,500 to 1,800 tons of iron ware. The forges, on an average, manufacture more than 1,000 tons annually, and the ſlitting and rolling mills, at leaſt 1,500 tons. The various manufactures of theſe mills, have given riſe to many other branches in iron and ſteel, viz. cut and hammered nails, ſpades and ſhovels, card teeth, ſaws, ſcythes, metal buttons, cannon balls, bells, fire arms, &c. In theſe counties are alſo manufactured hand-bellows, combs, ſheet-iron for the tin manufacture, wire, linſeed oil, ſnuff, ſtone and earthen ware. The iron-works, called the Federal Furnace, are 7 miles from Plymouth harbour.—*Morſe.*

PLYMOUTH, a town in Litchfield county, Connecticut.—*ib.*

PLYMOUTH, a poſt-town of New-Hampſhire, ſituated in Grafton county, at the mouth of Baker's river, on its S. ſide, where it falls into the river Pemigewaſſet; 45 miles N. of Concord, 71 north-weſterly of Portſmouth, and 445 N. E. of Philadelphia. The townſhip was incorporated in 1763, and contains 625 inhabitants.—*ib.*

PLYMOUTH, formerly *Apple-Town*, in New-York State, lies on the weſt ſide of Seneca Lake, 12 miles ſouth-eaſt of Geneva, on a beautiful declivity, falling gradually towards the lake, and commands a delightful proſpect to the weſtern country, and up and down the lake. Twenty houſes were building here in 1796, and as the new State-road, from the Cayuga, interſects the town, a ferry eſtabliſhed, and another town laid out on the oppoſite ſide of the lake, it promiſes fair to become a conſiderable and very thriving village. It is well watered by copious ſprings.—*ib.*

PLYMOUTH, the name of two townſhips in Pennſylvania, the one in Luzerne county, the other in that of Montgomery.—*ib.*

PLYMOUTH, a ſmall poſt-town of N. Carolina, on the ſouth ſide of Roanoke river, about 5 miles above Albemarle Sound. It is 23 miles ſouth-weſt by S. of Edenton, and 463 ſouth by weſt of Philadelphia.—*ib.*

PLYMOUTH, a ſettlement on the ſouth peninſula of the iſland of St Domingo, and in the dependence of Jeremie.—*ib.*

PLYMOUTH-TOWN, in the iſland of Tobago, in the Weſt-Indies. N. lat. 10 10, W. long. 60 32. —*ib.*

PLYMPTON, a townſhip in Plymouth county, Maſſachuſetts, 45 miles S. E. of Boſton. It was incorporated in 1707, and contains 956 inhabitants.—*ib.*

r Prin- 's air- ump.

PNEUMATICS. In this article in the Encyclopædia, (154) an erroneous account was given of Dr Prince's Air Pump. The following is the account of it, publiſhed in the Memoirs of the American Academy, vol. i. p. 497.

Agreeably to your requeſt, I will endeavour to give you ſome account of the air-pump I have lately conſtructed, upon a plan different from any I have ever ſeen.

Reading the account of the ingenious Mr *Smeaton's* air-pump, in vol. xlvii. of the Philoſophical Tranſactions, and the high recommendation of it by Dr *Prieſtley*, in vol. lxiv. of the ſame work, I was deſirous of poſſeſſing one of that kind: but finding, by the Doctor's paper, they were not commonly made by the philoſophical inſtrument-makers in *London*, it induced me to attempt making one myſelf, with ſuch aſſiſtance as I could get here.

Before I had proceeded far, I thought Mr *Smeaton's* pump might be improved, if not in its power of rarefying the air, at leaſt in ſimplicity. With this in view, I have finiſhed mine. To ſhow the ground on which I have gone, it will be neceſſary to conſider the rationale of an air-pump, and make ſome obſervations on Mr *Smeaton's*. It is well known that the valve at the bottom of the barrel of an air-pump is opened by the ſpring of the air acting againſt it underneath, when the weight of the air is removed from the top of the valve, by raiſing the piſton in the barrel. In order to remove this reſiſtance from the top of the valve moſt effectually, the piſton ſhould be made to fit very exactly to the valve-plate, when put down upon it: for if there be any ſpace between the bottom of the piſton and valve, part of the air will be retained in it; and this air, even when the piſton is raiſed to the higheſt, will, by its expanſion, in ſome meaſure, obſtruct the opening of the valve. When the air in the receiver, or underneath the valve, is rarefied to an equal degree with the air contained in the barrel, (the piſton being drawn up to the higheſt) the valve can riſe no longer, becauſe the reſiſtance above is equal to the power below. The reſiſtance from this air, retained in the barrel, againſt the valve at the bottom, will be uniformly the ſame, when the piſton is at the ſame diſtance from it; becauſe the weight of the atmoſphere is continually preſſing on the piſton-valve, and will prevent the air below paſſing through it, while this air is rarer than the atmoſphere: and when the piſton is put down to the bottom of the barrel, it will not eſcape through the piſton, but only be compreſſed into the vacancy between the bottom of the piſton and the valve-plate at the bottom of the barrel, and be of equal denſity with the atmoſphere. Beſides the reſiſtance ariſing from this retained air, we muſt conſider the weight of the valve, its coheſion to the plate, occaſioned by the oil, and its being ſtretched tight over the hole, as increaſing the obſtruction: eſpecially when the ſpring of the air under the valve is much weakened by rarefaction. And if we take into the account the reſiſtance ariſing from theſe cauſes, the denſity of the air in the barrel, when compreſſed into the abovementioned vacancy, will be as much greater than the denſity of the atmoſphere above the piſton, as the addition of this reſiſtance; for this obſtruction belongs to the piſton-valve, as well as to the other. And ſo alſo, when this retained air is expanded, ſay one hundred times, by raiſing the piſton, the air in the receiver cannot be rarefied to the ſame degree, becauſe of this reſiſtance of the valve at the bottom of the barrel.

In order to produce a greater rarefaction of the air in the receiver than what the common pump will effect, the valves, where uſed, muſt be made to open more eaſily, by removing, as far as poſſible, theſe obſtructions. In the common pump theſe impediments are great; becauſe the ſurface of the valve, which is expoſed to the air underneath, is generally very ſmall; and the vacancy between the piſton and the bottom of the barrel bears a greater proportion to the whole barrel than it would if the work were properly executed.

Theſe imperfections Mr *Smeaton* conſidered, and endeavoured to remove in the conſtruction of his pump. For this purpoſe he expoſed a much larger ſurface of the lower valve to the air underneath, by forming a kind of grating in the plate. By this the coheſion was leſſened, and more power could apply to open the valve in the firſt inſtant. The difficulty ariſing from the air retained in the barrel he removed, in a great meaſure, by making the piſton fit more nicely to the bottom, and by taking the weight of the atmoſphere from off the piſton, which allowed the valve in it to be more eaſily opened, ſo that much more of the air could paſs through it. The weight of the atmoſphere he removed from the piſton, by cloſing the top of the barrel with a plate, on which he fixed a collar of leathers; through this the cylindrical part of the piſton-rod moves air-tight. And the air, having paſſed through the piſton, is forced out of the barrel through a hole in the top-plate, over which is a valve to prevent the return of air, when the piſton deſcends. The piſton is made to fit as exactly to the top, as to the bottom, of the barrel, to exclude the air more effectually.

By this improvement, Mr *Smeaton* ſays, "I have been able to rareſy the air one thouſand times, when the pump was put clean together; and that it ſeldom failed of doing it five hundred, after it had been uſed for ſeveral months without cleaning: whereas the degree of rarefaction produced by the beſt common pumps never exceeded one hundred and forty times, when tried by my gauge."

I have taken up much of your time in this account; but I hope you will not think unneceſſarily, as it ſhows the ground on which I have gone, and a deſcription of Mr *Smeaton's* pump is, in ſome meaſure, a deſcription of mine.

Mr *Smeaton* having done ſo much to facilitate the opening of the valves, at the bottom of the barrel, and in the piſton, by which means he carried the degree of rarefaction much further than the common pump could do; I ſuppoſed, if thoſe valves were entirely removed, and the remaining air in the barrel could be more perfectly expelled, the rarefaction might be carried ſtill further. Upon this plan I have conſtructed my pump. I have removed the lower valve, and opened the bottom of the barrel into a ciſtern, on which it is placed, and which has a free communication with the receiver. For the valve on the plate, at the top of the barrel, (which is conſtructed like Mr *Smeaton's*) makes it unneceſſary there ſhould be any at the bottom, in order to rareſy the air in the receiver.

The ciſtern is deep enough to allow the piſton to deſcend into it, below the bottom of the barrel. Suppoſe then the piſton to be ſolid; that is, without a valve in it; when it enters the barrel and riſes to the top-plate, which is made air-tight with a collar of leathers, &c. like Mr *Smeaton's*, it forces out all the air above it; and as the air cannot return into the barrel, on account of the valve on the top-plate, when the piſton deſcends there will be a vacuum formed between that and the plate; every thing being ſuppoſed perfect. But in working the pump, the piſton is not allowed to deſcend entirely into the ciſtern, ſo far as to leave the bottom of the barrel open; becauſe, as the ciſtern, for another purpoſe, is made larger than the bore of the barrel, this might make the piſton-rod work unſteadily in the collar of leathers, and cauſe it to leak: but it deſcends below a hole in the ſide of the barrel, near the bottom, which opens a free communication between the barrel, ciſtern, and receiver. Through this hole the air ruſhes from the ciſtern into the exhauſted barrel, when the piſton has dropped below it; and by its next aſcent this air is forced out as the other was before. If now the capacity of the receiver, ciſtern, pipes, &c. below the bottom of the barrel, taken together, be equal to the capacity of the barrel, half the remaining air will be expelled by every ſtroke.

But as working a pump of this kind, with a ſolid piſton, would be laborious, on account of the reſiſtance it would meet with in its deſcent from the air beneath, (though this would be leſſened by every ſtroke, as the air became more rarefied) I have, to remedy this inconvenience, pierced three holes in the piſton, at equal diſtances from each other; and a circular piece of bladder, which is tied over the top of the piſton, to make the joint more perfect with the top-plate, and to defend them from injury when the piſton is brought up againſt it, forms a kind of valve over the holes, which open eaſily enough to prevent any labour in working the pump, as it allows the air to paſs through the piſton when it deſcends. But the air does not neceſſarily depend upon a paſſage through the piſton in order to get into the barrel: for when the air becomes ſo weak, from its rarefaction, that it cannot open this valve, it will ſtill get into the barrel when the communication is opened by the hole at the bottom. This piſton, therefore, will deſcend as eaſily as any other; and this valve does not impede the rarefaction; ſince it is of no conſequence, as to this, whether it open or not. By this conſtruction, the valves, which Mr *Smeaton* only made to open with more eaſe, are rendered unneceſſary in rareſying the air: and that at the bottom of the barrel, which is the moſt difficult to be made and kept in order, is entirely removed; that on the top-plate being the only one neceſſary in rareſying the air.

But as in a ſingle barrelled pump of this conſtruction, where there is no valve at the bottom to prevent the air, which follows up the piſton in its aſcent, from returning into the receiver in its deſcent, a fluctuation would be produced which might prove detrimental in ſome experiments, this pump is made with two barrels, which rarefies the air at every ſtroke of the winch. In this conſtruction, the capacity of the two barrels taken together, below the piſtons, is always the ſame; for while one is deſcending, the other is aſcending; and what is taken from the one is added to the other.

Having thus ſet aſide the valves, which in ſome meaſure prevented the air from getting into the barrel and above the piſton, I next attempted to expel the air more perfectly out of the barrel than Mr *Smeaton* has done, by making a better vacuum between the piſton and the top-plate, which would allow more of the air to expand itſelf into the barrel from the receiver. But to ſhow in what manner I have attempted this, it will be neceſſary to give ſome further deſcription of the machine.

I have, upon Mr *Smeaton's* plan, contrived to connect the valves on the top-plates with the receiver, occaſionally, by means of a pipe and cock, by the turning of which, the machine may be made to exhauſt or condenſe at pleaſure. This is done in the following manner: There is a croſs-piece laid over the valves, extending from one barrel to the other, which has a duct through it, connected with a ſmall pipe ſtanding between the barrels: through this pipe the air paſſes into a duct in the bottom-piece leading to the cock. In this piece is likewiſe the duct leading from the ciſtern to the cock; and with this cock alſo is connected the pipe leading to the receiver. The key is pierced with two holes in ſuch a manner, that one of them will connect the pipe coming from the receiver with the duct in the bottom-piece leading to the ciſtern, or with the other leading to the valves, as may be required for exhauſting, or condenſing. The other hole through the key will open, occaſionally, to the atmoſphere, either of theſe ducts round the cock. So that having the direction of the air, which paſſes through the valves, under the command of this cock, the pump may exhauſt or condenſe at pleaſure: for when the key connects the pipe from the receiver, and the duct leading to the ciſterns together, the pump will exhauſt; and when it connects the pipe with the duct leading to the valves, it will condenſe; as the other hole in the key, at the ſame time, opens to the atmoſphere the duct leading to the ciſterns, by which paſſage the air enters the barrel from the atmoſphere, is forced out at the valves, and through the pipe and cock into the receiver. In this part of the machine, which is contrived for condenſation, I have, by an additional part, endeavoured to get the air more perfectly out of the barrel.

We have ſeen that Mr *Smeaton*, by making the piſton of his pump fit more exactly to the bottom of the barrel, and by ſhutting up the top to prevent the preſſure of the atmoſphere on the piſton-valve, was able to get more of the air above it than could be effected in the common pump. But ſtill the difficulty, though ſo far removed, remains in the top of the barrel: for as the piſton cannot be made to fit ſo exactly to the top-plate, but that there will be ſome lodgment for air, it is impoſſible to expel it entirely; more, perhaps, might be expelled if the valve on the top could be made to open more eaſily, by removing the weight of the air from it; for the atmoſphere, preſſing on this valve, will prevent its opening freely, in the ſame manner as, when preſſing on the piſton-valve, it obſtructs the opening of that in the common pump.

The difficulty which Mr *Smeaton* removed from the piſton-valves, I have endeavoured to remove from the valve on the top-plate; that this valve, having the preſſure of the atmoſphere taken off, might open with the ſame eaſe as the piſton-valve does in his pump. To effect this, there is connected with the duct on the bottom-piece, which conveys the air from the valves to the cock, a ſmall pump of the ſame conſtruction as the large one; having the barrel opening into a ciſtern, the piſton-rod moving through a collar of leathers, and a valve near the top, through which the air is forced into the atmoſphere. This piſton is ſolid; becauſe the diameter, being only half-inch, does not make it work hard. This pump, which is of one barrel only, I call the valve-pump; its chief uſe being to rareſy the air above the valves, or remove the weight of the atmoſphere from off them. To uſe this pump, it is neceſſary the key of the cock ſhould be pierced differently from that of Mr *Smeaton's*; for as the pipes round his are placed at equal diſtances, when the one from the bottom of the barrel is connected with that from the receiver to exhauſt it, the other, from the valve on the top-plate, is opened to the atmoſphere by the other paſſage through the cock. But in order to rareſy the air above the valve in my pump, it is neceſſary this laſt paſſage ſhould be ſhut up, when the valve-pump is uſed. Inſtead, therefore, of placing the three ducts at equal diſtances round the cock, I have divided the whole into five equal parts; leaving the diſtance of one-fifth between the ducts leading from the ciſtern and the valves to the cock, and two-fifths between each of theſe and the one leading from the cock to the receiver. By this adjuſtment, when the communication is open between the receiver and valves, for condenſation, the other hole through the cock opens the ciſtern to the atmoſphere: but when the communication is made between the ciſterns and the receiver, for exhauſtion, a ſolid part of the key comes againſt the duct leading to the valves, and ſhuts it up; and the air, which is forced out of the barrel, paſſes into the atmoſphere through the valve-pump; for the valve of the ſmall pump may be kept open while the great one is worked.

Now, to apply Mr *Smeaton's* reaſoning to this conſtruction. After mentioning his taking off the weight of the atmoſphere from the piſton, by ſhutting up the top of the barrel, he ſays, "The conſequence of this conſtruction is, that when the piſton is put down to the bottom of the cylinder, the air in the lodgment under the piſton will evacuate itſelf ſo much the more, as the valve of the piſton opens more eaſily, when preſſed by the rarefied air above it, than when preſſed by the whole weight of the atmoſphere. Hence, as the piſton may be made to fit as nearly to the top of the cylinder, as it can to the bottom, the air may be rarefied as much above the piſton as it could before have been in the receiver. It follows, therefore, that the air may now be rarefied in the receiver, in duplicate proportion of what it could be upon the common principle; every thing elſe being ſuppoſed perfect." The ſame may be ſaid with regard to the valve on the top-plate in this machine. It will open more eaſily, when preſſed by the rarefied air above it than when preſſed by the weight of the whole atmoſphere. Hence, as by the conſtruction of the valve-pump the air may be rarefied as much above the valves, as it could before have been in the barrel and receiver, with which there is a free communication; it therefore follows, that the air may now be rarefied in the receiver in duplicate proportion of what it could be by Mr *Smeaton's* pump; every thing elſe being ſuppoſed perfect; and the nature of the air permitting it.

In this eſtimation, any advantage which may ariſe from the removal of the valves at the bottom of the barrels and in the piſton, is not conſidered: But if they made any reſiſtance in Mr *Smeaton's* pump, may we not conclude, that the rarefaction might be carried

further

further by a machine wherein no ſuch valves are made uſe of? Mr *Smeaton* ſays, that when he contrived to open his valves by the winch, independent of the ſpring of air, he did not find it anſwer the purpoſe better than when the air was the agent. There is no reaſoning againſt experiment: but it certainly appears probable from theory, that there muſt be conſiderable reſiſtance from the valves when the air is greatly rarefied.

He afterwards ſays, "the degree, to which I have been able to rarefy the air, by experiment, has generally been about one thouſand times, when the pump is put clean together: but the moiſture that adheres to the inſide of the barrel, as well as the other internal parts, upon letting in the air, is, in the ſame ſucceeding trials, worked together with the oil, which ſoon renders it ſo clammy as to obſtruct the action of the pump, upon a fluid ſo ſubtle as the air is, when ſo much expanded.—But in this caſe it ſeldom fails to act upon the air in the receiver, till it is expanded five hundred times: and this I have found it to do, after being frequently uſed for ſeveral months without cleaning." Does it not appear probable, that this clammineſs muſt have a bad effect upon the valves, as well as the other internal parts of the pump, in thoſe ſame ſucceeding trials? and that the ſtiffneſs which the oil acquires by evaporation, the corroſion of the braſs, &c. when the pump is foul, muſt greatly obſtruct the opening of the valves, and bear a principal part in reducing the rarefaction from one thouſand to five hundred times?

I ſuppoſed the valves to be a great obſtruction, and have endeavoured to avoid them: and if no further advantage be derived from it, the machine is more ſimple without them.

Upon this conſtruction, alſo, we are able to make the pump with two barrels, like the common pump, which cannot be done conveniently where the lower valve is retained; becauſe it would be difficult to make the piſton in one barrel come exactly to the bottom, at the ſame time that the piſton in the other touched as exactly at the top: it would, at leaſt, require a nicety in the workmanſhip, which would be troubleſome to execute.

In this pump, the piſtons do not move the whole length of the barrels: there is a horizontal ſection made in them, a little more than half way from the bottom, where the top-plates are inſerted. By this mean the pump is made more convenient and ſimple, as the head of it is brought down upon the top of the barrels, in the ſame manner as in the common air-pump. The barrels alſo ſtand upon the ſame plane with the receiver-plate; and this plane is raiſed high enough to admit the common gauge of thirty-two, or three, inches, to ſtand under it, without any inconvenience in working the pump, as the winch moves through *a leſs* portion of an arch, at each ſtroke, than it would if the piſtons moved the whole length of the barrels.

There is alſo placed, between the barrels in this pump, on the croſs-piece over the valves, a gauge to meaſure the degree of condenſation, having a free communication with the valves, cock, &c. This gauge is ſo conſtructed, that it will alſo ſerve to meaſure the rarefaction above the valves, when the air is worked off by the valve-pump. It conſiſts of a pedeſtal, which forms a ciſtern for the mercury, a hollow braſs pillar, and glaſs tube, hermetically ſealed at one end, which moves up and down in the pillar, through a collar of leathers. The dye of the pedeſtal is made of glaſs, as well to hold the quickſilver, as to expoſe its ſurface to view, that it may be ſeen when the open end of the tube is put down into it, or raiſed out of it. The body of the pillar is partly cut away to expoſe the tube to view in the ſame manner.

If the pump be uſed as a condenſer, the degree of condenſation is ſhown by a ſcale marked on one edge of the pillar: if it be uſed as an exhauſter, the degree of the rarefaction of the air above the valves, is ſhown by a ſcale marked on the other edge of the pillar.

This gauge will alſo ſerve to ſhow when the valves have done playing, either with the weight of the atmoſphere on them, or taken off. If we want to know when they ceaſe opening, with the weight of the atmoſphere on them, draw the piſton of the valve pump up into its barrel, to prevent any air eſcaping through that valve; in this ſituation, work the great pump again, and if any air paſſes through the valves into the pipe, the gauge will riſe by condenſation. This condenſed air muſt then be let out by opening the communication, at the cock, with the outward air. By repeating this till the gauge riſes no longer, we may know the valves will open no more while the weight of the atmoſphere lies on them; and the rarefaction in the receiver can be carried no further. When the weight of the atmoſphere is to be removed, after conducting as in the former experiment, raiſe the open end of the tube above the ſurface of the mercury, and then work the valve-pump, and the air will be rarefied over the valves, and in the tube, to the ſame degree: (we may ſee when the valve of this pump has done playing by unſcrewing the cap that covers it.) The open end of the tube is then to be immerſed into the mercury, and the great pump worked. The air which paſſes through the valves will then raiſe the gauge by condenſation: and thus, by alternately raiſing and depreſſing the tube, and working the two pumps in their turns, we may carry the rarefaction of the air in the receiver as far as the power of the pump will go. If one of Mr *Smeaton's* pear-gauges be uſed in the receiver, as he directs, the difference of the rarefaction, in the two experiments, may be known. And as the air above the valves may be rarefied to different degrees, we may know, by the two gauges, what proportion the rarefaction above the valves bears to the degree of exceſs in the receiver. This condenſing guage can be taken off, and a button ſcrewed into the hole in its ſtead, in any caſe wherein a greater degree of condenſation is required than the glaſs will bear. When a glaſs receiver is uſed, this gauge may be placed within it, where it will meaſure any degree of condenſation the receiver will bear, without danger to the gauge: or the capacity of any receiver may be meaſured by this gauge, before it is removed from its place, by ſhowing how many ſtrokes of the winch will throw one atmoſphere into the receiver; then turning the cock, to prevent any air eſcaping, change the gauge for the button: when this is done, the degree of condenſation may be further meaſured by the number of ſtrokes.

As in caſes where great condenſation is required, there

there muſt be a great deal of labour, and a great ſtrain on the teeth of the wheel and piſton-rods, on account of the great diameter of the piſtons; [A] to remedy this, I have fitted a condenſer, of a ſmaller bore than the barrel of the great pump, to the ciſtern of the valve-pump, to be ſcrewed on occaſionally; by which the condenſation may be finiſhed, inſtead of the great pump. Or, to ſave the work and expenſe of this condenſer, the valve-pump, if made a little larger, may be eaſily fitted for the ſame purpoſe, by having a plate made to ſcrew into the bottom of the cylinder, occaſionally, with a valve on it, opening into the ciſtern: a hole muſt alſo be made to be opened, on the ſame occaſion, near the top of the cylinder, to let air in below the piſton, when this is drawn up above it.

The common gauge, which is generally placed under the receiver-plate, in this pump, is placed in the front; that it may be ſeen by the perſon who is working the pump, and that the plate may be left free for other uſes.

The plate is ſo fixed to the pipe, leading to the cock, that it may be taken off at pleaſure, and uſed as a transferer; or any tube, or apparatus, may be fixed to it, to perform ſome experiments without removing it, which will ſave trouble, and make leſs apparatus neceſſary.

The head of this pump is not divided, as the common one is, to diſlodge the teeth of the wheel from the piſton-rods, when the pump is to be taken apart; but is made whole, except a ſmall piece in the back, where the wheel is let in; which makes it much more convenient to remove the head, or place it on the barrels. The wheel is freed from the piſton-rods, when required, by puſhing it into the back part of the head; and when it is drawn into its place and connected with them again, a button is ſcrewed into the ſocket of the axis behind, to keep it in its place. This makes the head leſs troubleſome to remove: but its chief uſe is to diſlodge the piſton-rods from the wheel, that they may be put down into the ciſterns, when the pump is not in uſe, where they will ſtand uncompreſſed, and retain their elaſticity better than if kept in the barrels. In theſe ciſterns they may alſo ſtand covered with oil, if neceſſary, as they are large enough to admit of it.

The principal joints of the pump are ſunk in ſockets, that the leathers, which cloſe them, may be covered with oil, to prevent leaking. [B]

For convenience, the lower part of the pump is fitted with drawers, to contain the apparatus. A door opens behind one range, to a place reſerved the whole height, to get at the under part of the receiver plate, and fix apparatus to it for ſome experiments. In this place ſtand the long tubes, and ſuch tall glaſſes belonging to the apparatus, as will not go into the drawers. The barrels, &c. of the pump are covered with a caſe, or head, which keeps them from duſt and accident, when the pump is not in uſe. The apparatus is ſecured between ſliders, &c. in the drawers, ſo that the whole machine may be eaſily removed, in one body, without danger.

Having given you this account of the machine, I wiſh, Sir, I could add to it, at this time, the reſult by experiment, and inform you to what degree it will rarefy the air; but the want of a proper apparatus to meaſure the rarefaction, prevents me.

As we have no glaſs-manufactory here, I ſent to *Europe* for my apparatus, about twelve months ſince: but, unluckily, this part, with ſome others, have not yet been forwarded to me. As ſoon as I can ſatisfy myſelf, I will let you know the reſult. I have, at preſent, only a ſmall tube of two-tenths inch bore, I accidentally met with, which I uſe as a common gauge: but this will not determine the power of the pump.

All I can ſay of the inſtrument at preſent is, that I find it much more convenient to uſe than one of the common ſort: that it will exhauſt a receiver much ſooner, and keep in order much longer, for being made without valves, which muſt depend on the ſpring of the air to open them. When a common pump, which I have, has been fitted up with valves, leathers, &c. at the ſame time with this; the valves of the common pump have become too dry and ſtiff to uſe, while this pump has continued in good order. I attribute this, in part, to the moiſture which the valves on the top-plates receive from the piſtons every time the pump is uſed; the piſtons being always kept moiſtened with oil in the ciſterns, where they ſtand when the pump is not in uſe; and in part, to the power which the piſtons have over theſe valves, by condenſing the air againſt them. In the common pump, and in Mr *Smeaton's*, the valves, at the bottom of the barrels, can only be opened by the ſpring of the air acting againſt them: but in this pump the valves are forced open, by raiſing the piſtons, and muſt, therefore, yield much longer to the power applied in this way.

I mentioned above, that the piſtons in this pump did not move the whole length of the barrels; but were intercepted by the plate, a little more than half way from the bottom, for convenience: but on this conſtruction, they may be made to move through the whole length, as in Mr *Smeaton's* pump; and then it will exhauſt a receiver in half the time that his will, if the capacity of each barrel in the two pumps be equal. And perhaps the air may be further rarefied by a pump on this conſtruction without the valves, whoſe barrels are of greater length than the barrels of my pump. For ſince the piſton may be made to fit as well to the top of one barrel as another, if the length of the barrel, through which the piſton moves, be twelve inches inſtead of ſix, the vacancy, which is unavoidably left between the top-plate and the piſton, when the latter is drawn up to the former, will bear a leſs proportion to the capacity of the whole barrel. Suppoſe, then, the

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[A] In my pump, the piſtons are two inches diameter; ſo that there will be about forty-eight pounds added to the reſiſtance in opening the valves, for every atmoſphere thrown into the receiver.

[B] This, I find, is very effectual; having never known one of the joints, ſecured in this way, to leak, though the pump has ſtood for a long time: whereas a portable pump which I have, made by Mr *Nairne*, *London*, has leaked, and repeatedly been refitted with new-oiled leathers, in the ſame time.

valve on the top plate will riſe only till the air be expanded one hundred times in a barrel of ſix inches length, becauſe this is the proportion which the vacancy bears to the capacity of the whole barrel, (the reſiſtance of the valve not being taken into the account) it will riſe till the air is expanded two hundred times in a barrel of twelve inches length, the diameters being the ſame in both, becauſe the capacity of the barrel being doubled, the vacancy bears ſo much leſs proportion to it than to one of ſix inches. And if the air can be rarefied in proportion to the difference between the vacancy and the capacity of the barrel, by leſſening this proportion, (which, after having made the work to fit as well as poſſible, is to be done by enlarging the capacity of the barrel), the power of the pump muſt be increaſed.

This, Sir, is reaſoning from theory: but theſe circumſtances, I think, ought to be conſidered in the conſtruction of an air-pump; and experiment only muſt determine how far an attention to them may be uſeful.

The rarefaction which a pump will produce, by experiment, may come very far ſhort of what it ought to do by the theory of its conſtruction. If the common pump will, in experiment, rarefy the air only one hundred times, when in its beſt ſtate, and Mr *Smeaton's*, by conſtruction, in duplicate proportion to this, it ought to go to ten thouſand; every thing being ſuppoſed perfect: but in its beſt ſtate, Mr. *Smeaton's* pump will only rarefy the air about one thouſand times; ſo that the nine-tenths which it falls ſhort of what it ought to do by theory, is to be attributed either to the imperfection of the machine alone, or to the nature of the air, in not permitting the rarefaction to go further than one thouſand times, or both theſe cauſes together. The way to prove how far this is owing to the air itſelf, is by making a machine, which, in theory, will carry the rarefaction further. A pump conſtructed without the valves, as mine is, ought to rarefy the air in duplicate proportion of what Mr *Smeaton's* ſhould do by theory, and in quadruplicate proportion of the common pump, which would be one hundred million, allowing the common one to rarefy the air one hundred times. Nothing like this, however, is to be expected, ſince we ſee Mr *Smeaton's* pump, in experiment, falls ſo far ſhort of the theory. But ſuppoſing my pump to rarefy the air in duplicate proportion of what Mr *Smeaton's* does by experiment, this would carry the rarefaction to one million times: and whatever it falls ſhort of this, muſt be attributed either to the imperfection of the machine, or the nature of the air, or both together: or if this pump ſhould rarefy the air only to the ſame degree with Mr *Smeaton's*, ſince by conſtruction it ought to go ſo much further, will it not aſcertain to us, in a direct line, that the nature of the air does not admit of being further rarefied by a pump; and that this is the reaſon why Mr *Smeaton's* pump, in experiment, fell ſo far ſhort of the theory? If this ſhould be the caſe, will it not be a confirmation that the power of mechaniſm is not wanting to produce a much greater rarefaction in the receiver, where no body acts immediately upon the air to expel it, and from which place it can only be induced to come, by making room for its expanſion into ſome other? I hope, in a little time, to be able to inform you what the reſult is by experiment, and to what degree this pump will exhauſt the receiver.

Note. Since this letter was communicated, I have ſeen, in the 67th vol. of the Philoſophical Tranſactions, an account of ſome experiments made by Mr *Nairne*, with a pump conſtructed on Mr *Smeaton's* principle: from which it appears that Mr *Smeaton* was deceived with reſpect to the rarefaction in his receiver, as indicated by the pear-gauge; and that the greateſt power of the pump, when the experiment was properly made, would carry the rarefaction in the receiver only to ſix hundred, inſtead of one thouſand times. By an account of Mr *Cavallo's*, in the 73d vol. of the Philoſophical Tranſactions, I find an improvement made in Mr *Smeaton's* pump, by Mr *Haas*, inſtrument-maker. He has contrived to open the valve at the bottom of the barrel independent of the ſpring of the air underneath; and by this improvement he has increaſed the power of the pump to one thouſand times. This experiment is a confirmation of what is to be expected from the removal of the valve in my pump, which is done with greater ſimplicity, as Mr *Haas's* contrivance is complex, conſiſting of a ring lying at the bottom of the barrel, to which ring the valve is faſtened; this ring is raiſed by a pedal, connected with two wires moving through two collars of leathers, and is depreſſed by a ſpiral ſpring contained in a ſocket, the whole being fixed under the barrel of the pump: But he has done nothing to remove the reſiſtance from the valve in the piſton, nor the weight of the atmoſphere from off the valve on the top-plate.

Plate
Append
fig. 2.

Fig. 2. A perpendicular ſection of one of the barrels, the two ciſterns, condenſing gauge, &c. where A B repreſents the barrel; C D the ciſtern on which it ſtands; *a a a a* the leathered joint, ſunk into a ſocket, and buried in oil; E F is the piſton; the cylindrical rod paſſing through a collar of leathers, GG, in the box H I. K ſhows the place of the valve on the top-plate K L, covered by the croſs-piece MM, into which the pipe O O is ſoldered; that conveys the air from the valves to the duct going under the valve-pump, as may be ſeen in Plate I. Appendix fig. 2. *o* is part of the ſaid duct; *p* is the joint ſunk into a ſocket in the croſs-piece P P, which connects the ciſterns, and has a duct through it leading to them. Into this duct open the ducts *q* and *r*, the firſt leading to the gauge in front of the pump, the other to the cock and receiver. The other barrel is left out of the figure, to ſhow ſome of the parts more diſtinctly; except Q Q, which is the top of the barrel retained and brought down out of its place, to ſhow the top plate, that ſhuts up the barrel, ſeparated from the box, which contains the collar of leathers. S ſhows one of the holes in the plate over which the valve lies, and which is covered by R in the croſs piece. V V is the piſton ſhowing the valve open on the top, which is to prevent labour when the pump condenſes. W X is the ciſtern, in which is more diſtinctly ſeen the ſhoulder for the leather which cloſes the joint between this and the barrel, and alſo the ſocket in which the oil lies over the leather. Y Z is the condenſing gauge, with the orifice of the tube raiſed above the ſurface of the quick-ſilver. *e e* is the collar of leathers, through which the glaſs tube moves. *i* is a ſmall pipe coming up through the quick-ſilver to make a communication between the valves and the gauge.

Fig. 3. is a view of the upper ſurface of the top-plate which cloſes the barrel, being ſoldered into it, ſhowing the

the place of the valve over the three ſmall holes, one of which only can be ſeen at S, in fig. 2.

pendix,
e II.

Plate II. fig. 1. is a perpendicular ſection of the bottom-piece, pipes, valve-pump, cock, &c. at right angles with the other ſection, fig. 2. Pl. I. A B is the pipe between the barrels, as repreſented in Pl. I. The button *o* is here ſcrewed into the top inſtead of the gauge. CD is the valve-pump and its ciſtern; *e* the place of the valve under the cap; EF the cock, ſhowing the duct through it leading to the atmoſphere; GH the pipe leading from it to the ſtem of the receiver-plate, in which is the cock I, to ſhut up the duct when the plate is uſed as a transferrer. K K is the plate. L a piece to ſhut up the hole into which tubes, &c. are occaſionally ſcrewed to perform experiments without removing the plate: the pricked line at O ſhows the place of the ſcrew which preſſes the plate againſt the pipe: P Q the pipe and common gauge ſtanding in front of the pump.

Fig. 2. is a horizontal ſection of the cock and pieces, containing the ducts leading from it to the receiver, the ciſterns, and the valves on the top of the barrels. A B the duct connecting the ciſterns together. C D the duct leading from the ciſterns to the cock. G H the duct leading from the cock, through the pipe A B, (fig. 1.) to the valves. D E the duct through the cock, which occaſionally connects the two laſt-mentioned ducts with the duct E F, leading from the cock to the receiver. I the duct in the cock leading to the atmoſphere, which, when connected with the duct at D, lets the air into the ciſterns and barrels for condenſation; the other duct through the cock at the ſame time connecting H and E. This duct alſo, when connected with E, reſtores the equilibrium in the receiver. KL is part of the duct leading from the ciſterns to the gauge. The pricked circles ſhow the places of the pipe and valve-pump on the piece, and *r* the place where the air enters the valve-pump from the duct GH, and is thrown into the atmoſphere, when the pump exhauſts.

Fig. 3. ſhows the under ſurface of the boxes, which contain the collars of leathers, with the croſs-piece, which connects them together, having a duct through it, as repreſented by the pricked line, through which the air paſſes from the valves to the pipe: this fig. is deſigned chiefly to ſhow the places in which the valves play, as at I.

Fig. 4. is a ſide view of the pump, ſhowing the ſituation of the valve-pump and handle of the cock; where A is the pump, and B the handle.

Fig. 5. is the top-plate which ſcrews the key of the cock into its ſhell, and keeps it tight: the upper ſurface of it is marked with directions to turn the key ſo as to produce the effect deſired: for when the mark on the key agrees with the mark on the plate, the pump exhauſts, and ſo of the reſt.

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The editor has received the following remarks upon the account of this pump publiſhed in the Encyclopædia.

'The compiler of the article Pneumatics in the Encyclopædia, in his account of the American air-pump, makes ſome objections to it, which a perſon unacquainted with the pump may think of ſome weight. He ſays "great inconveniences were experienced from the oſcillations of the mercury in the gauge. As ſoon as the piſton comes into the ciſtern, the air from the receiver immediately ruſhes into the barrel, and the mercury ſhoots up in the gauge, and gets into a ſtate of oſcillation. The ſubſequent riſe of the piſton will frequently keep time with the ſecond oſcillation, and increaſe it. The deſcent of the piſton produces a downward oſcillation, by allowing the air below it to collapſe; and by improperly timing the ſtrokes, this oſcillation becomes ſo great as to make the mercury enter the pump."

'This is a very ſingular account of the working of the American air-pump, aſſerting that an *extraordinary* oſcillation of the mercury is produced in this pump; that it is greater than in thoſe made with valves at the bottom of the barrels. It ſeems to be founded on experiment, and yet it is contradicted by numerous experiments performed on the original pump, and on one of the ſame conſtruction made by the late Mr *George Adams* in London, and ſent out to the inventor. The experiments to ſhew the effect of the pump on the barometer-gauge were performed in the preſence of ſeveral ſcientific and reſpectable perſons, who were witneſſes that no ſuch extra-oſcillations were produced by it. The mercury roſe in the gauge in the ſame manner as it did on a double-barrelled pump of the common conſtruction made by Mr *Nairne*, and tried at the ſame time with the other. Mr *Adams*, who made the firſt pump in England on this plan, mentions no ſuch effect of extra-oſcillation in it, neither in his letter to the inventor on this pump, nor in his public account of it: nor does Mr *Jones*, another eminent philoſophical inſtrument-maker, who has ſince made pumps on this plan, and given an account of their exhauſting power.

'This extra-oſcillation is alſo contrary to the theory of the American pump. In the original deſcription of this pump it is ſaid, "but as in ſingle-barrelled [c] pumps of this conſtruction, where there is no valve at the bottom to prevent the air, which follows up the piſton in its aſcent, from returning into the receiver in its deſcent, a fluctuation would be produced, which might prove detrimental in ſome experiments, this pump is made with two barrels, which rarefies the air at every ſtroke of the winch. In this conſtruction, the capacity of the two barrels taken together, below the piſtons, is always the ſame; for while one is deſcending, the other is aſcending; and what is taken from the one is added to the other." The ſpace therefore in the two barrels, below the piſtons, being always the ſame, it was ſuppoſed this would prevent the return of the air into the receiver, on the deſcent of the piſton. Experiment has proved the theory true. For on putting a cloſed bladder, containing a little air, under the receiver, and working the pump, the bladder expanded in the ſame manner as when put under the receiver of the common air-pump; no impulſe from returning air could be perceived on it. It did the ſame when the bladder was put under the lead weights, which would have made the impulſe more perceptible, had there been any. If there were no ſuch effect on the bladder, there could be none on the gauge, which communicates freely with the receiver. It ſeems as if

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[c] The American pump was an attempt to improve Mr *Smeaton's* pump, which is always made with a ſingle barrel.

the objector to the Americn air-pump had never attended to the above obſervation in the original account of it. If he ever ſaw an experiment producing the extra-oſcillation he mentions, it muſt have been made with a ſinge-barrelled pump, in which alone the deſcent of the piſton can cauſe a " downward oſcillation."

" To prevent this" (downward oſcillation) he ſays, " valves were put into the piſtons; but as theſe require force to open them, the addition ſeemed rather to increaſe the evil, by rendering the oſcillation more ſimultaneous with the ordinary rate of working." If ſuch an evil were produced by the deſcent of the piſton, it is difficult to conceive how putting valves into the piſtons could have increaſed it. They could not increaſe the evil unleſs they increaſed the reſiſtance to the air under the piſton. But it muſt be a ſtrange aſſertion, that a piſton with a *valve* in it will give more reſiſtance to the air than a *ſolid* piſton. He had before ſaid, one cauſe of this oſcillation was the ſudden ruſhing of the air into the barrel, when the piſton comes into the ciſtern. A piſton with a valve in it would not leave ſo great a vacuum in the barrel above it, as a ſolid piſton. If therefore his firſt poſition were true, that one cauſe of the extra oſcillation was the ruſhing of the air into this vacuum, the tendency of the valve would be to leſſen it by gradually letting the air into the vacuum. It certainly would leſſen the evil *below*, by leſſening the reſiſtance of the piſton to the air under it, which, he ſays, produces "a downward oſcillation." But theory and experiment prove that no ſuch effect, as extra-oſcillation, will be produced by the *deſcent* of the piſton, if the pump be properly made with two barrels, though there be no valves at the bottom.

' Neither will there be any greater oſcillation of the mercury produced in the gauge of the American pump, than there is in the common pump, by the ruſhing of the air into the exhauſted barrels. The writer ſpeaks of the " mercury ſhooting up into the gauge, and getting into a ſtate of oſcillation;" and that " the ſubſequent riſe of the piſton will frequently keep time with the ſecond oſcillation, and increaſe it;" as though this was peculiar to the American pump. Every experimenter knows, that in working any air-pump, having a barometer-gauge, the firſt ſtrokes of the winch, if made quick, will cauſe a rapid riſe and fall of the mercury; and that the ſtrokes may be ſo timed as to increaſe the oſcillations by making them ſimultaneous with the working of the pump: but not in the American, more than in the common, air-pump.

' In the original account of the American air-pump, to illuſtrate the method by which it exhauſts the receiver, there is a ſuppoſition made that the piſton is *ſolid*, and that in its deſcent it is allowed to paſs *out* of the bottom of the barrel into the ciſtern, by which an opening is made for the air to paſs from the receiver into the exhauſted barrel. Such a large and free paſſage as this, ſuddenly opened, might operate with ſo much force on the gauge, as to cauſe a very rapid riſe of the mercury, on the firſt working of the pump. But it is expreſsly ſtated in the account, that " in working the pump, the piſton is not allowed to deſcend entirely into the ciſtern, ſo far as to leave the bottom of the barrel open: but it deſcends below a hole in the ſide of the barrel, near the bottom, which opens a free communication between the barrel, ciſtern, and receiver. Through this hole the air ruſhes from the ciſtern into the exhauſted barrel, when the piſton has dropped below it."[D] The air is more gradually admitted in this way than by opening the bottom of the barrel. No eſſential difference was found in the riſing of the gauge, by admitting the air through this hole, without a covering valve, from what takes place in the common pump, in which the air is admitted into the barrel through a hole in the bottom-plate under a valve: though in one experiment ſolid piſtons were uſed. But when the piſtons are made with valves on the top, as directed in the original account, there is no difference in the oſcillation of the gauge in the two pumps.

' A moment's attention to the two conſtructions will ſhew that there cannot be any difference. In the common pump the barrel is exhauſted *below* the piſton, by its riſing; and the air gradually paſſes into the barrel through a hole under a valve at the bottom-plate. In the American pump the barrel is exhauſted *above* the piſton, by its deſcending: and the air as gradually paſſes through a hole in the piſton under a valve which covers it, into the exhauſted part of the barrel, as it does in the common pump. The effect on the gauge muſt therefore be the ſame in both pumps, in their firſt working: for one can produce no more oſcillation than the other by the entering of the air into the exhauſted barrels. This part of the objection of extra-oſcillation in the American pump, ſaid to ariſe from " the air from the receiver immediately ruſhing into the barrel, as ſoon as the piſton comes into the ciſtern," has therefore no more foundation than the other, the want of valves at the bottom of the barrels.

' It is proper to remark here, that although the air will paſs through the piſtons into the exhauſted barrel, in the firſt working of the American pump; yet when the air becomes too weak to raiſe the valve on the top of the piſton, it will paſs through the hole in the ſide of the barrel, where there is no reſiſtance, when the piſton falls below it. This is one of the principal advantages the American pump has over the common one: for the reſiſtance of the lower valve in the latter, will always limit its exhauſting power to a leſs degree than that of the former. And by the time the air becomes too weak to raiſe the piſton-valve, the mercury will have riſen ſo high as to prevent any oſcillation in the gauge; ſuppoſing a ſolid piſton, and the want of a valve over the hole in the ſide of the barrel, could have produced a great degree of it, in the firſt working of the pump. It is neceſſary to obſerve, that the valves were not put " *in* the piſtons," as this writer ſays, but *on* them, that leſs room might be left for the lodgment of air between the piſtons and top plates of the barrels.

' It is difficult to conceive what is meant by ſaying the valves in the piſtons were alſo intended to " prevent a greater irregularity of working as a condenſer." There can be no irregularity in the gauge, of which he had been ſpeaking, when the pump condenſes; whether the

piſtons

[D] This hole is repreſented in the figure of the piſton and barrel given in the Encyclopædia; though no notice is taken of its uſe in that account of the pump.

piſtons be ſolid, or have valves in them: for the barometer-gauge is no ways affected by that operation. The bottom of the barrels, and the gauge, are then opened to the atmoſphere, and the mercury remains quieſcent. There is no more irregularity in condenſing with the American pump, than there is extra-oſcillation in exhauſting. The valves on the piſtons leſſen the labour in condenſing with this pump, by taking off part of the reſiſtance of the atmoſphere againſt the piſtons. For this purpoſe they are often put into common condenſers. And this is the only uſe of them, in *condenſing* experiments, mentioned in the original account.

"If this difficulty (the great oſcillation) could be got over," ſays the compiler, "the conſtruction ſeems promiſing." It is difficult to deſtroy what does not exiſt. But if the evil did exiſt, it would be no hard matter to remove it. This might be done by placing a ſmall ſtop-cock over the gauge to cut off the communication between the barrels, or receiver, during the firſt working of the pump. It is the firſt ſtrokes which cauſe the moſt rapid riſe of the mercury in all air-pumps. When the receiver is nearly exhauſted, the air might be gradually let out of the tube, and the mercury would riſe ſlowly in it. The exhauſtion might then be completed without any oſcillation in the gauge, as the mercury riſes but very ſlowly when the receiver is nearly exhauſted. This is ſuggeſted, not becauſe there is any neceſſity for it in the American double-barrelled air-pump; but leſt any perſon ſhould wiſh to poſſeſs a ſingle-barrelled pump of this conſtruction, in which ſuch an oſcillation might take place.

'The next objection has more weight, though it is not peculiar to the American air-pump, as the writer inſinuates. "It appears," ſays he, "of very difficult execution. It has many long, ſlender, and crooked paſſages, which muſt be drilled through broad plates of braſs, ſome of them appearing ſcarcely practicable. It is rare to find plates and other pieces of braſs without air-holes, which it would be difficult to find out and cloſe," &c. When a machine is deſigned to effect more purpoſes than one by the ſame moving power, it is almoſt neceſſarily complex in its conſtruction. It was by following the method uſed by Mr *Smeaton*, of making the pump perform exhauſting and condenſing experiments by the ſame winch and barrels, that the American air-pump was, like his, made with a cock ſo pierced as to regulate theſe effects; though in the American pump it is a little differently conſtructed from the cock in Mr *Smeaton's* pump, but not more complex. The writer very juſtly commends Mr *Smeaton's* pump, eſpecially as made by Mr *Nairne*; but he has not given a figure of the original pump, with its regulating cock; though this is an eſſential part of Mr *Smeaton's* conſtruction. It is omitted, perhaps, becauſe he has given a full account of Mr *Nairne's* improvement, in which this complex cock is excluded, and the ſame effects produced by two others, added by Mr *Nairne*.

'In all air-pumps, made to exhauſt and condenſe by the ſame barrel and winch, there muſt be more pipes, ducts and cocks than what are neceſſary in the ſimple exhauſting pump, to command and regulate the different operations. But it is ſurpriſing that the compiler ſhould object to "long, ſlender and crooked paſſages" in the American air-pump: that he ſhould ſingle out this pump as the *moſt* liable to ſuch an objection, when by actual meaſurement there is not ſo much pipe and duct-work in the American air-pump, by more than one half, as in Mr *Nairne's* improved pump of *Smeaton*, againſt which he brings no ſuch objection. The original American pump has but one pipe, of ſeven inches length, ſtanding between the barrels; one of ſix inches, leading from the cock to the receiver-plate; and one of about three inches, leading to the gauge in front. But in Mr *Nairne's* pump there is one pipe more than two feet in length, and "crooked" at one end, leading from the bottom of the barrel to the broad piece of braſs which is connected with the receiver-plate. Through this piece, and the cock it contains, a paſſage is "drilled," longer than any in the American pump. Another "crooked" pipe goes from the top of the barrel to another "broad, drilled piece of braſs," connecting it with the other cock and the receiver-plate for condenſing. The pipe connecting the gauge with the receiver-plate in the American pump is ſtraight; in Mr *Nairne's* "crooked." It is preſumed, that though it may be "rare to find plates and other pieces of braſs without air-holes," the braſs-work may be caſt as free from them for one pump as another, where the forms are equally ſimple. If the American pump be made only to exhauſt, the pipe-work may be made nearly the ſame as in the common pump.

'How much more applicable is the objection of "long, ſlender and crooked paſſages" to Mr *Cuthbertſon's* air-pump, which this writer conſiders as "the moſt perfect air-pump that has yet appeared!" Let any one examine the "drilled paſſages through plates of braſs" in fig. 7 and 8, Pl. CCCCIX. of the Encylopædia, and at the bottom of the barrel, fig. 1—the "long, ſlender paſſages" leading from the bottom of the barrels to the receiver-plate; the "crooked" pipes on the top of the oil-boxes; the hollow piſton rods, made to accommodate the ſliding wires which open the lower-valves; the compound and complex piſtons and double collars of leathers; the oil-boxes and wire-valves; and then judge which is the moſt "difficult of execution," the American, or *Cuthbertſon's* pump: which the moſt liable to the above objections of the compiler.

'The piſton in *Cuthbertſon's* pump, which is complex, and muſt be accurately made to anſwer its purpoſe, does no more, with the aid of the lower wire-valve, and its rod working through a collar of leathers in the hollow piſton-rod, than the ſimple piſton of the American pump, with a ſolid rod; and without any valve at the bottom of the barrel. The aim in both conſtructions is to get the air from the receiver into the exhauſted barrels *above* the piſtons, without any reſiſtance from valves. On this part of the two conſtructions of the American, and *Cuthbertſon's*, pump, Mr *Nicholſon*, a philoſopher of reputation, whoſe writings are well known to the public, ſays, "With regard to the lower valves, *Cuthbertſon*, by an admirable diſplay of talents as a workman, has inſured their action. *Prince*, on the other hand, has, by a proceſs of reaſoning, ſo much improved the inſtrument, that no valves are wanted. In this reſpect he has the advantage of ſimplicity and cheapneſs, with equal effect. [E] The late Mr *George Adams*, mathe-

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[E] See his account of the two pumps in the firſt volume of his Philoſophical Journal, page 130.

matical inſtrument-maker, whoſe philoſophical writings are alſo well known and whoſe ability to judge of the merits of an air-pump cannot be doubted, advertiſed "the American double-barrelled air-pump, the lateſt improvement on this inſtrument, in which the air receives no impediment from the action of valves or cocks, exceeding *Smeaton's* in accuracy and ſimplicity, and far ſuperior in both reſpects to ſeveral later contrivances." And in his lectures on natural philoſophy, vol. I. ſpeaking of the invention of the air-pump and its improvements, after mentioning thoſe by *Hook* and *Boyle*, he ſays, "ſubſequent improvements have been made by Meſſrs *Graveſande*, *Nollet*, *Smeaton*, *Haas* and *Cuthbertſon*; but the laſt and moſt perfect is that of the Rev *John Prince*, of Boſton, in America, to which I have given the name of the American air pump." The Analytical Reviewers, in their review of the controverſy between Mr *Nairne* and Mr *Brook*, reſpecting the diſcovery of the true power of *Smeaton's* pump, ſay, "the contention ſeems to relate to an object which has for ſome time been rendered of no importance, by the invention of an air-pump on a much better conſtruction than either, deſcribed by the Rev *John Prince*, in the Tranſactions of the American Academy for the year 1783. The idea is ſo ſimple and ſo valuable, that we are convinced we ſhall receive the thanks of our readers if we devote a few lines to the deſcription of it." After giving a ſhort deſcription of it, they add, "the conſtruction evidently deſerves the attention of the curious; and it is ſomewhat wonderful that it ſhould have ſo long remained unapplied to the purpoſe of exhauſting, when from the earlieſt modern times it has been uſed in condenſing ſyringes." [F] Mr *William Jones*, before mentioned, ſpeaking of the American air-pump, gives this account of its power of exhauſting. "By the compariſon of the height of the mercury in a good barometer, I obſerved not above $\frac{1}{40}$ of an inch difference with that of the barometer gauge to the pump; conſequently the rarefaction was about 1200 times; and I judge it to be equal in power to what is ſaid of Mr *Cuthbertſon's*, or any pump whatſoever." [G] In a letter to the inventor of the American air-pump, Mr *Jones* further ſays, "I have ſeen Mr *Cuthbertſon's* pump in experiment, and it certainly exhauſts to very great nicety; and I have alſo been witneſs to two good ones made upon your plan; they appeared full as accurate as Mr C's."

'In this American edition of the Encyclopædia, to let the objections ſtated in it againſt the American air-pump paſs unnoticed, would look like a tacit acknowledgment of their truth: but it is preſumed the above remarks and teſtimonies in favour of this pump will be ſufficient to ſhew the contrary; and prove that it is not, as the writer of theſe objections obſerves, "rather a ſuggeſtion of theory than a thing warranted by its actual performance." To ſome perſons, who are acquainted with the operation of the American air-pump, the partial and unjuſt account of it in the Encyclopædia appeared at firſt very ſurpriſing. But their ſurpriſe abated, and the prejudice againſt it was fully accounted for, on reading the compiler's remark at the end of his account of air-pumps. For he ſeems to have condemned it that he might be able to ſay, "we may be indulged in one remark, that although this noble inſtrument originated in Germany, all its improvements were made in Britain!"

'The following improvements have been made in the American air-pump, by the inventor, to render it more ſimple and convenient. It has been obſerved above, that in all air-pumps, made to condenſe as well as exhauſt by the ſame barrels and winch, there muſt be additional pipes, ducts and cocks to command and regulate the operations: But this is not the beſt method of conſtructing the inſtrument for exhauſting and condenſing experiments: for a great ſtrain is brought upon the rackwork of the pump when ſeveral atmoſpheres are thrown into the receiver: and the pump may be made with leſs trouble and expenſe by fixing a common condenſing ſyringe to it, in the following manner. Let a ſtraight pipe be fixed to the ciſterns, and paſs horizontally to the receiver-plate, as in the common table air-pump. At a convenient diſtance from the barrels this pipe muſt be ſwelled out ſo as to admit the key of a ſtop cock. The key of this cock muſt be pierced quite through in the direction of its handle; and half way through, at a right angle to meet the other hole. A ſmall pin muſt be fixed in the handle, on that ſide which correſponds with the ſhort hole. A hole muſt be made in the ſide of the pipe to correſpond occaſionally with the holes in the key. This cock is more ſimple than the one in the original pump, and will regulate the exhauſting and condenſing experiments. To ſet the cock for exhauſting the receiver, bring the handle of the key parallel with the pipe, with the ſolid part of the key againſt the hole in the ſide of the pipe; then will the communication be opened between the barrels and receiver, and the receiver may be exhauſted. To reſtore the equilibrium, or let the air into the receiver, ſet the handle of the key at right angles with the pipe, and let its projecting pin point to the receiver; then will the communication be opened between the atmoſphere and receiver, through the hole in the ſide of the pipe and the cock. In this ſituation the ſolid part of the key will cloſe the paſſage in the pipe leading to the barrels. If a condenſer, having a valve at its end, be now attached to the ſide of the pipe, oppoſite the hole, the air may be forced into the receiver through the cock without entering the barrels. The ſwelled part of the pipe, in which the key is inſerted, ſhould be ſo made as that the condenſer may be ſcrewed on or off, at pleaſure. The equilibrium may be reſtored in the receiver, either by unſcrewing the condenſer a little, or by letting the air out through the barrels.

'In this conſtruction, the pipe ſtanding between the barrels in the original pump, and the drilled paſſages in the horizontal piece connecting this pipe with the regulating cock, are unneceſſary. The pump is rendered more ſimple, and every difficulty of execution on account of crooked paſſages, &c. removed. This alteration in the American air-pump was contrived by its inventor, and a table-pump made on this plan, for him, by the late Mr *George Adams*, before the laſt edition of the Encyclopedia was printed.

'Another alteration, ſince made, is in the ſituation of the

[F] See the Review for July 1789.

[G] See his note in his edition of Adam's Lectures, vol. I. page 153.

the valve-pump: the laſt mentioned pump not having one fixed to it. In all air-pumps having the tops of the barrels cloſed with plates and collars of leather, as in *Nairne's*, *Cuthbertſon's*, and the American pump (as now altered by removing the middle pipe,) it is neceſſary to connect oil boxes with the top-plates to receive the oil which is thrown out of the barrels in working the pump. *Cuthbertſon's* pump has two, one to each barrel. By removing the pipe from between the barrels, in the American pump, a ſmall barrel is ſcrewed in its place to the croſs-piece, which connects the top-plates covering the valves. The barrel anſwers the purpoſe of an oil-box in common exhauſtions. When greater vacuums are wanted in the receiver, this barrel anſwers alſo for a valve-pump. On the top of the croſs-piece is ſcrewed a collar of leathers containing a piſton and its rod, to work occaſionally in the barrel below. At the lower end of the barrel is a valve covered with a cap: by unſcrewing the cap, and paſſing down the piſton, all the oil in the barrel is expelled through the valve; and afterwards the barrel, and the ſpace above the valves on the top-plates of the great barrels, are exhauſted of air, by working this ſmall pump. The ſmall piſton when drawn up to its collar of leathers is above the holes in the croſs-piece leading from the valves. When the ſmall barrel is uſed only as an oil-box, the collar of leathers, with the piſton, is removed, and a button, with a ſhort pipe in it, ſcrewed in its place to give vent to the air when expelled from the barrels: In this valve-pump there is not ſo much work as in *Cuthbertſon's* two oil-boxes; nor is it an additional expenſe; for the ſyringe, which is uſed with the lead weight in the receiver, is made to ſcrew to the croſs-piece for this purpoſe; the weight being taken off, and a cap ſcrewed on over the valve, when uſed as an oil-box. In the collars of leathers, on the tops of the barrels, are put two ſmall flat boxes, below one or two rings of the leathers, the piſton rods paſſing through them. Theſe boxes contain the oil to keep the leathers moiſt, and air-tight. In this ſituation the oil is not thickened by evaporation, nor carried up from off the leathers, when the piſton riſes, as in *Nairne's* pump, and the leathers are better ſupplied than by the dirty oil paſſing through the pump and returned to the collars by *Cuthbertſon's* crooked pipes. The American air-pump, made in this manner, is the ſimpleſt form of any pump of equal power.'

POCAHONTAS, a town in Cheſterfield county, Virginia, within the juriſdiction of Peterſburg in Dinwiddie county. It probably derives its name from the famous princeſs Pocahontas, the daughter of king Powhatan.—*Morſe.*

POCOMOKE, an eaſtern water of Cheſapeak Bay, navigable a few miles. On its eaſtern ſide, about 20 miles from its mouth, is the town of Snow Hill.—*ib.*

POGE, *Cape*, the N. E. point of Chabaquiddick Iſland, near Martha's Vineyard, Maſſachuſetts. From Holmes's Hole to this cape the courſe is S. E. by E. 3½ leagues diſtant. In the channel between them there are 11 and 12 fathoms water. N. lat. 41 25, W. long. from Greenwich 70 22.—*ib.*

POINT, a townſhip in Northumberland county, Pennſylvania.—*ib.*

Point *Alderton*, the S. W. point of Boſton-harbour. N. lat. 42 20, W. long. 70 54.—*ib.*

Point *le Pro*, the eaſtern limit of Paſſamaquoddy Bay, on the coaſt of New-Brunſwick.—*ib.*

Point *Judith*, in the townſhip of South-Kingſtown, is the ſouth extremity of the weſtern ſhore of Narraganſet Bay in Rhode-Iſland. It is 9 miles ſouth-ſouth-weſt of Newport. N. lat. 41 24, W. long. 71 28.—*ib.*

Point *Petre*, in the iſland of Guadaloupe, has ſtrong fortifications, and lies about 20 miles from Fort Louis. —*ib.*

POINT-AU-FER, a place near the head or northern part of Lake Champlain, within the limits of the United States. It was delivered up by the Britiſh in 1796.—*ib.*

POINTE *des Pieges*, a cape on the ſouth ſide of the iſland of St Domingo, 2 leagues weſt of the mouth of Pedernales river.—*ib.*

POJAUHTECUL, called by the Spaniards Volcan de Orizaba, a celebrated mountain in Mexico, or New-Spain, which began to ſend forth ſmoke in 1545, and continued to do ſo for 20 years; but for two centuries paſt, there has not been obſerved the ſmalleſt ſign of burning. The mountain, which is of a conical figure, is the higheſt land in Mexico, and is deſcried by ſeamen who are ſteering that way, at the diſtance of 50 leagues; and is higher than the Peak of Teneriffe. Its top is always covered with ſnow, and its border adorned with large cedars, pine, and other trees of valuable wood, which make the proſpect of it every way beautiful. It is 90 miles eaſtward of the city of Mexico.—*ib.*

POKONCA, a mountain in Northampton county, Pennſylvania, 22 miles N. W. of Eaſton, and 26 ſouth-eaſterly of Wyoming Falls.—*ib.*

POLAND, a townſhip in Cumberland county, Diſtrict of Maine.—*ib.*

POLLARDS, the name of a coarſe kind of wheaten flour. When the flour of wheat is ſeparated into three degrees of fineneſs, the third is the pollards. There is nothing between it and the bran.

POLLIPLES *Iſland*, a ſmall rocky iſland, about 80 or 100 rods in circumference, at the northern entrance of the High Lands in Hudſon's river; remarkable only as the place where ſailors require a treat of perſons who have never before paſſed the river.—*Morſe.*

POMALACTA, a village in the juriſdiction of the town of Guaſuntos, in the province of Quito, famous for the ruins of a fortreſs built by the Yncas, or ancient emperors of Peru.—*ib.*

POMFRET, a townſhip in Windſor county, Vermont, containing 710 inhabitants. It is 11 miles W. of the ferry on Connecticut river, in the town of Hartford, and 64 N. E. of Bennington.—*ib.*

Pomfret, a poſt-town of Connecticut, in Windham county. It is 40 miles E. by N. of Hartford, 66 S. W. of Boſton, and 264 N. E. of Philadelphia; and contains a Congregational church, and a few neat houſes. The townſhip was firſt ſettled in 1686 by emigrants from Roxbury. It was part of the *Maſhamoquet* purchaſe, and in 1713 it was erected into a townſhip. Quinabaug river ſeparates it from Killingly on the eaſt. In Pomfret is the famous cave, where General Putnam conquered and ſlew the wolf.

Pompeon, in Bergen county, New-Jerſey, lies on Ringwood, a branch of Paſſaik river, about 23 miles north-weſt of New York city.—*ib.*

Pompey, a military townſhip in Onondago county, New

New York, incorporated in 1794. It comprehends the townſhips of Pompey, Tully, and Fabius, together with that part of the lands called the Onondago Reſervation; bounded northerly by the Geneſee road, and weſterly by the Onondago Creek. In 1796, there were 179 of the inhabitants qualified electors.—*ib.*

PONTCHARTRAIN, a lake of Weſt-Florida, which communicates eaſtward with the Gulf of Mexico, and weſtward with Miſſiſſippi river, through Lake Maurepas and Ibberville river. It is about 40 miles long, 24 broad, and 18 feet deep. The following creeks fall into it on the N. ſide, viz. Tangipaho, and Le Comble, 4 feet deep; Chefuncta, 7; and Bonfouca, 6; and from the peninſula of Orleans, Tigahoc, at the mouth of which was a ſmall poſt. The Bayouk of St John alſo communicates on the ſame ſide. The French inhabitants, who formerly reſided on the N. ſide of this lake, chiefly employed themſelves in making pitch, tar, and turpentine, and raiſing ſtock, for which the country is very favourable. See *Maurepas.*—*ib.*

PONTCHARTRAIN, an iſland in lake Superior, ſouth by weſt of Maurepas iſland, and N. W. of Hocquart Iſland.—*ib.*

PONTEQUE, or *Pontique*, a point on the W. coaſt of Mexico, 10 leagues N. by E. of Cape Corientes, between which is the bay of de Valderas. To the weſtward of it are two ſmall iſlands of its name, a league from the main. There are alſo rocks, called the rocks of Ponteque, 20 leagues ſouth-weſt of the port of Matanchel.—*ib.*

POPA MADRE, a town of S. America, in Terra-Firma, 50 miles eaſt of Carthagena. N. lat. 10 15, weſt long. 74 32.—*ib.*

POPAYAN, a province of S. America, in New Granada, about 400 miles in length and 300 in breadth. The country is unhealthy, but vaſt quantities of gold are found in it. It is ſtill moſtly in poſſeſſion of the native Americans.—*ib.*

POPAYAN, the capital of the above province, and a biſhop's ſee, inhabited chiefly by creoles. It is 220 miles N. E. of Quito.—*ib.*

POPLAR *Spring*, in the north-weſtern part of Ann Arundel county, Maryland, near a brook, 3 miles ſoutherly of the weſt branch of Patapſco river, on the high road from Baltimore to Frederickſtown, about 27 miles weſt of Baltimore, and 41 N. W. of Annapolis.—*ib.*

POPLIN, a townſhip of New-Hampſhire, in Rockingham county, 12 miles weſterly of Exeter, and 26 weſterly of Portſmouth. It was incorporated in 1764, and contains 493 inhabitants.—*ib.*

POOUSOOMSUCK, a river of Vermont, which runs a ſoutherly courſe, and falls into Connecticut river in the townſhip of Barnet, near the Lower bar of the 15 mile falls. It is 100 yards wide, and noted for the quantity and quality of ſalmon it produces. On this river, which is ſettled 20 miles up, are ſome of the beſt townſhips in the State.—*ib.*

PORCAS, *Ilhade*, or *Iſland of Hogs*, lies eaſtward of St Sebaſtian's Iſland, on the coaſt of Brazil, and 20 miles eaſtward of the Bay of Saints.—*ib.*

PORCAS, *Morro de*, or *Hog's Strand*, on the weſt coaſt of New Mexico, is northward of Point Higuerra, the ſouth-weſt point of the peninſula which forms the bay of Panama. From thence ſhips uſually take their departure, to go ſouthward for the coaſt of Peru.—*ib.*

PORCELAIN, a kind of earthen or ſtone ware, of the manufacture of which a full account is given in the *Encyclopædia* from Groſier and Reaumur. It may be proper, however, to add here, from Sir George Staunton, that one of the principal ingredients in the Chineſe porcelain called *pe-tun-tſe*, is a ſpecies of fine granite, or compound of quartz, feldſpath, and mica, in which the quartz bears the largeſt proportion. "It appears (ſays Sir George) from ſeveral experiments, that *pe-tun-tſe* is the ſame as the growan-ſtone of the Corniſh miners. The micaceous part in ſome of this granite from both countries, often contains ſome particles of iron; in which caſe it will not anſwer the potter's purpoſe. This material can be calcined and ground much finer by the improved mills of England, than by the very imperfect machinery of the Chineſe, and at a cheaper rate, than the prepared *pe-tun-tſe* of their own country, notwithſtanding the cheapneſs of labour there. The *kao lin*, or principal matter mixed with the *pe-tun-tſe*, is the growan-clay alſo of the Corniſh miners. The *wha-ſhe* of the Chineſe is the Engliſh ſoap rock; and the *ſhe-kan* is aſſerted to be gypſum.

"The manufacture of porcelain is ſaid to be precarious, from the want of ſome preciſe method of aſcertaining and regulating the heat within the furnaces, in conſequence of which, their whole contents are baked ſometimes into one ſolid and uſeleſs maſs." If this be ſo, Wedgewood's thermometer would be a preſent highly valuable to the Chineſe potter, if that arrogant and conceited people would condeſcend to be taught by a native of Europe.

PORCO, a juriſdiction of S. Americo, in the province of Charcos, beginning at the weſt end of the town of Potoſi, about 25 miles from the city of La Plata, and extending about 20 leagues.—*Morſe.*

PORCO, a town in the above juriſdiction, weſt of the mines of Potoſi. S. lat. 19 40, W. long. 64 50.

PORPOISE, *Cape*, on the coaſt of York county, Diſtrict of Maine, is 7 leagues N. by E. of Cape Neddock, and 5 ſouth-weſt of Wood Iſland. It is known by the highlands of Kennebunk, which lie to the north-weſt of it. A veſſel that draws 10 feet water will be aground at low water in the harbour here. It is ſo narrow that a veſſel cannot turn round; is within 100 yards of the ſea, and ſecure from all winds, whether you have anchor or not.—*ib.*

PORTAGE, *Point*, on the eaſt coaſt of New-Brunſwick, and in the ſouth-weſt part of the Gulf of St Lawrence, forms the N. limit of Miramichi Bay, as Point Ecoumenac does the ſouth.—*ib.*

PORT AMHERST, a bay on the ſouth-eaſtern coaſt of Nova-Scotia, ſouth-weſt of Port Roſeway, and 17 miles N. E. of Cape Sable.—*ib.*

PORT ANGEL, a harbour on the W. coaſt of Mexico, about half way between St Pedro and Compoſtella. It is a broad and open bay, having good anchorage, but bad landing. N. lat. 13 32, W. long. 97 4.—*ib.*

PORT ANTONIO, in the north-eaſtern part of the Iſland of Jamaica, lies W. by N. of the north-eaſt point; having Fort George and Navy Iſland on the weſt, and Wood's Iſland eaſtward. It is capable of holding a large fleet; and if it were fortified and accommodated for

for refitting ſhips of war, would be of great importance, as it is only 36 leagues weſterly of Cape Tiburon in St Domingo, and opens directly into the Windward Paſſage. The town of Titchfield lies on this bay.—*ib.*

PORTA *Maria*, in the N. E. part of the Iſland of Jamaica, is ſouth-eaſterly from Gallina point.—*ib.*

PORTA *Port*, on the N. W. ſide of the Iſland of Newfoundland; the ſouth entrance into which is 10 or 12 leagues from Cape St George.—*ib.*

PORT *au Prince*, a juriſdiction and ſea-port, at the head of the great Bay or Bight of Leogane, in the weſt part of the Iſland of St Domingo. The town which is ſeated on the head of the bay, is the ſeat of the French government in time of peace, and a place of conſiderable trade. Though ſingularly favoured with the eaſt winds, it was long the tomb of the unhappy Europeans, in conſequence of the difficulty of obtaining good water. By the exertions of M. de Marbois, who reſided here about 5 years, in conſtructing fountains, public baſons, and airy priſons, the place has become far more healthy and deſirable. The juriſdiction contains 6 pariſhes and its exports from January 1, 1789, to Dec. 31, of the ſame year, were as follow: 2,497,321 lbs. white ſugar; 44,716,226 lbs. brown ſugar; 17,829,424 lbs. coffee; 1,878,999 lbs. cotton; 137,951 lbs. indigo; other articles, as hides, molaſſes, ſpirits, &c. to the value of 8,248½ livres. The total value of duties on the above articles on exportation was 189,945 dolls. 46 cents. This fine town was nearly burnt down by the revolting negroes, in Nov. and Dec. 1791. It is only fit for a ſhipping place for the produce of the adjacent country, and for that of the rich plains of the Cul de Sac to the northward. The Iſland of Gonave to the weſtward would enable a ſquadron to block up the port. The line of communication between Port au Prince and the town of St Domingo, is by the ponds, and through the towns of Neybe, Azua, Bani, &c. The diſtance from Port au Prince to St Domingo city being 69 leagues eaſt by ſouth; for they reckon it 14 leagues from the guard El Fondo to Port au Prince. To ſhorten this way a little, and particularly to render it leſs diſagreeable, one may croſs the Brackiſh Pond in a canoe. Port au Prince is 7 leagues eaſt by north of the town of Leogane, and about 50 ſouth by eaſt as the road runs from Port de Paix. N. lat. 18 34, W. long. from Paris 74 45.—*ib.*

PORT BANKS, on the north-weſt coaſt of N. America, lies ſouth-eaſt of Pitt's Iſland, and north-weſt of Point Bukarelli.—*ib.*

PORT CABANAS, on the northern ſide of the iſland of Cuba, lies E. by N. of Bahia Hondu, and weſtward of Port Mariel.—*ib.*

PORT DAUPHIN, a bay on the eaſtern coaſt of Cape Breton Iſland, about 18 leagues S. by W. of Cape Raye in Newfoundland.—*ib.*

PORT DE PAIX, a juriſdiction and ſea-port, on the north ſide of the iſland of St Domingo, towards the weſtern end, and oppoſite the iſland of Tortue, 4 leagues diſtant. The juriſdiction contains 7 pariſhes; the exports from which, from Jan. 1, 1789 to Dec. 31, of the ſame year, were as follow: 331,900 lbs. white ſugar; 515,500 lbs. brown ſugar; 1,957,618 lbs. coffee; 35,154 lbs. cotton; 29,181 lbs. indigo. The duties on exportation of the above amounted to 9,407 dollars 60 cents. It is 30 leagues north of St Mark, 17 E. by N. of the Mole, and 19½ weſtward of Cape Francois. N. lat. 19 54, W. long. from Paris 75 12.—*ib.*

PORT DE LA CHAUDIERE, on the S. coaſt of the iſland of St Domingo, lies at the eaſtern entrance of the Bay of Ocoa, which is 18 leagues W. by S. of the city of St Domingo. This port is large, open, and deep enough to admit veſſels of any burden.—*ib.*

PORT DESIRE, a harbour on the E. coaſt of Patagonia, S. America, where veſſels ſometimes touch in their paſſage to the South Sea. It is about 150 miles N. E. of Port St Julian. S. lat. 47 6, W. long. 64 24.—*ib.*

PORT DU PRINCE, a town on the northern coaſt of the iſland of Cuba, having a good harbour. The town ſtands in a large meadow, where the Spaniards feed numerous herds of cattle.—*ib.*

PORT EGMONT, on the N. coaſt of one of the Falkland Iſles, and towards the W. end of that coaſt. It is one of the moſt extenſive and commodious harbours in the world; ſo that it has been aſſerted that the whole navy of Great-Britain might ride ſecurely in it. Commodore Byron diſcovered this excellent harbour in 1775, on being ſent to take poſſeſſion of the Iſlands for the Britiſh government.—*ib.*

PORTER, a lake of Nova-Scotia, which empties itſelf into the ocean, 5 leagues eaſtward of Halifax. It is 15 miles in length, and half a mile in width, with iſlands in it.—*ib.*

PORTERFIELD, a ſmall ſettlement in York county, Diſtrict of Maine.—*ib.*

PORTERO, a river of Peru, which empties into the ſea at the city of Baldivia.—*ib.*

PORT JULIAN, or *Port St Julian*, a harbour on the E. coaſt of Patagonia, in S. America, 150 miles S. by W. of Port Deſire. It has a free and open entrance, and ſalt is found near it. The continent is not above 100 leagues broad here. Beſides ſalt ponds, here are plenty of wild cattle, horſes, Peruvian ſheep, and wild dogs, but the water is bad. S. lat. 49 10, W. long. 68 44.—*ib.*

PORTLAND, a poſt-town and port of entry, in Cumberland county, Diſtrict of Maine. It is the capital of the diſtrict, and is ſituated on a promontory in Caſco Bay, and was formerly a part of Falmouth. It is 50 miles S. by W. of Wiſcaſſet, 123 N. by W. of Boſton, and 469 N. E. of Philadelphia. In July, 1786, this part of the town, being the moſt populous and mercantile, and ſituated on the harbour, together with the iſlands which belong to Falmouth, was incorporated by the name of Portland. It has a moſt excellent, ſafe, and capacious harbour, which is ſeldom or never completely frozen over. It is near the main ocean, and is eaſy of acceſs. The inhabitants carry on a conſiderable foreign trade, build ſhips, and are largely concerned in the fiſhery. It is one of the moſt thriving commercial towns in the Commonwealth of Maſſachuſetts. Although three-fourths of it was laid in aſhes by the Britiſh fleet in 1775, it has ſince been entirely rebuilt, and contains about 2300 inhabitants. Among its public buildings are 3 churches, 2 for Congregationaliſts, and 1 for Epiſcopalians, and a handſome court-houſe. A light houſe was erected in 1790, on a point of land called Portland Head, at the entrance of the harbour. It is a ſtone edifice, 72 feet high, excluſive of the lanthorn, and ſtands in lat. 44 2 N. and long. 69 52 W. The following

following directions are to be obſerved in coming into the harbour. Bring the light to bear N. N. W. then run for it, allowing a ſmall diſtance on the larboard hand; and when abreaſt of the ſame, then run N. by W. This courſe will give good anchorage from half a mile, to a mile and a half. No variation of the compaſs is allowed. The works erected in 1795, for the defence of Portland, conſiſt of a fort, a citadel, a battery for 10 pieces of cannon, an artillery-ſtore, a guard-houſe, an air furnace for heating ſhot, and a covered way from the fort to the battery.—*ib*.

PORTLAND *Head*, in Caſco Bay, in the Diſtrict of Maine, the promontory on which the light-houſe above deſcribed ſtands. From the light-houſe to Alden's Ledge, is 4 leagues S. S. E. High water in Portland harbour, at full and change, 45 minutes after 10 o'clock.—*ib*.

PORTLAND *Point*, on the ſouth coaſt of the Iſland of Jamaica, and the moſt ſoutherly land in it, lies in lat. 17 48 N. and long. 77 42 W.—*ib*.

PORTLOCK'S *Harbour*, on the N. W. coaſt of N. America, has a narrow entrance compared with its circular form within. The middle of the entrance lies in lat. 57 43 30, N. and long. 136 42 30 W.—*ib*.

PORT *Marquis*, a harbour on the coaſt of Mexico, in the North Pacific Ocean, 3 miles eaſtward of Acapulco, where ſhips from Peru frequently land their contraband goods. N. lat. 17 27, W. long. 102 26.—*ib*.

PORTO *Bello*, a ſea-port town of S. America, having a good harbour on the northern ſide of the Iſthmus of Darien, in the province of Terra Firma Proper, nearly oppoſite to Panama on the ſouthern ſide of the iſthmus. It is ſituated cloſe to the ſea, on the declivity of a mountain which ſurrounds the whole harbour. It abounds with reptiles in the rainy ſeaſon, and at all times is very unhealthy; and is chiefly inhabited by people of colour, and negroes. It was taken by Admiral Vernon in 1742, who demoliſhed the fortifications. But it is now ſtrongly fortified. N. lat. 9 34 35, W. long. 81 52.—*ib*.

PORTO *Caballo*, a maritime town of the Caraccas, in Terra Firma, S. America, 6 leagues from Leon; chiefly inhabited by fiſhermen, ſailors, and factors.—*ib*.

PORTO *Cavallo*, a ſea-port town of S. America, in Terra Firma, and on the coaſt of the Caraccas. The Britiſh loſt a great many men here, in an unſuccefsful attack by ſea and land, in 1743. N. lat. 10 20, W. long. 64 30.—*ib*.

PORTO *del Principe*, a ſea port on the north coaſt of the iſland of Cuba, 300 miles S. E. of the Havannah, and 186 N. W. of Baracoa. It was formerly a large and rich town, but being taken by Capt. Morgan, with his buccaneers, after a ſtout reſiſtance, it never recovered itſelf. Near it are ſeveral ſprings of bitumen.—*ib*.

PORTO RICO, one of the Antille Iſlands, in the Weſt-Indies, belonging to the Spaniards, about 100 miles long, and 40 broad, and contains about 3,200 ſquare miles. It is 20 leagues E. S. E. of the iſland of St Domingo. The lands are beautifully diverſified with woods, valleys, and plains, and are very fruitful; yielding the ſame produce as the other iſlands. The iſland is well watered by ſprings and rivers, but is unhealthy in the rainy ſeaſons. Gold, which firſt induced the Spaniards to ſettle here, is no longer found in any conſiderable quantity. In 1778, this Iſland contained 80,660 inhabitants, of which, only 6,530 were ſlaves. There were then reckoned upon the iſland, 77,384 head of horned cattle; 23,195 horſes; 1,515 mules; 49,058 head of ſmall cattle; 5,861 plantations, yielding 2,737 quintals of ſugar; 1,163 quintals of cotton; 19,556 quintals of rice; 15,216 quintals of maize; 7,458 quintals of tobacco, and 9,860 quintals of molaſſes.—*ib*.

PORTO *Rico*, or *St Juan de Porto Rico*, the capital town of the iſland of that name, above deſcribed, ſtands on a ſmall iſland, on the north ſide of the iſland of Porto Rico, to which it is joined by a cauſeway, extending acroſs the harbour, which is very ſpacious, and where the largeſt veſſels may lie in the utmoſt ſecurity. It is large and well built, and is the ſee of a biſhop; and the forts and batteries are ſo well ſituated and ſtrong, as to render it almoſt inacceſſible to an enemy. It was, however, taken by Sir Francis Drake, and afterwards by the earl of Cumberland. It is better inhabited than moſt of the Spaniſh towns, being the centre of the contraband trade carried on by the Britiſh and French, with the king of Spain's ſubjects. In 1615, the Dutch took and plundered this city; but could not retain it. N. lat. 18 20, W. long 65 35.—*ib*.

PORTO *Santo*, an iſland on the coaſt of Peru, a league W. N. W. of the port and city of Santo or Santa, nearly oppoſite to the port of Ferol, a league diſtant northerly, and 9 N. W. of Guanape Iſland.—*ib*.

PORTO *Santo*, a port ſituated in the mouth of the river of its name, on the coaſt of Peru, N. N. E. of point Ferol, and 6 leagues S. E. of Cape de Chao or Chau, and in lat. 8 47 S.—*ib*.

PORTO *Seguro*, a captainſhip on the coaſt of Brazil, in S. America, bounded E. by the government of Rio dos Hilois: N. by the South Atlantic Ocean; S. by Spiritu Santo, and weſt by the country of the Tupick Indians. The country is very fertile.—*ib*.

PORTO *Seguro*, the capital of the above captainſhip, is ſeated on the top of a rock, at the mouth of a river on the ſea-coaſt, and inhabited by Portugueſe. S. lat. 17, W. long. 38 50.—*ib*.

PORT *Penn*, a town of Newcaſtle county, Delaware, on the weſt ſhore of Delaware river, and ſeparated from Reedy Iſland on the eaſt by a narrow channel. It contains about 30 or 40 houſes, and lies 50 miles below Philadelphia.—*ib*.

PORT *Royal*, an iſland on the coaſt of South Carolina, is ſeparated from the main land on the weſt by Broad river. It conſiſts of about 1,000 acres of excellent land; and on it ſtands the town of Beaufort. It has an excellent harbour, ſufficient to contain the largeſt fleet in the world. It is 6 leagues N. E. ¼ E. of Tybee light-houſe, at the mouth of Savannah river. N. lat. 32 12, W. long. 80 54. At *Port Royal Entrance* it is high water at full and change a quarter paſt 8 o'clock.—*ib*.

PORT *Royal*, a poſt town of Virginia, ſeated on the ſouth bank of Rappahannock river, in Caroline county. It is laid out on a regular plan, and contains about 200 houſes which make a handſome appearance, being built of brick. Here are 3 churches, viz. for Epiſcopalians, Preſbyterians and Methodiſts. It is 22 miles ſouth-eaſt of Fredericksburg, 58 above Urbanna, and 230 ſouth-weſt of Philadelphia. N. lat. 38 13, W. long. 77 34.—*ib*.

PORT *Royal*, on the S. ſide of the iſland of Jamaica, formerly called *Puerta de Cagnaya*, once a place of the greateſt wealth and importance in the Weſt-Indies, is now reduced by repeated calamities to 3 ſtreets, a few lanes, and about 200 houſes. It contains, however, the royal navy-yard, for heaving down, and refitting the king's ſhips; the naval hoſpital, and barracks for a regiment of ſoldiers. The fortifications are kept in excellent order, and vie in ſtrength, it is ſaid, with any fortreſs in the Britiſh dominions. The excellence of the harbour, and its ſituation, were ſo alluring, that it was not until the town had been 3 times entirely deſtroyed, (firſt by a terrible earthquake, the 9th of June 1692; then by a great fire, 10 years after, and laſtly, by a hurricane in 1782, the moſt terrible on record) that the inhabitants could be prevailed upon, to relinquiſh this ill-fated ſpot. After this laſt calamity, they reſolved to remove to the oppoſite ſide of the Bay, where they built *Kingston*, now the capital of the iſland. In the harbour of Port Royal, veſſels of 700 tons can lie cloſe along ſhore. N. lat. 18, W. long. 76 45.—*ib.*

Port *Royal*, a town and harbour in the iſland of Martinico, in the Weſt-Indies; which, with St Peter's, are the chief places of the iſland. N. lat. 14 36, W. long. 61 9.—*ib.*

Port *Royal*, an iſland and harbour in the ſouth-weſt part of the Gulf of Mexico, at the bottom of the bay of Campeachy. The harbour is 18 leagues S. W. by S. of Champetan; and the iſland, 3 miles long and 1 broad, lies weſt of the harbour.—*ib.*

Port *St John*, a ſmall town in the province of Nicaragua, in New-Spain, at the mouth of a river on the N. Pacific Ocean. The harbour is ſafe and capacious, and is the ſea-port of the city of Leon, 30 miles to the S. E. N. lat. 12 10, W. long. 87 38.—*ib.*

PORTSMOUTH, the metropolis of New-Hampſhire, and the largeſt town in the State, and its only ſeaport, is ſituated about two miles from the ſea, on the ſouth ſide of Piſcataqua river. It is the ſhire town of Rockingham county, and its harbour is one of the fineſt on the continent, having a ſufficient depth of water for veſſels of any burden. It is defended againſt ſtorms by the adjacent land, in ſuch a manner, as that ſhips may ſecurely ride there in any ſeaſon of the year; nor is it ever frozen by reaſon of the ſtrength of the current, and narrowneſs of the channel. Beſides, the harbour is ſo well fortified by nature, that very little art will be neceſſary to render it impregnable. Its vicinity to the ſea renders it very convenient for naval trade. A light-houſe, with a ſingle light, ſtands on Newcaſtle Iſland, at the entrance of the harbour, in lat. 43 5 north, and long. 70 41 weſt. Ships of war have been built here; among others, the America, of 74 guns, launched November, 1782, and preſented to the king of France, by the Congreſs of the United States. Portſmouth contains about 640 dwelling-houſes and nearly as many other buildings, beſides thoſe for public uſes, which are 3 Congregational churches, 1 Epiſcopal church, 1 for Univerſaliſts, a State-houſe, a market-houſe, 4 ſchool-houſes, a work-houſe, and a bank. The exports for one year ending Sept. 30, 1794, amounted to the value of 153,865 dollars. A ſettlement was begun here in 1623, by Captain Maſon and other merchants, among whom Sir F. Georges had a ſhare. They deſigned to carry on the fiſhery, to make ſalt, trade with the natives, and prepare lumber. As agriculture was only a ſecondary object, the ſettlement failed. The town was incorporated in 1633. It is 10 miles ſouth-weſterly of York in the diſtrict of Maine, 22 northerly of Newbury-Port, 65 N. N. E. of Boſton, and 411 N. E. by N. of Philadelphia.—*ib.*

Portsmouth, a townſhip of good land on the N. end of Rhode-Iſland, Newport county, containing 1560 inhabitants, including 17 ſlaves; on the road from Newport to Briſtol.—*ib.*

Portsmouth, a ſmall ſea-port town of N. Carolina, in Carteret county, on the N. end of Core Bank, near Ocrecock Inlet. Its chief inhabitants are fiſhermen and pilots.—*ib.*

Portsmouth, a pleaſant, flouriſhing, and regularly built town in Norfolk county, Virginia; ſituated on the weſt ſide of Elizabeth river, oppoſite to and a mile diſtant from Norfolk; both which conſtitute but one port of entry. It contains about 300 houſes, and 1702 inhabitants, including 616 ſlaves. It is 111 miles E. by S. of Peterſburg, and 390 ſoutherly of Philadelphia.—*ib.*

Portsmouth, a town on the N. W. ſide of the iſland of Dominica, in the Weſt-Indies; ſituated on Prince Rupert's Bay, between the ſalt-works and the coaſt.—*ib.*

Port *Tobacco*, a poſt-town of Maryland, and capital of Charles county, ſituated a little above the confluence of two ſmall ſtreams which form the creek of its name, which empties through the N. bank of the Patowmac at Thomas's Point, about 4 miles below the town. It contains about 80 houſes, and a large Epiſcopal church, not in good repair, and a ware-houſe for the inſpection of tobacco. In the vicinity are the celebrated cold waters of Mount Miſery. It is 52 miles S. W. of Annapolis, 9 from Allen's Freſh, 83 S. S. W. of Baltimore, and 194 S. W. by S. of Philadelphia.—*ib.*

POSITION, Centre or, is a point of any body, or ſyſtem of bodies, ſo ſelected, that we can eſtimate with propriety the ſituation and motion of the body or ſyſtem by the ſituation and motion of this point. It is very plain that, in all our attempts to accurate diſcuſſion of mechanical queſtions, eſpecially in the preſent extended ſenſe of the word *mechaniſm*, ſuch a ſelection is neceſſary. Even in common converſation, we frequently find it neceſſary to aſcertain the diſtance of objects with a certain preciſion, and we then perceive that we muſt make ſome ſuch ſelection. We conceive the diſtance to be mentioned, neither with reſpect to the neareſt nor the remoteſt point of the object, but as a ſort of average diſtance; and we conceive the point ſo aſcertained to be ſomewhere about the middle of the object. The more we reflect on this, we find it the more neceſſary to attend to many circumſtances which we had overlooked. Were it the queſtion, to decide in what preciſe part of a country pariſh the church ſhould be placed, we find that the geometrical middle is not always the moſt proper. We muſt conſider the populouſneſs of the different quarters of the pariſh, and ſelect a point ſuch, that the diſtances of the inhabitants on each ſide, in every direction, ſhall be as equally balanced as poſſible.

In mechanical diſcuſſions, the point by whoſe poſition and diſtance we eſtimate the poſition and diſtance of the whole, muſt be ſo ſelected, that its poſition and diſtance, eſtimated in any direction whatever, ſhall be the average of the poſitions and diſtances of every particle of the aſſemblage, eſtimated in that direction.

This will be the caſe, if the point be ſo ſelected that, when a plane is made to paſs through it *in any direction whatever*, and perpendiculars are drawn to this plane from every particle in the body or ſyſtem, the ſum of all the perpendiculars on one ſide of this plane is equal to the ſum of all the perpendiculars on the other ſide. If there be ſuch a point in a body, the poſition and motion of this point is the average of the poſitions and motions of all the particles.

Plate XL. For if P (fig. 1.) be a point ſo ſituated, and if QR be a plane (perpendicular to the paper) at any diſtance from it, the diſtance P*p* of the point from this plane is the average of the diſtances of all the particles from it. For let the plane APB be paſſed through P, parallel to QR. The diſtance CS of any particle C from the plane QR is equal to DS—DC, or to P*p*—DC. And the diſtance GT of any particle G, lying on the other ſide of APB, is equal to HT+GH, or to P*p*+GH. Let *n* be the number of particles on that ſide of AB which is neareſt to QR, and let *o* be the number of thoſe on the remote ſide of AB, and let *m* be the number of particles in the whole body, and therefore equal to $n+o$. It is evident that the ſum of the diſtances of all the particles, ſuch as C, is *n* times P*p*, after deducting all the diſtances, ſuch as DC. Alſo the ſum of all the diſtances of the particles, ſuch as G, is *o* times P*p*, together with the ſum of all the diſtances, ſuch as GH. Therefore the ſum of both ſets is $\overline{n+o} \times Pp$ + ſum of GH — ſum of DC, or $m \times Pp$ + ſum of GH — ſum of DC. But the ſum of GH, wanting the ſum of DC, is nothing, by the ſuppoſed property of the point P. Therefore $m \times Pp$ is the ſum of all the diſtances, and P*p* is the *m*th part of this ſum, or the average diſtance.

Now ſuppoſe that the body has changed both its place and its poſition with reſpect to the plane QR, and that P (fig. 2.) is ſtill the ſame point of the body, and $\pi P \varpi$ a plane parallel to QR. Make $p\pi$ equal to *p*P of fig. 1. It is plain that P*p* is ſtill the average diſtance, and that $m \times Pp$ is the ſum of all the preſent diſtances of the particles from QR, and that $m \times \pi p$ is the ſum of all the former diſtances. Therefore $m \times P\pi$ is the ſum of all the changes of diſtance, or the whole quantity of motion eſtimated in the direction πP. Pπ is the *m*th part of this ſum, and is therefore the average motion in this direction. The point P has therefore been properly ſelected; and its poſition, and diſtance, and motion, in reſpect of any plane, is a proper repreſentation of the ſituation and motion of the whole.

It follows from the preceding diſcuſſion, that if any particle C (fig. 1.) moves from C to N, in the line CS, the centre of the whole will be transferred from P to Q, ſo that PQ is the *m*th part of CN; for the ſum of all the diſtances has been diminiſhed by the quantity CN, and therefore the average diſtance muſt be diminiſhed by the *m*th part of CN, or PQ is $= \frac{CN}{m}$.

But it may be doubted whether there is in every body a point, and but one point, ſuch that if a plane paſs through it, *in any direction whatever*, the ſum of all the diſtances of the particles on one ſide of this plane is equal to the ſum of all the diſtances on the other.

It is eaſy to ſhew that ſuch a point may be found, with reſpect to a plane parallel to QR. For if the ſum of all the diſtances DC exceed the ſum of all the diſtances GH, we have only to paſs the plane AB a little nearer to QR, but ſtill parallel to it. This will diminiſh the ſum of the lines DC, and increaſe the ſum of the lines GH. We may do this till the ſums are equal.

In like manner we can do this with reſpect to a plane LM (alſo perpendicular to the paper), perpendicular to the plane AB. The point wanted is ſomewhere in the plane AB, and ſomewhere in the plane LM. Therefore it is ſomewhere in the line in which theſe two planes interſect each other. This line paſſes through the point P of the paper where the two lines AB and LM cut each other. Theſe two lines repreſent planes, but are, in fact, only the interſection of thoſe planes with the plane of the paper. Part of the body muſt be conceived as being above the paper, and part of it behind or below the paper. The plane of the paper therefore divides the body into two parts. It may be ſo ſituated, therefore, that the ſum of all the diſtances from it to the particles lying above it ſhall be equal to the ſum of all the diſtances of thoſe which are below it. Therefore the ſituation of the point P is now determined, namely, at the common interſection of three planes perpendicular to each other. It is evident that this point alone can have the condition required in reſpect of theſe three planes.

But it ſtill remains to be determined whether the ſame condition will hold true for the point thus found, in reſpect to *any other* plane paſſing through it; that is, whether the ſum of all the perpendiculars on one ſide of *this fourth* plane is equal to the ſum of all the perpendiculars on the other ſide. Therefore

Let AGHB (fig. 3.), AXYB, and CDFE, be three planes interſecting each other perpendicularly in the point C; and let CIKL be any other plane, interſecting the firſt in the line CI, and the ſecond in the line CL. Let P be any particle of matter in the body or ſyſtem. Draw PM, PO, PR, perpendicular to the firſt three planes reſpectively, and let PR, when produced, meet the oblique plane in V; draw MN, ON, perpendicular to CB. They will meet in one point N. Then PMNO is a rectangular parallelogram. Alſo draw MQ perpendicular to CE, and therefore parallel to AB, and meeting CI in S. Draw SV; alſo draw ST perpendicular to VP. It is evident that SV is parallel to CL, and that STRQ and STPM are rectangles.

All the perpendiculars, ſuch as PR, on one ſide of the plane CDFE, being equal to all thoſe on the other ſide, they may be conſidered as compenſating each other; the one being conſidered as poſitive or additive quantities, the other are negative or ſubtractive. There is no difference between their ſums, and the ſum of both ſets may be called 0 or nothing. The ſame muſt be affirmed of all the perpendiculars PM, and of all the perpendiculars PO.

Every line, ſuch as RT, or its equal QS, is in a certain invariable ratio to its correſponding QC, or its equal PO. Therefore the poſitive lines RT are compenſated by the negative, and the ſum total is nothing.

Every line, ſuch as TV, is in a certain invariable ratio to its correſponding ST, or its equal PM, and therefore their ſum total is nothing.

Therefore the ſum of all the lines PV is nothing; but each

each is in an invariable ratio to a correſponding perpendicular from P on the oblique plane CIKL. Therefore the ſum of all the poſitive perpendiculars on this plane is equal to the ſum of all the negative perpendiculars, and the propoſition is demonſtrated, *viz.* that in every body, or ſyſtem of bodies, there is a point ſuch, that if a plane be paſſed through it *in any direction whatever*, the ſum of all the perpendiculars on one ſide of the plane is equal to the ſum of all the perpendiculars on the other ſide.

The point P, thus ſelected, may, with great propriety, be called the CENTRE OF POSITION of the body or ſyſtem.

If A and B (fig. 4) be the centres of poſition of two bodies, whoſe quantities of matter (or numbers of equal particles) are *a* and *b*, the centre C lies in the ſtraight line joining A and B, and $AC : CB = b : a$, or its diſtance from the centres of each are inverſely as their quantities of matter. For let $\alpha C \beta$ be any plane paſſing through C. Draw $A\alpha$ $B\beta$, perpendicular to this plane. Then we have $a \times A\alpha = b \times B\beta$, and $A\alpha : B\beta = b : a$, and, by ſimilarity of triangles, $CA : CB = b : a$.

If a third body D, whoſe quantity of matter is *d*, be added, the common centre of poſition E of the three bodies is in the ſtraight line DC, joining the centre D of the third body with the centre C of the other two, and $DE : EC = a + b : d$. For, paſſing the plane $\delta E \kappa$ through E, and drawing the perpendiculars $D\delta$, $C\kappa$, the ſum of the perpendiculars from D is $d \times D\delta$; and the ſum of the perpendiculars from A and B is $\overline{a+b} \times C\kappa$, and we have $d \times D\delta = \overline{a+b} \times C\kappa$; and therefore $DE : EC = a + b : d$.

In like manner, if a fourth body be added, the common centre is in the line joining the fourth with the centre of the other three, and its diſtance from this centre and from the fourth is inverſely as the quantities of matter: and ſo on for any number of bodies.

If all the particles of any ſyſtem be moving uniformly, in ſtraight lines, in any directions, and with any velocities whatever, the centre of the ſyſtem is either moving uniformly in a ſtraight line, or is at reſt.

For, let *m* be the number of particles in the ſyſtem. Suppoſe any particle to move uniformly in any direction. It is evident from the reaſoning in a former paragraph, that the motion of the common centre is the *m*th part of this motion, and is in the ſame direction. The ſame muſt be ſaid of every particle. Therefore the motion of the centre is the motion which is compounded of the *m*th part of the motion of each particle. And becauſe each of theſe was ſuppoſed to be uniform and rectilineal, the motion compounded of them all is alſo uniform and rectilineal; or it may happen that they will ſo compenſate each other that there will be no diagonal, and the common centre will remain at reſt.

Cor. 1. If the centres of any number of bodies move uniformly in ſtraight lines, whatever may have been the motions of each particle of each body, by rotation or otherwiſe, the motion of the common centre will be uniform and rectilineal.

Cor. 2. The quantity of motion of ſuch a ſyſtem is the ſum of the quantities of motion of each body, reduced to the direction of the centre's motion. And it is had by multiplying the quantity of matter in the ſyſtem by the velocity of the centre.

The velocity of the centre is had by reducing the motion of each particle to the direction of the centre's motion and then dividing the ſum of thoſe reduced motions by the quantity of matter in the ſyſtem.

By the ſelection of this point, we render the inveſtigation of the motions and actions of bodies incomparably more ſimple and eaſy, freeing our diſcuſſions from numberleſs intricate complications of motion, which would frequently make our progreſs almoſt impoſſible.

POSITION, in arithmetic, called alſo *Falſe Poſition*, or *Suppoſition*, or *Rule of Falſe*, is a rule ſo called, becauſe it conſiſts in calculating by falſe numbers ſuppoſed or taken at random, according to the proceſs deſcribed in any queſtion or problem propoſed, as if they were the true numbers, and then from the reſults, compared with that given in the queſtion, the true numbers are found.

Thus, take or aſſume any number at pleaſure for the number ſought, and proceed with it as if it were the true number, that is, perform the ſame operations with it as, in the queſtion, are deſcribed to be performed with the number required: then if the reſult of thoſe operations be the ſame with that mentioned or given in the queſtion, the ſuppoſed number is the ſame as the true one that was required; but if it be not, make this proportion, *viz.* as your reſult is to that in the queſtion, ſo is your ſuppoſed falſe number to the true one required.

Example. What number is that, to which if we add $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, and $\frac{1}{6}$ of itſelf, the ſum will be 240?

Suppoſe 99

$49.5 = \frac{1}{2}$
$33. = \frac{1}{3}$
$24.75 = \frac{1}{4}$
$16.5 = \frac{1}{6}$
$222.75 =$ reſult

Then, as $222.75 : 240 :: 99 : 106.6 =$ Anſwer.

$53.\dot{3} = \frac{1}{2}$
$33.\dot{5} = \frac{1}{3}$
$29.\dot{6} = \frac{1}{4}$
$17.\dot{7} = \frac{1}{6}$
$240. =$ proof.

This is *ſingle* poſition.

Sometimes it is neceſſary to make two different ſuppoſitions or aſſumptions, when the ſame operations muſt be performed with each as in the ſingle rule. If neither of the ſuppoſed numbers ſolve the queſtion, find the differences between the reſults and the given number; multiply each of theſe differences into the other's poſition; and if the errors in both ſuppoſitions be of the ſame kind, *i. e.* if both ſuppoſitions be either leſs or greater than the given number, divide the differences of the products by the differences of the errors. If the errors be not of the ſame kind, *i. e.* if the one be greater and the other leſs than the given number, divide the ſum of the products by the ſum of the errors. The quotient, in either caſe, will be the anſwer.

Example. Three partners, A, B, and C, bought a ſugar-work which coſt them L.2000; of which A, paid a certain ſum unknown; B paid as much as A, and

L. 50 over ; C paid as much as them both, and L. 25 over : What ſum did each pay ?

```
        (1.) Suppoſe A paid L. 500
                          B —— 550
                          C —— 1075
                               ————
                               2125
                               2000
                               ————
                               125 = error of exceſs.
    (2.) Suppoſe A paid L.     400
                          B —— 450
125  = exceſs.            C —— 875
                               ————
  400 = 2d poſition.           1725
————                           2000
50000                          ————
                               275  = error of defect.
                                 500 = 1ſt poſition.
                               ————
        1ſt error, 125         137500
        2d  ——     275         50000
                   ———         ————
                   400        )187500
                               ————
                  ⎧ 468.75 = ſum paid by A.
        Anſwers.  ⎨ 518.75 = ———— B.
                  ⎩ 1012 5 = ———— C.
                               ————
                               2000... = proof.
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This is called double poſition.

POTATOE, a bay ſo named, on the S. coaſt of the iſland of St Chriſtopher's Iſland, in the Weſt-Indies.—*Morse.*

POTOSI, a town of Peru ſituated in the archbiſhopric of Plata and province of Los Charcos, 75 miles S. E. of the city of La Plata. The famous mountain of this name is known all over the commercial world, for the immenſe quantities of ſilver it has produced. The mines in its vicinity are now much exhauſted, although ſtill very rich ; and the town, which once contained 90,000 inhabitants, Spaniards and Indians, (of which the latter compoſed above four-fifths) does not now contain above 25,000. The principal mines are in the northern part of the mountain, and their direction is from N. to S. The moſt intelligent people of Peru have obſerved that this is the general direction of the richeſt mines. The fields round Potoſi are cold, barren, and bear little elſe than oats, which ſeldom ripen, but are cut up and given for forage in the blade; and proviſions are brought here from the neighbouring provinces. It is 300 miles S. E. of Arica, lat. 21 S. and long. 77 W.—*ib.*

POTTERS, a townſhip of Pennſylvania, ſituated on Suſquehannah river.—*ib.*

POTTERSTOWN, in Hunterdon county, New Jerſey, is about 5 miles E. of Lebanon, and about 22 N. W. of New Brunſwick.—*ib.*

POTTERY is an art of very conſiderable importance; and in addition to what has been ſaid on it in the *Encyclopædia*, the following reflections, by that eminent chemiſt Vauquelin, will probably be acceptable to many of our readers.

Four things (ſays he) may occaſion difference in the qualities of earthen-ware : 1*ſt*, The nature or compoſition of the matter ; 2*d*, The mode of preparation ; 3*d*, The dimenſions given to the veſſels ; 4*th*, The baking to which they are ſubjected. By compoſition of the matter, the author underſtands the nature and proportions of the elements of which it is formed. Theſe elements, in the greater part of earthen ware, either valuable or common, are ſilex, argil, lime, and ſometimes a little oxyd of iron. Hence it is evident that it is not ſo much by the diverſity of the elements that good earthen-ware differs from bad, as by the proportion in which they are united. Silex or quartz makes always two-thirds at leaſt of earthen-ware ; argil or pure clay, from a fifth to a third ; lime, from 5 to 20 parts in the hundred ; and iron from 0 to 12 or 15 parts in the hundred. Silex gives hardneſs, infuſibility, and unalterability ; argil makes the paſte pliable, and renders it fit to be kneaded, moulded and turned at pleaſure. It poſſeſſes at the ſame time the property of being partially fuſed by the heat which unites its parts with thoſe of the ſilex ; but it muſt not be too abundant, as it would render the earthen-ware too fuſible and too brittle to be uſed over the fire.

Hitherto it has not been proved by experience that lime is neceſſary in the compoſition of pottery : and if traces of it are conſtantly found in that ſubſtance, it is becauſe it is always mixed with the other earths, from which the waſhings and other manipulations have not been able to ſeparate it. When this earth, however, does not exceed five or ſix parts in a hundred, it appears that it is not hurtful to the quality of the pottery ; but if more abundant, it renders it too fuſible.

The oxyd of iron, beſides the inconvenience of communicating a red or brown colour, according to the degree of baking, to the veſſels in which it forms a part, has the property of rendering them fuſible, and even in a greater degree than lime.

As ſome kinds of pottery are deſtined to melt very penetrating ſubſtances, ſuch as ſalts, metallic oxyds, glaſs, &c. they require a fine kind of paſte, which is obtained only by reducing the earths employed to very minute particles. Others deſtined for melting metals and ſubſtances not very penetrating, and which muſt be able to ſupport, without breaking, a ſudden tranſition from great heat to great cold, require for their fabrication a mixture of calcined argil with raw argil. By theſe means you obtain pottery, the coarſe paſte of which reſembles *breche*, or ſmall-grained pudding-ſtone, and which can endure ſudden changes of temperature.

The baking of pottery is alſo an object of great importance. The heat muſt be capable of expelling humidity, and agglutinating the parts which enter into the compoſition of the paſte, but not ſtrong enough to produce fuſion ; which, if too far advanced, gives to pottery a homogeneouſneſs that renders it brittle. The ſame effect takes place in regard to the fine pottery, becauſe the very minute diviſion given to the earths reduces them nearly to the ſame ſtate as if this matter had been fuſed. This is the reaſon why porcelain ſtrongly baked is more or leſs brittle, and cannot eaſily endure alternations of temperature. Hence coarſe porcelain, in the compoſition of which a certain quantity of calcined argil is employed, porcelain retorts, crucibles, tubes, and common pottery, the paſte of which is coarſe, are much leſs brittle than diſhes and ſaucers formed of the ſame ſubſtance, ground with more labour.

The general and reſpective dimenſions of the different parts of veſſels of earthen-ware have alſo conſiderable influence on their capability to ſtand the fire.

In ſome caſes the glazing or covering, eſpecially when too thick, and of a nature different from the body of the pottery, alſo renders them liable to break. Thus in making ſome kinds of pottery, it is always eſſential, *1ſt*, To follow the beſt proportion in the principles; *2d*, To give to the particles of the paſte, by grinding, a minuteneſs ſuited to the purpoſe for which it is intended, and to all the parts the ſame dimenſions as far as poſſible; *3d*, To carry the baking to the higheſt degree that the matter can bear without being fuſed; *4th*, To apply the glazing in thin layers, the fuſibility of which ought to approach as near as poſſible to that of the matter, in order that it may be more intimately united.

C. Vauquelin, being perſuaded that the quality of good pottery depends chiefly on uſing proper proportions of the earthy matters, thought it might be of importance, to thoſe engaged in this branch of manufacture, to make known the analyſis of different natural clays employed for this purpoſe, and of pottery produced by ſome of them, in order that, when a new earth is diſcovered, it may be known by a ſimple analyſis whether it will be proper for the ſame object, and to what kind of pottery already known it bears the greateſt reſemblance.

	Heſſian Crucibles.	Argil of Dieux.	Porcelain Capſules.	Wedgewood's Pyrometers.
Silex	69	43·5	61	64·2
Argil	21·5	33·2	28	25
Lime	1	3·5	6	6
Oxyd of iron	8	1	0·5	0·2
Water		18	...	6·2

Raw kaolin 100 parts.—Silex 74, argil 16·5, lime 2, water 7. A hundred parts of this earth gave eight of alum, after being treated with the ſulphuric acid.

Waſhed kaolin 100 parts.—Silex 55, argil 27, lime 2, iron 0·5, water 14. This kaolin, treated with the ſulphuric acid, gave about 45 or 50 *per cent.* of alum.

Petunzé.—Silex 74, argil 14·5, lime 5·5, loſs 6. A hundred parts of this ſubſtance, treated with the ſulphuric acid, gave ſeven or eight parts of alum. But this quantity does not equal the loſs ſuſtained.

Porcelain of retorts.—Silex 64, argil 28·8, lime 4·55, iron 0·50, loſs 2·77. Treated with the ſulphuric acid, this porcelain gave no alum.

There is a kind of earthen veſſels, called *Alcarrezes*, uſed in Spain for cooling the water intended to be drunk. Theſe veſſels conſiſt of 60 parts of calcareous earth, mixed with alumina and a little oxyd of iron, and 36½ of ſilicious earth, alſo mixed with alumina and the ſame oxyd. The quantity of iron may be eſtimated at almoſt one hundredth part of the whole. This earth is firſt kneaded into a tough paſte, being for that purpoſe previouſly diluted with water; formed into a cake of about ſix inches in thickneſs, and left in that ſtate till it begin to crack. It is then kneaded with the feet, the workmen gradually adding to it a quantity of ſea ſalt, in the proportion of ſeven pounds to a hundred and fifty; after which it is applied to the lath, and baked in any kind of furnace uſed by potters. The alcarrezes, however, are only about half as much baked as the better kinds of common earthen ware; and being exceedingly porous, water oozes through them on all ſides. Hence the air which comes in contact with it by making it evaporate, carries off the caloric contained in the water in the veſſel, which is thus rendered remarkably cool.

POTTSGROVE, a poſt-town of Pennſylvania, ſituated on the N. bank of Schuylkill river, 17 miles S. E. of Reading, and 37 N. W. of Philadelphia.—*Morſe.*

POUGHKEEPSIE, a poſt-town of New York, and capital of Dutcheſs county, delightfully ſituated a mile from the E. bank of Hudſon's river, and contains a number of neat dwellings, a court-houſe, a church for Preſbyterians, one for Epiſcopalians, and an academy. Here is alſo a printing-office. It is about 28 miles N. W. of Danbury, in Connecticut, 84 N. of New York city, 81 S. of Albany, and 180 N. E. by N. of Philadelphia. The townſhip is bounded ſoutherly by Wappinger's Kill, or Creek, and weſterly by Hudſon's river. It contains 2,529 inhabitants, including 429 electors, and 199 ſlaves.—*ib.*

POULES, or Foulques, one of the principal nations which inhabit the banks of the Senegal. They poſſeſs an extent of more than ſixty leagues along the river, and exact heavy cuſtoms from the Senegal traders with the interior of the country. They are not ſo black as the other negroes, but of a copper colour, much inclining to red. It is remarkable, however, that their children who are ſent to Senegal, and reſide there for ſome years, become much blacker. The females are very handſome and the whites of Senegal generally take care to procure ſome of them. But they are of a bad diſpoſition, and utterly incapable of attachment. When a man has a miſtreſs of this nation, he muſt watch her conduct very narrowly, and even chaſtiſe her, that ſhe may not be guilty of infidelity to him whom ſhe honours with her favours. The dread of the baſtinado will, in ſuch caſe, effect what attention and complaiſance can never bring about.

Although the Poules inhabit one of the fineſt ſpots in Africa, they are nevertheleſs a wretched people; they are baſe, cruel, thieviſh, and fanatic in the extreme. They are commanded by a chief of their religion, which is a contemptible mixture of Mahometaniſm and idolatry. This chief is called the *Almamy*; he is always choſen from among the Tampſirs, who are twelve in number. The Tampſirs are the interpreters of the law, and are the moſt learned or rather the moſt fanatical among them. The Almamy has the power of life and death over his ſubjects; yet he may be depoſed by an aſſembly of Tampſirs: it is therefore his intereſt to keep on good terms with them. The payment of cuſtoms is made to the Almamy, and is afterwards diſtributed among the Tampſirs; and although a part belongs to the former, he nevertheleſs requires a ſeparate preſent for himſelf.

POULTNEY, a ſmall river of Vermont, which falls into Eaſt Bay, together with Caſtleton river, near Col. Lyon's iron works.—*Morſe.*

Poultney, a conſiderable and flouriſhing townſhip in Rutland county, bounded weſterly by Hampton in New York, which adjoins Skeenſborough on the weſt. It contains 1,121 inhabitants.—*ib.*

POUMARON,

POUMARON, or *Pumaron*, a river on the coaſt of Surinam, S. America, whoſe E. point is Cape Naſſau, or Cape Droogе.—*ib.*

POUNDRIDGE, a townſhip in Weſt Cheſter county, New York, bounded ſoutherly by the State of Connecticut, eaſterly and northerly by Salem, and weſterly by Bedford and Mahanus river. It contains 1,062 free inhabitants, of whom 141 are electors.—*ib.*

POWEL's *Creek*, in the State of Tenneſſee, riſes in Powell's Mountain, runs S. weſterly, and enters Clinch river, through its northern bank; 38 miles N. E. of Knoxville. It is ſaid to be navigable in boats 80 miles. —*ib.*

POWHATAN, a county of Virginia, bounded N. by James river, which ſeparates it from Goochland, and ſouth by Amelia county. It has its name in honour of the famous Indian king of its name, the father of Pocahontas. It contains 6,822 inhabitants, including 4,325 ſlaves. The *court-houſe* in the above county is 17 miles from Carterſville, 20 from Cumberland court-houſe, and 310 from Philadelphia.—*ib.*

POWNAL, a flouriſhing townſhip in the ſouth-weſt corner of Vermont, Bennington county, ſouth of the town of Bennington. It contains 1,746 inhabitants. Mount Belcher, a portion of which is within the town of Pownal, ſtands partly in 3 of the States, viz. New York, Vermont, and Maſſachuſetts. Mount Anthony, alſo, one of the moſt remarkable mountains in Vermont, lies between this and Bennington.—*ib.*

POWNALBOROUGH, the ſhire town of Lincoln county, Diſtrict of Maine, is ſituated on the eaſt ſide of Kennebeck river, and is a place of increaſing importance, and contains a Congregational church, and ſeveral handſome dwelling-houſes. The flouriſhing port and poſt-town of Wiſcaſſet is within the townſhip of Pownalborough. This town was incorporated in 1760, and contains in all 2,055 inhabitants. It is 13 miles north of Bath, 50 N. E. of Portland, 171 N. by E. of Boſton, and 525 N. E. of Philadelphia.—*ib.*

POWOW, a ſmall river of Eſſex county, Maſſachuſetts, which riſes in Kingſton in New Hampſhire. In its courſe, which is S. E. it paſſes over ſeveral falls, on which are mills of various kinds, and empties into Merrimack river, 7 miles from the ſea, between the towns of Saliſbury and Ameſbury, connected by a convenient bridge, with a draw, acroſs the river. It is navigable a mile from its mouth, and many veſſels are built on its banks.—*ib.*

POYAIS, a town of N. America, ſituated on the weſt ſide of Black river, in the province of Honduras, about 110 miles W. N. W. of Secklong, and 55 ſouth of Cape Cameron, which forms the north point of the entrance of the river in the Sea of Honduras.—*ib.*

PRAIRIE *de Rocher, la*, or *The Rock Meadows*, a ſettlement in the N. W. Territory, on the eaſt ſide of the Miſſiſſippi; ſituated on the eaſt ſide of a ſtream which empties into the Miſſiſſippi, 12 miles to the ſouth. It is 15 miles N. W. of Kaſkaſkias village, and 5 N. E. by E. of Fort Chartres. About 20 years ago it contained 100 white inhabitants and 80 negroes.—*ib.*

Prairie, *La*, a populous little village, with narrow dirty ſtreets, on the river St Lawrence in Canada, 18 miles north of St John, and 9 ſouth-weſt of Montreal. —*ib.*

PRASLIN, *Port*, is on the N. ſide of the lands of Arſacides, in S. lat. 7 25, E. long. from Paris 155 32; diſcovered and entered by M. de Surville, Oct. 12, 1769. The iſlands which form this port are covered with trees, and at high water are partly overflowed. The artful natives entrapped ſome of Surville's men in an ambuſcade, in conſequence of which 30 or 40 of the ſavages were killed. The inhabitants of theſe iſlands are in general of the negro kind, with black woolly hair, flat noſes, and thick lips.—*ib.*

PRESCOTT, a ſmall plantation in Lincoln county, Diſtrict of Maine, which together with Carr's plantation, has 159 inhabitants.—*ib.*

PRESQUE *Iſle*, a ſmall peninſula, on the ſouth-eaſt ſhore of Lake Erie, almoſt due ſouth of Long Point on the oppoſite ſide of the lake; 15 miles from Fort Beauf, and 60 N. by W. of Venango, on Alleghany river. The garriſon about to be erected by the United States at Preſque Iſle, will be upon a very commanding ſpot, juſt oppoſite the entrance of the bay. The town commences 30 yards weſt of the old Britiſh fort, leaving a vacancy of 600 yards for a military parade and public walk. The town, which is now building, will extend nearly 3 miles along the lake and 1 mile back. It lies in lat. about 42 10 N.—*ib.*

PRESTON, a town in New-London county, Connecticut, 6 or 8 miles eaſt of Norwich, from which it is divided by Shetucket river. The townſhip was incorporated in 1687, and contains 3,455 inhabitants, who are chiefly farmers. Here are two Congregational churches, and a ſociety of Separatiſts.—*ib.*

PRESUMSCUT, a ſmall river of Cumberland county, Diſtrict of Maine, which is fed by Sebacook Lake, and empties into Caſco Bay, eaſt of Portland.—*ib.*

PRINCE EDWARD, a county of Virginia, between the Blue Ridge and the tide-waters. It contains 8,100 inhabitants including 3,986 ſlaves. The academy in this county has been erected into a college by the name of "Hampden Sydney College." The court-houſe, at which a poſt-office is kept, is 28 miles from Cumberland court-houſe, 50 from Lynchburgh, and 358 from Philadelphia.—*ib.*

PRINCE FREDERICK, a pariſh in Georgetown diſtrict, S. Carolina, containing 8,135 inhabitants; of whom 3,418 are whites, and 4,685 ſlaves. It ſends 4 repreſentatives and one ſenator to the State legiſlature. —*ib.*

Prince Frederick, the chief town of Calvert county, Maryland; 3 miles ſoutherly of Huntingtown, and 6 north-eaſterly of Benedict, by the road to Mackall's ferry.—*ib.*

PRINCE GEORGE, a pariſh of Georgetown diſtrict, S. Carolina, containing 11,762 inhabitants; of whom 5,031 are whites, and 6,651 ſlaves. It ſends 5 repreſentatives and one ſenator to the State legiſlature.—*ib.*

Prince George, a county of Virginia, bounded N. by James river, which waſhes it about 35 miles. The medium breadth is 16 miles. It contains 8173 inhabitants, including 4519 ſlaves; of this number 1200 are reſidents in Blandford. There are 5 Epiſcopal churches in the county, one meeting for Friends, and ſeveral Methodiſt meetings. The Baptiſts have occaſional meetings, and to this ſect the negroes ſeem particularly

particularly attached. It is a fruitful country, and abounds with wheat, corn, flax, cotton, and tobacco. Cotton here is an annual plant; and in ſummer, moſt of the inhabitants appear in outer garments of their own manufacture. The timber conſiſts of oaks of various kinds, and of a good quality, ſufficient to build a formidable navy, and within a convenient diſtance of navigation. It has all the different ſpecies known in the eaſtern States, and others which do not grow there. Here is alſo abundance of wild grapes, flowering ſhrubs, ſarſaparilla, ſnake-root, and ginſeng. Apples are inferior in ſpirit and taſte to thoſe in the eaſtern States; but peaches have a flavour unknown in thoſe States. The almond and fig will grow here in the open air, if attended to. Immenſe quantities of pork and bacon are cured here, and indeed form the principal food of the inhabitants. Veal is excellent; mutton indifferent: poultry of every kind in perfection and in abundance. The winters are ſhort and generally pleaſant; and the country cannot be conſidered as unhealthy.—*ib.*

Prince George, a county of Maryland, on the weſtern ſhore of Cheſapeak Bay, ſituated between Patowmac and Patuxent rivers, and is watered by numerous creeks which empty into thoſe rivers. The eaſtern corner of the territory of Columbia, borders upon the weſt part of this county. It contains 21,344 inhabitants, of whom 11,176 are ſlaves.—*ib.*

PRINCE OF WALES, *Cape*, is remarkable for being the moſt weſterly point of the continent of N. America, and the eaſtern limit of Behring's Straits, between Aſia and America; the two continents being here only about 39 miles apart. The mid channel has 28 fathoms water. N. lat. 65 46, W. long. 168 15.—*ib.*

Prince of Wales, *Fort*, in New North Wales, N. America, a factory belonging to the Britiſh Hudſon's Bay Company, on Churchill river. The mean heat here is 18 7

Leaſt heat —45

Greateſt heat 85

It lies in lat. 58 47 30 N. and long. 94 7 30 W.—*ib.*

Prince of Wales *Iſland*, in the S. Pacific Ocean, is about 20 leagues long, and W. 10 S. diſtant 48 leagues from Otaheite, or King George's Iſland. S. lat. 15, and W. long. 151 53 at the W. end. The variation of the needle in 1766, was 5 30 E.—*ib.*

PRINCE RUPERT'S *Bay*, on the N. W. coaſt of the iſland of Dominica, one of the Caribbee Iſlands, where there is excellent ſhelter from the winds. It is deep, capacious and ſandy, and is the principal bay in the iſland. It is of great advantage in time of a war with France, as a fleet may here intercept all their Weſt-India trade. On this bay is ſituated the new town of Portſmouth, N. of which is a cape called Prince Rupert's Head.—*ib.*

PRINCE'S BAY, on the S. ſide of Staten Iſland, in New-York State.—*ib.*

PRINCESS ANNE, a maritime county of Virginia, bounded E. by the Atlantic Ocean, and W. by Norfolk county. It contains 7,793 inhabitants, of whom 3,202 are ſlaves.—*ib.*

Princess Ann, a poſt-town of Maryland, on the eaſtern ſhore of Cheſapeak bay, in Somerſet county, on the E. ſide of Monokin river, 89 miles S. E. of Baltimore, and 178 S. by W. of Philadelphia. It contains about 200 inhabitants.—*ib.*

Princeton.

PRINCETON, a townſhip of Maſſachuſetts, in Worceſter county, 15 miles N. by W. of Worceſter, and 52 W. by N. of Boſton. The townſhip contains 19,000 acres of elevated hilly, but ſtrong, and rich land, adapted to graſs and grain. Excellent beef, butter and cheeſe, are its principal productions. The manſion-houſe and farm of his Honor Lieut. Governor Gill, one of the moſt elegant ſituations, and fineſt farms in the Commonwealth, is in this town and adds much to its ornament and wealth. A handſome Congregational church has lately been erected, on a high hill, and commands a moſt extenſive and rich proſpect of the ſurrounding country. Wachuſett Mountain, the moſt noted in the State, is in the north part of the townſhip. Here, as in many other towns, is a valuable ſocial library. Princetown was incorporated in 1759, and contains 1016 inhabitants.—*ib.*

Princeton, a poſt-town of New Jerſey, ſituated partly in Middleſex, and partly in Somerſet counties. Naſſau Hall College, an inſtitution which has produced a great number of eminent ſcholars, is very pleaſantly ſituated in the compact part of this town. Here are about 80 dwelling houſes and a brick Preſbyterian church. The college edifice is a handſome ſtone building, of 180 feet by 54, four ſtories high, and ſtands on an elevated and healthful ſpot, and commands an extenſive and delightful proſpect. The eſtabliſhment, in 1796, conſiſted of a preſident who is alſo profeſſor of moral philoſophy, theology, natural and revealed; hiſtory, and eloquence; a profeſſor of mathematics, natural philoſophy, and aſtronomy; a profeſſor of chemiſtry, which ſubject is treated in reference to agriculture and manufactures, as well as medicine: beſides theſe, two tutors have the inſtruction of the two loweſt claſſes. The choice of the claſſical books, and the arrangement of the ſeveral branches of education, of the lectures, and of other literary exerciſes, are ſuch, as to give the ſtudents the beſt opportunity for improvement, in the whole Encyclopædia of ſcience. The number of ſtudents is from 70 to 90, beſides the grammar ſchool. The annual income of the college at preſent, by the fees of the ſtudents, and otherwiſe, is about £ 1000 currency a year. It has, beſides, funds in poſſeſſion, through the extraordinary liberality of Mr James Leſlie, of New York, and Mrs Eſther Richards, of Rahway, to the amount of 10,000 dolls. for the education of poor and pious youth for the miniſtry of the goſpel; and the reverſion of an eſtate in Philadelphia for the ſame purpoſe, of between 200 and £ 300 per annum, a legacy of the late Mr Hugh Hodge, a man of eminent piety which is to come to the college at the death of a very worthy and aged widow. The college library was almoſt wholly deſtroyed during the late war; but out of the remains of that, and by the liberal donations of ſeveral gentlemen, chiefly in Scotland, it has collected one of about 2,300 volumes. There are beſides this, in the college, two libraries belonging to the two literary ſocieties, into which the ſtudents have arranged themſelves, of about 1,000 volumes; and the library of the preſident, conſiſting of 1,000 volumes more, is always open to the ſtudents. Before the war, this college was furniſhed with a philoſophical apparatus, worth £ 500, which (except the elegant orrery conſtructed by Mr Rittenhouſe) was almoſt entirely deſtroyed by the Britiſh army in the late war. Princeton

is

Princeton, ‖ Prince William.

is 12 miles N. E. of Trenton, 18 S. W. of Brunſwick, 53 S. W. of New York, and 42 N. E. of Philadelphia. N. lat. 40 22 12, W. long. 74 34 45.—*ib.*

PRINCETON, a ſmall poſt-town of N. Carolina, 3 miles from Murfreeborough, 35 from Halifax, and 419 from Philadelphia —*ib.*

PRINCE WILLIAM, a county of Virginia, bounded W. by Fraquier, and E. by Patowmac river, which divides it from Maryland. It contains 11,615 inhabitants, of whom 4,704 are ſlaves.—*ib.*

PrinceW liam's

PRINCE WILLIAM, a pariſh in Beaufort diſtrict, S. Carolina.—*ib.*

PRINCE WILLIAM'S *Sound*, ſituated on the N. W. coaſt of N. America, lies eaſtward of the mouth of Cook's river. At its mouth are three iſlands, Montague, Roſe, and Kay. It was judged by Captain Cook to occupy a degree and a half of latitude, and two of longitude, excluſively of its arms and branches, which were not explored.—*ib.*

THE completion of the Second Volume of this work having been long ſuſpended on account of an important article which was delayed much longer than was at first expected, it was judged proper to begin the Third Volume with the article PRINTING, *and conſiderable progreſs was made in the printing of the volume before the Second was finiſhed. Some of the original articles extended to a greater length than the room allotted for them. The Second Volume therefore was cloſed with the article* PHILOSOPHIST. *This made it neceſſary to prefix to the Third Volume a ſeries of Forty-eight pages in order to bring forward the ſubjects which preceded the article* PRINTING.

SUPPLEMENT

TO THE

ENCYCLOPÆDIA.

PRINTING, (See that article, *Encycl.* and Typography in this *Supplement.*) We ſhall here only deſcribe a *Printing-Preſs*, for the invention of which a patent was granted, in 1790, to Mr William Nicholſon of New North-ſtreet, Red-Lion Square, London. This machine, with ſome ſlight varieties, is adapted for printing on *paper*, *linen*, *cotton*, *woollen*, and other articles, in a more neat, cheap, and accurate method, the author thinks, than the printing preſſes now in uſe.

The invention conſiſts in three particulars, 1*ſt*, The manner of preparing and placing the types, engravings, or carvings, from which the impreſſion is to be made; 2*dly*, In applying the ink or colouring matter to types or engravings; and, 3*dly*, In taking off the impreſſion.

1*ſt*, Mr. Nicholſon makes his moulds, punches, and matrices, for caſting letters, in the ſame manner, and with the ſame materials, as other letter-founders do, excepting that, inſtead of leaving a ſpace in the mould for the ſtem of one letter only, he leaves ſpaces for two, three, or more letters, to be caſt at one pouring of the metal; and at the lower extremity of each of thoſe ſpaces (which communicate by a common groove at top) he places a matrix, or piece of copper, with the letter punched upon its face in the uſual way. And moreover, he brings the ſtem of his letters to a due form and finiſh, not only by rubbing it upon a ſtone, and ſcraping it when arranged in the finiſhing-ſtick, but likewiſe by ſcraping it, on one or more ſides, in a finiſhing-ſtick whoſe hollowed part is leſs deep at the inner than the outer ſide. He calls that ſide of the groove which is neareſt the face of the diſpoſed letter, the outer ſide; and the purpoſe accompliſhed by this method of ſcraping is, that of rendering the tail of the letter gradually ſmaller the more remote it is, or farther from the face. Such letters may be firmly impoſed upon a cylindrical ſurface, in the ſame manner as common letters are impoſed upon a flat ſtone.

2*dly*, He applies the ink or colouring matter to the types, forms or plates, by cauſing the ſurface of a cylinder, ſmeared or wetted with the colouring matter, to roll over the ſurfaces of the ſaid forms or plates, or by cauſing the forms or plates apply themſelves ſucceſſively to the ſurface of the cylinder. The ſurface of this colouring cylinder is covered with leather, or with woollen, linen, or cotton-cloth. When the colour to be uſed is thin, as in calico-printing, and in almoſt every caſe, the covering is ſupported by a firm elaſtic ſtuffing, conſiſting of hair, or wool, or woollen cloth wrapped one or more folds round the cylinder. When the covering conſiſts of woollen cloth, the ſtuffing muſt be defended by leather, or oilſkin, to prevent its imbibing too much colour, and by that means loſing its elaſticity. It is abſolutely neceſſary that the colouring matter be evenly diſtributed over the ſurface of the cylinder; and for this purpoſe, when the colour is thick and ſtiff, as in letter-preſs printing, he applies two, three, or more ſmall cylinders, called diſtributing-rollers, longitudinally againſt the colouring cylinders, ſo that they may be turned by the motion of the latter; and the effect of this application is, that every lump or maſs of colour which may be redundant, or irregularly placed upon the face of the colouring cylinder, will be preſſed, ſpread, and partly taken up, and carried by the ſmall rollers to the other parts of the colouring cylinder; ſo that this laſt will very ſpeedily acquire and preſerve an even face of colour. But if the colouring matter be thinner, he does not apply more than one or two of theſe diſtributing-rollers; and, if it be very thin, he applies an even blunt edge of metal, or wood, or a ſtraight bruſh, or both of theſe laſt, againſt the colouring cylinder, for the purpoſe of rendering its colour uniform. When he applies colour to an engraved plate, or cylinder, or through the interſtices of a perforated pattern, as in the manufacturing of ſome kinds of paper-hangings, he uſes a cylinder entirely covered with hair or briſtles in the manner of a bruſh.

3*dly*, He performs all his impreſſions, even in letter-preſs printing, by the action of a cylinder or cylindrical ſurface. The conſtruction of this machine, and the manner of uſing it, will be intelligible to every reader, who ſhall attentively conſider Plate XL; where fig. 1. repreſents a printing preſs, more eſpecially applicable to the printing of books. A and E are two cylinders, running or turning in a ſtrong frame of wood, or metal, or both. The cylinder A is faced with woollen cloth, and is capable of being preſſed with more or leſs force upon HI, by means of the lever M. HI is a long table, which is capable of moving endwiſe, backwards and forwards, upon the rollers E and K. The roller A acts upon this table by means of a cog-wheel, or by ſtraps, ſo as to draw it backwards and forwards by the motion of its handle L. The table is kept in the ſame line by grooves on its ſides, which contain the cylinder A. D is a chaſe, containing letter ſet up and impoſed. B is a box, containing a colouring-roller, with its diſtributing-rollers CC; it is ſupported by the arm N. O is a cylinder faced with leather, and lying acroſs an ink-block; this cylinder is fixed by the middle to a bended lever moveable on the joint Q.

The action. When D, or the letter, is drawn beneath the

the cylinder B, it receives ink; and when it has paſſed into the poſition R, a workman places or turns down a tympan with paper upon it (this tympan differs in no reſpect from the uſual one, except that its hinge opens ſidewiſe); it then proceeds to paſs under the cylinder A, which preſſes it ſucceſſively through its whole ſurface. On the other ſide, at S, the workman takes off the paper, and leaves the tympan up. This motion cauſes the cylinder B to revolve continually, and conſequently renders its inked ſurface very uniform, by the action of its diſtributing-rollers CC; and, when the table has paſſed to its extreme diſtance in the direction now ſpoken of, the arm G touches the lever P, and raiſes the cylinder O off the ink-block, by which means it dabs againſt one of the diſtributing-rollers, and gives it a ſmall quantity of ink. The returning motion of the table carries the letter again under the roller B, which again inks it, and the proceſs of printing another ſheet goes on as before.

Fig. 2. is another printing-preſs. In this, B is the inking-roller; A is a cylinder, having the letter impoſed upon its ſurface; and E is a cylinder, having its uniform ſurface covered with woollen cloth: theſe three cylinders are connected, either by cogs or ſtraps at the edges of each. The machine is uniformly turned in one direction by the handle L. The workman applies a ſheet of paper to the ſurface of E, where it is retained, either by points in the uſual manner, or by the apparatus to be deſcribed in treating of fig. 4. The paper paſſes between E and A, and receives an impreſſion; after which the workman takes it off, and applies another ſheet; and in the mean time the letter on the ſurface of A paſſes round againſt the ſurface of B, and receives ink during the rotation of B. The diſtributing-rollers CC do their office as in the machine fig. 1.; and once in every revolution the tail F, affixed to B, raiſes the inking-piece G, ſo as to cauſe it to touch one of the diſtributing-rollers, and ſupply it with ink. In this way therefore the repeated printing of ſheet after ſheet goes on.

Fig. 3. is a printing preſs, more particularly adapted to print cottons, ſilks, paper hangings, or other articles which run of a conſiderable length. A is a cylinder covered with woollen cloth, or other ſoft ſubſtance. The web or piece of cotton, or other goods, is paſſed round this cylinder, from the carrying-roller F to the receiving-rollers GH; which are connected by a piece of linen, woollen, or hair-cloth, in the manner of a jack-towel ſewed round them; the rotation of this towel carries away the printed ſtuff or goods, and depoſits them at I. KL is a moveable box, containing three rollers, which move againſt each other in rotation. The loweſt roller C revolves in a maſs of colour, contained in a trough or veſſel in the bottom part of the box KL; the ſurface of this colour is repreſented by the line MN. The next roller B is ſtuffed and covered as deſcribed in ſection 2. The preſſure of B againſt C prevents the cylinder B from receiving too much colour. D is a cut or carved cylinder, which receives colour, during the rotation, from the roller B, and impreſſes it upon the web as it paſſes round the cylinder A; in this way the conſtant and effectual action of the machine is ſufficiently obvious. It muſt be obſerved, that the cylinders ADB and G are connected together by cog-wheels, ſtraps, or other well known equivalent contrivances; ſo that the handle P drives the whole, without their neceſſarily depending on any adheſion or friction at their ſurfaces. The preſſure of B againſt D is governed by an adjuſtment of the axis of D, whoſe ſockets are capable of a ſmall motion; and the preſſure of D againſt A is governed by the poſition of the whole box KL. When it is required to print more than one colour upon a piece, Mr Nicholſon cauſes it to paſs two or more times through the machine; or, in theſe caſes where the materials are liable to change their dimenſions, he applies, at one and the ſame time, two or more ſuch boxes as KL, with their reſpective cylinders, ſo that the pattern cylinder of each may make its impreſſion upon the web or material to be printed on.

Fig. 4. is a printing-preſs, chiefly of uſe for books and papers. 1, 2, 3, 4, repreſents a long table, with ledges on each ſide; ſo that the two cylinders A and B can run backwards and forwards without any ſide ſhake. In one of theſe ledges is placed a ſtrip or plate of metal cut into teeth, which lock into correſpondent teeth in each cylinder; by which means the two cylinders roll along, without the poſſibility of changing the relative poſitions of their ſurfaces at any determinate part of the table. This may alſo be effected by ſtraps, and may indeed be accompliſhed, with tolerable accuracy, by the mere rolling of the cylinders on the ſmooth or flat ledges without any proviſion. A is the printing-cylinder, covered with woollen cloth, and B is the inking-cylinder, with its diſtributing-rollers. The table may be divided into four compartments, marked with a thicker bounding line than the reſt, and numbered 1, 2, 3, 4. At 1 is placed a ſheet of paper; at 2 is the form or chaſe, containing letter ſet and impoſed; at 3 is an apparatus for receiving the printed ſheet; and 4 is employed in no other uſe than as a place of ſtanding for the carriage E, after it has paſſed through one operation, and when it takes ink at F. Its action is as follows: the carriage is thruſt forward by the workman, and as the roller A paſſes over the ſpace numbered 1, it takes up the ſheet of paper previouſly laid there, while the roller B runs over the form and inks the letter. The ſheet of paper, being wrapped round the cylinder A, is preſſed againſt the form as that cylinder proceeds, and conſequently it receives an impreſſion. When A arrives at the ſpace numbered 3, it lets go the ſheet of paper, while the prominent part of the carriage G ſtrikes the lever P, and raiſes the inking-piece, which applies itſelf againſt one of the diſtributing-rollers. In this manner therefore the cylinder A returns empty, and the cylinder B inked, and in the mean time the workman places another ſheet of paper ready in the ſpace numbered 1. Thus it is that the operation proceeds in the printing of one ſheet after another.

The preceding deſcription is not incumbered with an account of the apparatus by which the paper is taken up and laid down. This may be done in ſeveral ways: Fig. 9. and 10. repreſent one of the methods. DE is a lever, moving on the centre pin C, and having its end D preſſed upwards by the action of the ſpring G. The ſhoulder which contains the pin C is fixed in another piece F, which is inſerted in a groove in the ſurface of the cylinder A (fig. 4.), ſo that it is capable of moving in and out, in a direction parallel to the axis of that cylinder. As that cylinder proceeds, it meets

meets a pin in the table; which (letter P, fig. 9.) acting on the inclined plane at the other end of the lever, throws the whole inwards, in the poſition repreſented in fig. 10.; in which caſe the extremity D ſhoots inwards, and applies itſelf againſt the ſide of the cylinder.

In fig. 11. is a repreſentation of part of the table; the dotted ſquare repreſents a ſheet of paper, and the four ſmall ſhaded ſquares denote holes in the board, with pins ſtanding beſide them. When the lever DE (fig. 10.) ſhoots forward, it is ſituated in one of theſe holes, and advances under the edge of the paper, which conſequently it preſſes and retains againſt the cylinder with its extremity D. Nothing more remains to be ſaid reſpecting the taking up, but that the cylinder is provided with two pair of theſe claſps or levers, which are ſo fixed as to correſpond with the four holes repreſented in fig. 11. It will be eaſy to underſtand how the paper is depoſited in the compartment nº 3. (fig. 4.) A pin P (fig. 10.) riſing out of the platform or table, acts againſt a pin E, projecting ſidewiſe out of the lever, and muſt of courſe draw the ſlider and its lever to the original poſition; the paper conſequently will be let go, and its diſengagement is rendered certain by an apparatus fixed in the compartment numbered 3. (fig. 4.) of exactly the ſame kind as that upon the cylinder, and which, by the action of a pin duly placed in the ſurface of the cylinder A, takes the paper from the cylinder in preciſely the ſame manner as that cylinder originally took it up in the compartment numbered 1 (fig. 4.).

Figs. 5, 6, and 7, repreſent a ſimpler apparatus for accompliſhing the ſame purpoſe. If A *a* B *b* (fig. 7.) be ſuppoſed to repreſent a thick plate of metal of a circular form, with two pins, A and B, proceeding ſidewiſe or perpendicularly out of its plane, and diametrically oppoſite to each other, and G another pin proceeding in the direction of that plane, then it is obvious that any force applied to the pin A, ſo as to preſs it into the poſition *a* (by turning the plate on its axis or centre X), will at the ſame time cauſe the pin G to acquire the poſition *g*; and, on the other hand, when B is at *b*, or the dotted repreſentation of the ſide-pin, if any preſſure be applied to reſtore its original poſition at B, the pin *g* will return back to G. Now the figures 5 and 6 exhibit an apparatus of this kind, applied to the cylinder A; and that cylinder, by rolling over the pins P and *p*, properly fixed in the table to re-act upon the apparatus, will cauſe its prominent part G either to apply to the cylinder and claſp the paper, or to riſe up and let it go. The compartment numbered 3 (fig. 4.) muſt of courſe have an apparatus of the ſame kind to be acted upon by pins from A, in order that it may take the paper from that cylinder.

There is one other circumſtance belonging to this machine which remains to be explained. When the carriage E (fig. 4.) goes out in the direction of the numbers 1, 2, 3, 4, both rollers, A and B, preſs the form of letter in their paſſage; but in their return back again the roller A, having no paper upon it, would itſelf become ſoiled, by taking a faint impreſſion from the letter, if it were not prevented from touching it: the manner of effecting this may be underſtood from fig. 12. The apparatus there repreſented is fixed upon the outſide of the carriage E, near the lower corner, in the vicinity of the roller A; the whole of this projects ſidewiſe beyond the ledge of the table, except the ſmall truck or wheel B. The irregularly-triangular piece, which is ſhaded by the ſtroke of the pen, carries this wheel, and alſo a catch moveable on the axis or pin E. The whole piece is moveable on the pin A, which connects it to the carriage. CD, or the part which is ſhaded by dotting, is a detent, which ſerves to hold the piece down in a certain poſition. It may be obſerved, that both the detent and the triangular piece are furniſhed each with a claw, which holds in one direction, but trips or yields in the other, like the jacks of a harpſichord, or reſembling certain pieces uſed in clock and watch making, as is clearly repreſented in the figure. Theſe claws overhang the ſide of the table, and their effect is as follows: There is a pin C (fig. 4.) between the compartments of the table numbered 2 and 3, but which is marked F in fig. 12. where GH repreſents the table. In the outward run of the carriage theſe claws ſtrike that pin, but with no other effect than that they yield for an inſtant, and as inſtantly reſume their original poſition by the action of their reſpective ſlender back-ſprings. When the carriage returns, the claw of the detent indeed ſtrikes the pin, but with as little effect as before, becauſe its derangement is inſtantly removed by the action of the back ſpring of the detent itſelf; but, when the claw of the triangular piece takes the pin, the whole piece is made to revolve on its axis or pin A, the wheel B is forced down, ſo as to lift that end of the carriage, and the detent, catching on the piece at C, prevents the former poſition from being recovered. The conſequence of this is, that the carriage runs upon the truck B (and its correſpondent truck on the oppoſite ſide) inſtead of the cylinder A, which is too much raiſed to take the letter, and ſoil itſelf; but as ſoon as the end of the carriage has paſſed clear of the letter, another pin R (fig. 4.) takes the claw of the detent, and draws it off the triangular piece; at which inſtant the cylinder A ſubſides to its uſual place, and performs its functions as before. This laſt pin R does not affect the claw of the triangular piece, becauſe it is placed too low; and the claw of the detent is made the longeſt, on purpoſe that it may ſtrike this pin.

Fig. 8. repreſents an inſtrument for printing floor-cloths, paper-hangings, and the like, with ſtiff paint and a bruſh. D is a copper or metallic cylinder fixed in a frame A, like a garden roller; its curved part is thin, and is cut through in various places, according to the deſired pattern. A ſtrong axis paſſes through the cylinder, and its extremities are firmly attached to the frame A. To this axis is fixed a veſſel or box of the ſame kind, and anſwering the ſame purpoſe as the box KL in fig. 3. It carries a cylinder P, which revolves in the colour; another cylinder E, which revolves in contact with P; and a third cylinder B, whoſe exterior ſurface is covered with hair, after the manner of a bruſh, and revolves in contact with E. This cylinder B is adjuſted by its axis, in ſuch a manner that its bruſh-part ſweeps in the perforated parts of the metallic cylinder D. The circle C repreſents a cog-wheel, fixed concentric to the cylinder D, and revolving with it; this wheel takes another wheel concentric to, and fixed to, B; hence the action is as follows: When the metallic cylinder is wheeled or rolled along any ſurface, its cog-wheel C drives the bruſh B in the contrary direction; and this bruſh-cylinder, being connected by cogs or otherwiſe with E and P, cauſes theſe alſo to

Prints.

revolve and ſupply it with colour. As the ſucceſſive openings of the cylinder D, therefore, come in contact with the ground, the ſeveral parts of the bruſh will traverſe the uncovered part of that ground, and paint the pattern upon it. The wheel G, being kept lightly on the ground, ſerves to determine the line of contact, that it ſhall be the part oppoſite to E, and no other.

PRINTS (ſee *Encycl.*) are valuable on many accounts; but they are liable to be ſoiled by ſmoke, vapour, and the excrements of inſects. Different methods have, of courſe, been practiſed to clean them. Some have propoſed ſimple waſhing with clear water, or a ley made of the aſhes of reeds, and then expoſing the prints to the dew. Others have cleaned prints with *aqua fortis* (ſulphuric acid); but both theſe methods are attended with a degree of riſk at leaſt equal to their advantages. The following method of cleaning prints is recommended in the ſecond volume of Nicholſon's Journal of Natural Philoſophy, &c. as at once ſafe and efficacious:

"Provide a certain quantity of the common muriatic acid, for example three ounces, in a glaſs bottle, with a ground ſtopper, of ſuch a capacity that it may be only half full. Half an ounce of minium muſt then be added; immediately after which the ſtopper is to be put in, and the bottle ſet in a cold and dark place. The heat, which ſoon becomes perceptible, ſhews the beginning of the new combination. The minium abandons the greateſt part of its oxygen with which the fluid remains impregnated, at the ſame time that it acquires a fine golden yellow, and emits the deteſtable ſmell of oxygenated muriatic acid. It contains a ſmall portion of muriat of lead; but this is not at all noxious in the ſubſequent proceſs. It is alſo neceſſary to be obſerved, that the bottle muſt be ſtrong, and the ſtopper not too firmly fixed, otherwiſe the active elaſtic vapour might burſt it. The method of uſing this prepared acid is as follows:

"Provide a ſufficiently large plate of glaſs, upon which one or more prints may be ſeparately ſpread out. Near the edges let there be raiſed a border of ſoft white wax half an inch high, adhering well to the glaſs and flat at top. In this kind of trough the print is to be placed in a bath of freſh urine, or water containing a ſmall quantity of ox-gall, and kept in this ſituation for three or four hours. The fluid is then to be decanted off, and pure warm water poured on, which muſt be changed every three or four hours until it paſſes limpid and clear. The impurities are ſometimes of a reſinous nature, and reſiſt the action of pure water. When this is the caſe, the waſhed print muſt be left to dry, and alcohol is then to be poured on and left for a time. After the print is thus cleaned, and all the moiſture drained off, the muriatic acid prepared with minium is to be poured on in ſufficient quantity to cover the print; immediately after which another plate of glaſs is to be laid in contact with the rim of wax, in order to prevent the inconvenient exhalation of the oxygenated acid. In this ſituation the yelloweſt print will be ſeen to recover its original whiteneſs in a very ſhort time. One or two hours are ſufficient to produce the deſired effect: but the print will receive no injury if it be left in the acid for a whole night. Nothing more is neceſſary to complete the work, than to decant off the remaining acid, and waſh away every trace of acidity by repeated affuſions of pure water. The print being then left to dry (in the ſun if poſſible) will be found white, clear, firm, and in no reſpect damaged either in the texture of the paper or the tone and appearance of the impreſſion."

Priſm,
|
Priſon

The judicious editor of the Journal ſubjoins the following note, to which collectors of prints will do well to pay attention: "As I have not repeated this proceſs, I cannot eſtimate how far the preſence of the lead may weaken the corroſive action of the acid on the paper; but I ſhould be diſpoſed to recommend a previous dilution of the acid with water. Whoever uſes this proceſs will of courſe make himſelf maſter of the proportion of water required to dilute the acid, by making his firſt trials with an old print of no value."

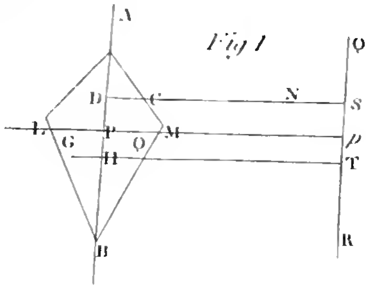
PRISM, in geometry, is a body or a ſolid, whoſe two ends are any plane figures which are parallel, equal, and ſimilar; and its ſides, connecting theſe ends, are parallelograms. The definition of this figure in the *Encyclopædia* we muſt, in candour, acknowledge to be unaccountably indiſtinct, if not unintelligible.

PRISMOID, is a ſolid or body, ſomewhat reſembling a priſm, but that its ends are any diſſimilar parallel plane figures of the ſame number of ſides; the upright ſides being trapezoids.—If the ends of the priſmoid be bounded by diſſimilar curves, it is ſometimes called a *cylindroid*.

PRISON is ſaid, in the *Encyclopædia*, to be only a place of ſafe cuſtody, not a place of puniſhment. Such was, no doubt the original intention of Engliſh priſons; but now temporary confinement is, in England as well as elſewhere, inflicted as a puniſhment for certain crimes. Perhaps it would be expedient to ſubſtitute this puniſhment more frequently than is yet done in Great Britain, for tranſportation and death; proportioning the length of the confinement, as well as its cloſeneſs, to the heinouſneſs of the crime. In no country, we believe, is this more accurately done, or to better purpoſe, than in Pennſylvania; and ſurely in no country has impriſonment been more abuſed than in Venice under the old government.

By the laws of Pennſylvania, puniſhment by impriſonment is impoſed, not only as an expiation of paſt offences, and an example to the guilty part of ſociety, but alſo for another important purpoſe—the reformation of the criminal's morals. The regulations of the gaol are calculated to promote this effect as ſoon as poſſible; ſo that the building deſerves the name of a *penitentiary houſe* more than that of a *gaol* (ſee PHILADELPHIA, *Encycl.*) He is ſeparately lodged, waſhed and cleanſed, and continues in ſuch ſeparate lodging until it is deemed prudent to admit him among the other priſoners. He is furniſhed with ſuitable cloathing, coarſe but clean, ſhaved twice a week, his hair cut once a month, is furniſhed with clean linen once a week, and is to waſh his hands and face regularly every morning or oftener as may be needful. Such as tranſgreſs the regulations of the priſon are puniſhed by cloſe ſolitary confinement and the quantity of their food reduced. The treatment of each priſoner, during his confinement, is varied according to his crime and his ſubſequent repentance. Solitary confinement in a dark cell

Fig 1



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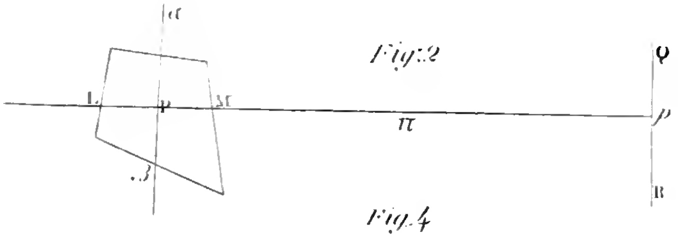

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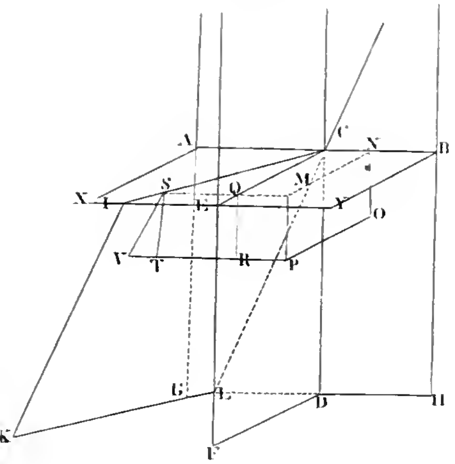

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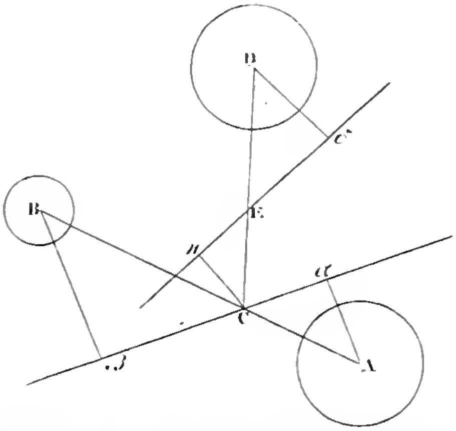

KEY &c OF MASON'S PIANO FORTE

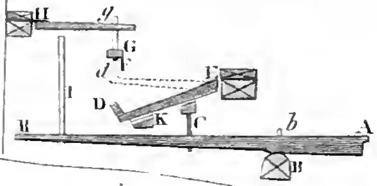

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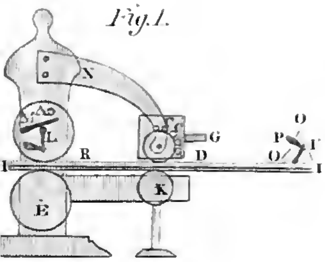
Fig.1.



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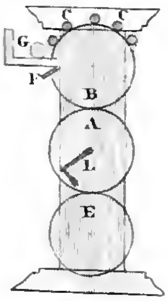

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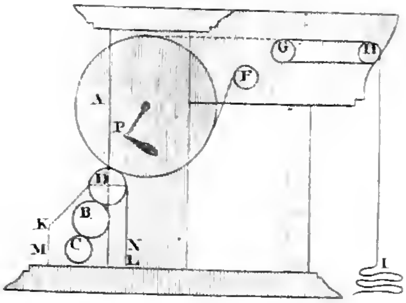

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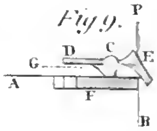

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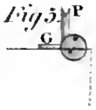

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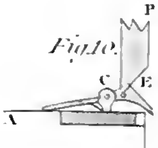
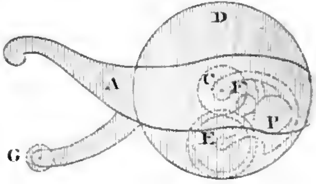


Fig.6.

Fig.8.



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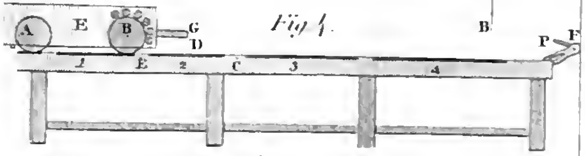

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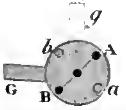

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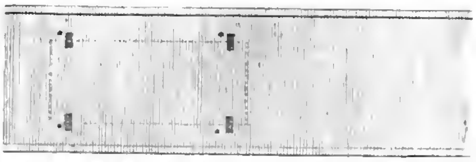

Fig.12.

Low.

cell is looked upon as the ſevereſt uſage; next, ſolitary confinement in a cell with the admiſſion of light; and, laſtly, labour in company with others. The longeſt period of confinement is for a rape, which is not to be leſs than ten years, nor more than twenty-one; for high treaſon, it is not to exceed twelve, nor fall ſhort of ſix years.

The priſoners are obliged to bathe frequently, proper conveniencies for that purpoſe being provided within the walls of the priſon, and alſo to change their linen, with which they are regularly ſupplied. Thoſe in ſolitary confinement are kept upon bread and water; but thoſe who labour are allowed broth, porridge, and the like. Meat is diſpenſed only in ſmall quantities, twice in the week; and on no pretence whatever is any other beverage than water ſuffered to be brought into the priſon. Thoſe who labour are employed in the trade to which they have been accuſtomed; and for thoſe acquainted with no particular trade, ſome kind of work is deviſed which they can perform. One room is ſet apart for ſhoemakers, another for tailors, a third for weavers, and ſo on. In the yards are ſtone ſawyers, with ſhops for ſmiths, nailers, &c. In a word, this priſon has all the advantages of the raſping houſe of Amſterdam, without any of its enormous defects. See *Correction-Houſe* in this *Suppl.*

The priſon of Venice is of a very different deſcription, and is worthy of notice here only as a curioſity in the annals of tyranny, which has, we hope, paſſed away with the government which contrived it. Dr Moſeley, in conſequence of his being an Engliſh phyſician (a character then highly reſpected in Venice), was permitted on the 16th of September 1787, to viſit the common priſon, but was abſolutely refuſed admittance into the *Sotto Piómbi* where the ſtate priſoners were kept. As the Doctor believes that no foreigner beſides himſelf ever witneſſed the ſcenes, even in the common priſon, which he relates, we ſhall give his relation in his own words.

"I was conducted (ſays he) through the priſon by one of its inferior dependants. We had a torch with us. We crept along narrow paſſages as dark as pitch. In ſome of them two people could ſcarcely paſs each other. The cells are made of maſſy marble; the architecture of the celebrated Sanſovini.

"The cells are not only dark, and black as ink, but being ſurrounded and confined with huge walls, the ſmalleſt breath of air can ſcarcely find circulation in them. They are about nine feet ſquare on the floor, arched at the top, and between ſix and ſeven feet high in the higheſt part. There is to each cell a round hole of eight inches diameter, through which the priſoner's daily allowance of twelve ounces of bread and a pot of water is delivered. There is a ſmall iron door to the cell. The furniture of the cell is a little ſtraw and a ſmall tub; nothing elſe. The ſtraw is renewed and the tub emptied through the iron door occaſionally.

"The diet is ingeniouſly contrived for the perduration of puniſhment. Animal food, or a cordial nutritious regimen, in ſuch a ſituation, would bring on diſeaſe, and defeat the end of this Venetian juſtice. Neither can the ſoul, if ſo inclined, ſteal away, wrapt up in ſlumbering deluſion, or ſink to reſt; from the admonition of her ſad exiſtence, by the gaoler's daily return.

"I ſaw one man who had been in a cell thirty years; two who had been twelve years; and ſeveral who had been eight and nine years in their reſpective cells.

"By my taper's light I could diſcover the priſoners horrid countenances. They were all naked. The man who had been there thirty years, in face and body was covered with long hair. He had loſt the arrangement of words and order of language. When I ſpoke to him, he made an unintelligible noiſe and expreſſed fear and ſurpriſe; and, like ſome wild animals in deſerts, which have ſuffered by the treachery of the human race, or have an inſtinctive abhorrence of it, he would have fled like lightning from me if he could.

"One whoſe faculties were not ſo obliterated; who ſtill recollected the difference between day and night; whoſe eyes and ears, though long cloſed with a ſilent blank, ſtill languiſhed to perform their natural functions—implored, in the moſt piercing manner, that I would prevail on the gaoler to murder him, or to give him ſome inſtrument to deſtroy himſelf. I told him I had no power to ſerve him in this requeſt. He then entreated I would uſe my endeavours with the inquiſitors to get him hanged, or drowned in the Canal' Orſano. But even in this I could not ſerve him: death was a favour I had not intereſt enough to procure for him.

"This kindneſs of death, however, was, during my ſtay in Venice, granted to one man, who had been 'from the cheerful ways of man cut off' thirteen years.

"Before he left his dungeon I had ſome converſation with him; this was ſix days previous to his execution. His tranſport at the proſpect of death was ſurpriſing. He longed for the happy moment. No ſaint ever exhibited more fervour in anticipating the joys of a future ſtate, than this man did at the thoughts of being releaſed from life, during the four days mockery of his trial.

"It is in the Canal' Orfano where veſſels from Turkey and the Levant perform quarantine. This place is the watery grave of many who have committed political or perſonal offences againſt the ſtate or ſenate, and of many who have committed no offences at all. They are carried out of the city in the middle of the night, tied up in a ſack with a large ſtone faſtened to it, and thrown into the water. Fiſhermen are prohibited on forfeiture of their lives, againſt fiſhing in this diſtrict. The pretence is the plague. This is the ſecret hiſtory of people being loſt in Venice.

"The government, with age, grew feeble; was afraid of the diſcuſſion of legal proceſs and of public executions; and navigated this rotten Bucentaur of the Adriatic, by ſpies, priſons, aſſaſſination, and the Canal' Orſano."

This is indeed a frightful narrative, and, we doubt not, true as well as frightful; but when, from the ſtate of the Venetian priſons, the author inſinuates, that Howard was not actuated by genuine benevolence, and infers, or wiſhes his reader to infer, that the propoſal of that celebrated philanthropiſt for ſubſtituting ſolitary confinement, in many caſes, for capital puniſhment, muſt have reſulted from his not taking into conſideration the *mind* of the criminal—the inſinuation, to ſay the leaſt of it, is ungenerous, and the concluſion is at war with the premiſes. That there was ſomething romantic and ſuperfluous in Howard's wanderings, we readily admit; but it ſeems impoſſible to doubt of the reality of his benevolence; and though the horrid priſon of Venice, into which, as the Doctor aſſures us, Mr Howard never entered, was calculated to injure the body, without improving the mind of the criminal, it does not follow but that ſolitary confinement, under ſuch regulations as at Philadelphia, is the beſt means that have yet been thought of for obtaining the object neareſt Howard's heart, the reformation of the morals of the criminal.

PROCYON, in aſtronomy, a fixed ſtar of the ſecond magnitude, in Canis Minor, or the Little Dog.

PROSPECT; Frankfort, in the Diſtrict of Maine is now ſo called. It adjoins Buckſton on Penobſcot river, and is 16 miles below Orrington.—*Morſe.*

Prospect *Harbour*, on the S. coaſt of Nova-Scotia, has Cape Sambro and Iſland eaſtward, and is 2 leagues N. E. of St Margaret's Bay.—*ib.*

PROSTHAPHERESIS, in aſtronomy, the difference between the true and mean motion, or between the true and mean place, of a planet, or between the true and equated anomaly; called alſo *equation of the orbit*, or *equation of the centre*, or ſimply the *equation*; and it is equal to the angle formed at the planet, and ſubtended by the eccentricity of its orbit.

PROTECTWORTH, a townſhip in the northern part of Cheſhire county, New-Hampſhire. It was incorporated in 1769, and contains 210 inhabitants.—*Morſe.*

PROTRACTING, or Protraction, in ſurveying, the act of plotting or laying down the dimenſions taken in the field, by means of a protractor, &c. Protracting makes one part of ſurveying.

Protracting-Pin, a fine pointed pin or needle, fitted into a handle, uſed to prick off degrees and minutes from the limb of the protractor.

PROVIDENCE, a river which falls into Narraganſet bay on the W. ſide of Rhode-Iſland. It riſes by ſeveral branches, part of which come from Maſſachuſetts. It is navigable as far as Providence for ſhips of 900 tons, 30 miles from the ſea. It affords fine fiſh, oyſters and lobſters.—*Morſe.*

Providence, a county of Rhode-Iſland State, bounded by Maſſachuſetts N. and E. Connecticut W. and Kent county on the ſouth. It contains 9 townſhips, and 24,391 inhabitants, including 82 ſlaves. Its chief town is Providence, and the town of Scituate is famous for its excellent cannon foundery.—*ib.*

Providence, the chief town of the above county, ſituated 30 miles N. by W. ½W. from Newport, and 35 from the ſea; ſeated at the head of navigation of Narraganſet Bay, on both ſides of Providence river, the two parts of the town being connected by a bridge 160 feet long and 22 wide. It is the oldeſt town in the State, having been ſettled by Roger Williams and his company in 1636; and lies in lat. 41 49 N. and long. 71 23 W. 44 miles S. by W. of Boſton, and 291 north-eaſt of Philadelphia. Ships of almoſt any ſize ſail up and down the channel, which is marked out by ſtakes, erected at points of ſhoals and beds lying in the river, ſo that a ſtranger may come up to the town without a pilot. A ſhip of 950 tons, for the Eaſt-India trade, was lately built in this town, and fitted for ſea. In 1764, there were belonging to the county of Providence 54 ſail of veſſels, containing 4,320 tons. In 1790, there were 129 veſſels, containing 11,942 tons. This town ſuffered much by the Indian war of 1675, when a number of its inhabitants removed to Rhode-Iſland for ſhelter. In the late war, the caſe was reverſed; many of the inhabitants of that iſland removed to Providence. The public buildings are an elegant meeting houſe for Baptiſts, 80 feet ſquare, with a lofty and beautiful ſteeple, and a large bell caſt at the Hope Furnace in Scituate; a meeting-houſe for Friends or Quakers; 3 for Congregationaliſts, one of which, lately erected, is the moſt elegant perhaps in the United States; an Epiſcopal church; a handſome court-houſe, 70 feet by 40, in which is depoſited a library for the uſe of the inhabitants of the town and country; a work-houſe; a market-houſe, 80 feet long and 40 wide, and a brick ſchool-houſe, in which 4 ſchools are kept. Rhode-Iſland college is eſtabliſhed at Providence. The elegant building erected for its accommodation, is ſituated on a hill to the eaſt of the town; and while its elevated ſituation renders it delightful, by commanding an extenſive, variegated proſpect, it furniſhes it with a pure, ſalubrious air. The edifice is of brick, 4 ſtories high, 150 feet long, and 46 wide, with a projection of 10 feet each ſide. It has 48 rooms for ſtudents, and 8 larger ones for public uſes. The roof is ſlated. It is a flouriſhing ſeminary, and contains upwards of 60 ſtudents. It has a library containing between 2 and 3000 volumes, and a valuable philoſophical apparatus. The houſes in this town are generally built of wood, though there are ſome brick buildings which are large and elegant. At a convenient diſtance from the town, an hoſpital for the ſmall-pox and other diſeaſes has been erected. There are two ſpermaceti works, a number of diſtilleries, ſugar-houſes and other manufactories. Several forts were erected in and near the town during the war, which, however, are not kept in repair. It has an extenſive trade with Maſſachuſetts, Connecticut, and part of Vermont; with the Weſt-Indies, with Europe, and lately with the Eaſt-Indies and China. A bank has alſo been eſtabliſhed here, and a cotton manufactory, which employs 100 hands; with which is connected a mill for ſpinning cotton, on the model of Sir R. Arkwright's mill. It is erected at Pawtucket Falls, in North-Providence, and is the firſt of the kind built in America. The exports for one year, ending Sept. 30, 1794, amounted to the value of 643,373 dollars. It contains 6,380 inhabitants, including 48 ſlaves. —*ib.*

Providence, *North*, a townſhip of Rhode-Iſland, in Providence county, north of the town of Providence; ſouth of Smithfield, and ſeparated from the State of Maſſachuſetts on the eaſt by Pawtucket river. It contains 1071 inhabitants, including 5 ſlaves.—*ib.*

Providence, a townſhip of New-York, ſituated in Saratoga county, taken from Galway, and incorporated in 1796.—*ib.*

Providence, *Upper* and *Lower*, townſhips in Delaware county, Pennſylvania.

Providence, a townſhip in Montgomery county, Pennſylvania.—*ib.*

PROVIDENCE, one of the Bahama Iſlands, and the ſecond in ſize of thoſe ſo called; being about 36 miles in length and 16 in breadth. N. lat. 24 58, W. long. at its eaſt part 77 21. 'It was formerly called *Abaco*, and is frequently named *New Providence*. Chief town, Naſſau.—*ib.*

PROVIDENCE, an uninhabited iſland on the coaſt of Honduras, 11 miles long and 4 broad. It has a fertile ſoil, wholeſome air, and plenty of water; and might be eaſily fortified. It is ſeparated from the continent by a narrow channel. Here are neither ſerpents nor venomous reptiles. N. lat. 13 26, W. long. 80 45.—*ib.*

PROVINCE, an iſland in Delaware river, 6 miles below Philadelphia. It is joined to the main land by a dam.—*ib.*

PROVINCE-TOWN is ſituated on the hook of Cape Cod, in Barnſtable county, Maſſachuſetts, 3 miles north-weſt of Race Point. Its harbour, which is one of the beſt in the State, opens to the ſouthward, and has depth of water for any ſhips. This was the firſt port entered by the Engliſh when they came to ſettle in New-England, in 1620. It has been in a thriving and decaying ſtate many times. It is now riſing, and contains 454 inhabitants; whoſe ſole dependence is upon the cod-fiſhery, in which they employ 20 ſail, great and ſmall. Ten of their veſſels, in 1790, took 11,000 quintals of cod-fiſh. They are ſo expert and ſucceſsful that they have not loſt a veſſel or a man in the buſineſs, ſince the war. The houſes, in number about 90, ſtand on the inner ſide of the cape, fronting the ſouth-eaſt. They are one ſtory high, and ſet up on piles, that the driving ſands may paſs under them; otherwiſe they would be buried in ſand. They raiſe nothing from their lands, but are wholly dependent on Boſton, and the towns in the vicinity, for every vegetable production. There are but 2 horſes and 2 yokes of oxen kept in the town. They have about 50 cows, which feed in the ſpring upon beach graſs, which grows at intervals upon the ſhore; and in ſummer they feed in the ſunken ponds and marſhy places that are found between the ſand-hills. Here the cows are ſeen wading, and even ſwimming, plunging their heads into the water up to their horns, picking a ſcanty ſubſiſtence from the roots and herbs, produced in the water. They are fed in the winter on ſedge, cut from the flats.—*ib.*

PRUCREOS, a cape on the coaſt of New-Spain, in the South Sea.—*ib.*

PRUDENCE, a ſmall iſland, nearly as large as Canonnicut, and lies N. of it, in Narraganſet Bay. It belongs to the town of Portſmouth, in Newport county Rhode-Iſland. The north end is nearly oppoſite to Briſtol on the eaſt ſide of the bay.—*ib.*

PRUNING. Under this title *(Encycl.)* it is obſerved, that when large branches of trees bearing ſtone-fruit are taken off, the trees are ſubject to gum and decay. For this a remedy has been invented by *Thomas Skip Dyot Bucknall*, Eſq: of Conduit-ſtreet, which, notwithſtanding many objections made to it at firſt, experience has proved to be ſucceſsful, and for the diſcovery of which the Society for the Encouragement of Arts, &c. voted the ſilver medal to the diſcoverer. It is as follows:

Cut every branch which ſhould be taken away cloſe to the place of its ſeparation from the trunk; ſmooth it well with a knife; and then with a painter's bruſh ſmear the wound over with what Mr Bucknall calls *medicated tar*. This medicated tar is compoſed of one quarter of an ounce of corroſive ſublimate, reduced to fine powder by beating with a wooden hammer, and then put into a three-pint earthen pipkin, with about a glaſs full of gin or other ſpirit, ſtirred well together, and the ſublimate thus diſſolved. The pipkin is then filled by degrees with vegetable or common tar, and conſtantly ſtirred, till the mixture be blended together as intimately as poſſible; and this quantity will at any time be ſufficient for two hundred trees. To prevent danger, let the corroſive ſublimate be mixed with the tar as quickly as poſſible after it is purchaſed; for, being of a very poiſonous nature to all animals, it ſhould not be ſuffered to lie about a houſe, for fear of miſchief to ſome part of the family.

By the application of this compoſition, Mr Bucknall can, without the ſmalleſt danger, uſe the pruning hook on all kinds of trees much more freely than we have recommended its uſe in the article referred to. "I give no attention (ſays he) to fruit-branches, and wood-branches; but beg, once for all, that no branch ſhall ever be ſhortened, unleſs for the figure of the tree, and then conſtantly taken off cloſe to the ſeparation, by which means the wound ſoon heals. The more the range of the branches ſhoots circularly, a little inclining upwards, the more equally will the ſap be diſtributed, and the better will the tree bear; for, from that circumſtance, the ſap is more evenly impelled to every part. Do not let the ranges of branches be too near each other; for remember all the fruit and the leaves ſhould have their full ſhare of the ſun; and where it ſuits let the middle of the tree be free from wood, ſo that no branch ſhall ever croſs another, but all the extreme ends point outwards."

PUAN, or *Green Bay*, has communication eaſtward with *Lake Michigan*.—*Morſe.*

PUEBLA DE LOS ANGELOS, the preſent capital of the province of Tlaſcala, or Los Angelos.—*ib.*

PUEBLO NUEVO, or *Newtown*, at the bottom of the gulf of Dolce, on the W. coaſt of Mexico. It is 7 leagues N. by W. of Baia Honda, or Deep Bay. The iſland of this name is oppoſite the town and mouth of the river of its name, in the bottom of Freſh Water bay, in lat. about 8 50 N. and long. 83 28 W.—*ib.*

PULO, the name of ſeveral iſlands of Aſia, in the Indian Ocean; the principal of which alone, according to Dr Brookes, is inhabited. This is the iſland

Pulo-Condore, which, being viſited by Lord Macartney as he ſailed to China, is thus deſcribed by Sir George Staunton. "It has the advantage of convenient anchoring places in either monſoon. The ſquadron accordingly ſtopped on the 17th of May, in a ſpacious bay on the eaſtern ſide of the iſland; and came to anchor at the entrance of its ſouthern extremity, as the water ſhoaled there to five fathoms and a half, occaſioned by a bank which ſtretches acroſs two-thirds of the entrance. It was found afterwards, that beyond the bank there is a ſafe paſſage to the inner part of the bay, the north of which is ſheltered by a ſmall iſland lying to the eaſtward. The whole of the bay is formed by four ſmall iſlands, which approach ſo nearly to each other, as to appear, from ſeveral points, to join.

They all ſeem to be the rude fragments of primitive mountains, ſeparated from the great continent in the lapſe of time. The principal iſland is eleven or twelve miles in length, and about three in breadth. It is in the form of a creſcent, and conſiſts of a ridge of peaked hills. Its latitude, as calculated from a meridional obſervation, is 8° 40′ north from the equator; and its longitude, according to a good chronometer, is 105° 55′ eaſt from Greenwich.

"The Engliſh had a ſettlement on Condore until the beginning of the preſent century, when ſome Malay ſoldiers in their pay, in reſentment for ſome unjuſtifiable treatment, murdered their ſuperiors, with the exception of a very few who eſcaped off the iſland, where no Europeans have ſince reſided. At the bottom of the bay was a village ſituated cloſe to a fine ſandy beach, with a long range of cocoa-nut trees before it, and it was defended from the north-eaſt ſea by a reef of coral rocks, within which was good anchorage for ſmall veſſels, and an eaſy landing for boats. A party went on ſhore from Lord Macartney's ſquadron, with the precaution, however, of being armed, as large canoes were eſpied within the reef, which might have been Malay pirates. Several of the inhabitants came to the beach, and with the appearance of much urbanity of manners welcomed them on ſhore, and conducted them to the houſe of their chief. It was a neat bamboo cabin, larger than the reſt. The floor was elevated a few feet above the ground, and ſtrewed with mats, on which were aſſembled as many men as the place could hold. It was apparently on the occaſion of ſome feſtival, or pleaſurable meeting. There was in one of the apartments an altar decorated with images, and the partitions hung with figures of monſtrous deities; but the countenances and deportment of the people conveyed no idea of religious awe, and no perſon was ſeen in the poſture of prayer or adoration. A few ſpears ſtood againſt the wall with their points downwards, together with ſome matchlocks and a ſwivel gun. The dreſs of thoſe people was compoſed chiefly of blue cotton worn looſely about them; and their flat faces and little eyes denoted a Chineſe origin or relation. Several long ſlips of paper, hanging from the ceiling, were covered with columns of Chineſe writing. One of the miſſionaries, who was of the party, could not, however, in any degree, underſtand their converſation; but when the words were written, they inſtantly became intelligible to him. Though their colloquial language was altogether different from what is ſpoken in China, yet the characters were all Chineſe; and the fact was clearly aſcertained on this occaſion, that thoſe characters have an equal advantage with Arabic numbers, of which the figures convey the ſame meaning wherever known; whereas the letters of other languages denote not things, but elementary ſounds, which combined variouſly together, form words, or more complicated ſounds, conveying different ideas in different languages, though the form of their alphabet be the ſame.

"The inhabitants of Pulo Condore were, it ſeems, Cochin-Chineſe, with their deſcendants, who fled from their own country, in conſequence of their attachment to one of its ſovereigns, dethroned by ſeveral of his own ſubjects. It was propoſed to purchaſe proviſions here; and the people promiſed to have the ſpecified quantity ready, if poſſible, the next day, when it was intended, if the weather ſhould be favourable, to land the invalids. The next morning was fair in the beginning; and a party of pleaſure was made from the Hindoſtan to a ſmall iſland cloſe to Pulo Condore. They were ſcarcely arrived upon it when the weather began to lower; and the boat ſet off on its return, in order to reach the ſhip before the impending ſtorm ſhould begin.

"With difficulty it reached the ſhip; and as ſoon as the weather became fair, meſſengers were diſpatched on ſhore to receive and pay for the proviſions promiſed. When they arrived at the village, they were aſtoniſhed to find it abandoned. The houſes were left open, and none of the effects, except ſome arms, that had on the firſt viſit been perceived within them, or even of the poultry feeding about the doors, were taken away. In the principal cabin a paper was found, in the Chineſe language, of which the literal tranſlation purported, as nearly as it could be made, that 'the people of the iſland were few in number, and very poor, yet honeſt, and incapable of doing miſchief; but felt much terror at the arrival of ſuch great ſhips and powerful perſons, eſpecially as not being able to ſatiſfy their wants in regard to the quantity of cattle and other proviſions, of which the poor inhabitants of Pulo Condore had ſcarcely any to ſupply, and conſequently could not give the expected ſatiſfaction. They therefore, through dread and apprehenſion, reſolved to fly to preſerve their lives. That they ſupplicate the great people to have pity on them; that they left all they had behind them, and only requeſted that their cabins might not be burnt; and conclude by proſtrating themſelves to the great people a hundred times.'

"The writers of this letter had probably received ill treatment from other ſtrangers. It was determined that they ſhould not continue to think ill of all who came to viſit them. On their return they were perhaps as much ſurpriſed to find their houſes ſtill entire, as their viſitors had been who found they were deſerted. Nothing was diſturbed; and a ſmall preſent, likely to be acceptable to the chief, was left for him in the principal dwelling, with a Chineſe letter, ſignifying that 'the ſhips and people were Engliſh, who called merely for refreſhment, and on fair terms of purchaſe, without any ill intention; being a civilized nation, endowed with principles of humanity, which did not allow them to plunder or injure others who happened to be weaker or fewer than themſelves."

Pulo Lingen, another of this cluſter, is likewiſe a conſiderable iſland, remarkable for a mountain in its centre, terminating in a fork like Parnaſſus; but to which the unpoetical ſeamen beſtow the name of *aſſes ears*. Every day preſented new iſlands to the view, diſplaying a vaſt variety in form, ſize, and colour. Some iſolated, and ſome collected in cluſters. Many were clothed with verdure; ſome had tall trees growing on them; others were mere rocks, the reſort of innumerable birds, and whitened with their dung.

PUNA, an iſland near the bay of Guyaquil, on the coaſt of Peru, about 12 or 14 leagues long from E. to W. and 4 or 5 broad. There is an Indian town of the ſame name, on its ſouth ſide, having about 20 houſes, and a ſmall church. The houſes all ſtand on poſts 10 or 12 feet high, with ladders on the outſide to go up to them. From the iſland Santa Clara in the bay of Guyaquil to the weſternmoſt point of the iſland, called

Punta Arena, is 7 leagues E. N. E. S. lat. 3 17, W. long. 81 6.—*Morse.*

PUNCTUATION, in grammar, is an art with which we have ſaid, in the *Encyclopædia*, that the ancients were entirely unacquainted. Candour obliges us to confeſs that this was ſaid raſhly. A learned writer, in the Monthly Magazine for September 1798, who ſubſcribes J. WARBURTON, has proved, we think completely, that the art is not wholly modern; and we ſhall lay his proofs, in his own words, before our readers.

" Some ſpecies of pauſes and diviſions of ſentences in ſpeaking and writing muſt have been coeval with the knowledge of communicating ideas by ſound or by ſymbols. Suidas* ſays, that the *period* and the *colon* were diſcovered and explained by Thraſymacus, about 380 years before the Chriſtian æra. Cicero† ſays, that Thraſymacus was the firſt who ſtudied oratorical numbers, which entirely conſiſted in the artificial ſtructure of periods and colons. It appears from a paſſage in Ariſtotle‡, that punctuation was known in his time. The learned Dr Edward Bernard§ refers the knowledge of pointing to the time of that philoſopher, and ſays, that it conſiſted in the different poſitions of one ſingle point. At the bottom of a letter, thus, (A.) it was equivalent to a comma; in the middle (A·) it was equal to a colon; at the top (A˙) it denoted a period, or the concluſion of a ſentence.

" This mode was eaſily practiſed in Greek manuſcripts, while they were written in capitals. But when the ſmall letters were adopted, that is, about the 9th century, this diſtinction could not be obſerved; a change was therefore made in the ſcheme of punctuation. *Unciales literas hodierno uſu dicimus eas in vetuſtis codicibus, quæ priſcam formam ſervant, ac ſolutæ ſunt, nec mutuò colligantur. Hujus modi literæ unciales obſervantur in libris omnibus ad nonum uſque ſæculum*—Montf. Palæog. Recens. p. xii.

" According to Cicero, the ancient Romans, as well as the Greeks, made uſe of points. He mentions them under the appellation of *librariorum notæ;* and in ſeveral parts of his works he ſpeaks of ' *interpunctæ clauſulæ in orationibus*,' of ' *clauſulæ atque interpuncta verborum*,' of ' *interpunctiones verborum*,' &c.*

" Seneca, who died A. D. 65, expreſsly ſays, that Latin writers, in his time, had been uſed to punctuation. ' *Nos*†, *cum ſcribimus interpungere conſuevimus*.' Muretus and Lipſius imagined that theſe words alluded to the inſertion of a point after each word: but they certainly were miſtaken; for they muſt neceſſarily refer to marks of punctuation in the diviſion of ſentences, becauſe in the paſſage in which theſe words occur, Seneca is ſpeaking of one Q. Haterius, who made no pauſes in his orations.

" According to Suetonius, in his *Illuſt. Gram.* Valerius Probus procured copies of many old books, and employed himſelf in correcting, pointing, and illuſtrating them; devoting his time to this and no other part of grammar. *Multa exemplaria contracta emendare, ac diſtinguere et adnotare curavit; ſoli huic, nec ulli præterea, grammatices parti deditus.*

" It appears from hence, that in the time of Probus, or about the year 68, Latin manuſcripts had not been uſually pointed, and that grammarians made it their buſineſs to ſupply this deficiency.

" Quintilian, who wrote his celebrated treatiſe on Oratory, about the year 88, ſpeaks of commas, colons, and periods; but it muſt be obſerved, that by theſe terms he means clauſes, members, and complete ſentences, and not the marks of punctuation‡.

" Ælius Donatus§ publiſhed a treatiſe on Grammar in the 4th century, in which he explains the *diſtinctio*, the *media diſtinctio*, and the *ſubdiſtinctio;* that is, the uſe of a ſingle point in the various poſitions already mentioned.

" Jerom*, who had been the pupil of Donatus, in his Latin Verſion of the Scriptures, made uſe of certain diſtinctions or diviſions, which he calls *cola* and *commata*. It has, however, been thought probable, that theſe diviſions were not made by the addition of any points or ſtops; but were formed by writing, in one line, as many words as conſtituted a clauſe, equivalent to what we diſtinguiſh by a comma or a colon. Theſe diviſions were called στιχοι or ρηματα; and had the appearance of ſhort irregular verſes in poetry. There are ſome Greek manuſcripts ſtill extant, which are written in this manner†."

Mr Warburton ſays, that the beſt treatiſe upon punctuation that he has ſeen, was publiſhed ſome years ſince by an anonymous author, and dedicated to Sir Clifton Wintringham, Bart. With that treatiſe we are not acquainted; but we do not think that the art of punctuation can be taught by rules. The only way to acquire it is to obſerve attentively how the moſt perſpicuous writers diſpoſe of their periods, colons, ſemicolons, and commas. This will make us acquainted with the importance of each; and then every writer, who knows his own meaning, muſt be capable of pointing his own pages more correctly than any other man.

PUNTA *Fort*, one of the large batteries or caſtles, and the ſecond in order, at the mouth of the harbour of the Havannah, in the iſland of Cuba. It is alſo called Meſa de Maria, or the Virgin Mary's Table.—*Morse.*

PUNTA DE PEDRAS, a cape on the north-weſtern extremity of the peninſula of Yucatan, in New-Spain.—*ib.*

PUNTA ESPADA, the S. E. point of the iſland of St Domingo; 65 leagues, following the turnings of the coaſt, eaſtward of Niſao, and 16 leagues from Cape Raphael. The ſouth-eaſtern part of the iſland conſiſts chiefly of extenſive, rich plains.—*ib.*

PUNTA GORDA, a peninſula on the ſouth ſide of the iſland of Cuba, S. E. of Iſle de Pinos, 90 weſt of the gulf of Xagua, and 70 eaſt of Bohia de Corles.—*ib.*

PUNTA NEGRILLO, the weſtern point of the iſland of Jamaica.—*ib.*

PURIFICATION, a town of New-Mexico, 14 leagues from the weſt coaſt, and maintains a fiſhery near the low lands of Chametla.—*ib.*

PURYSBURG, a handſome town of S. Carolina, ſituated in Beaufort diſtrict, on the eaſtern ſide of Savannah river, 37 miles from the ocean, and 20 from the town of Savannah. It contains between 40 and 50 dwelling-houſes, and an Epiſcopal church. It took its name from John Peter Pury, a Swiſs who ſettled a colony of his countrymen here about the year 1733, with a view to the culture of ſilk. The mulberry-trees are yet ſtanding, and ſome attention is ſtill paid to the making of ſilk.—*ib.*

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‡ *Quint.* l. ix. c. 4.

§ A. D. 340.

* *Hieron. Præf. in Eſaiam. Vide etiam, Præf. in Joſuam,* &c. tom. iii. p. 26.

† *Vide Montf. Palæog. Græca,* lib. iii. c. 4.

PUTAWATAMES, or *Poutoctamies*, Indians who inhabit between St Joſeph's and Detroit, and can furniſh about 500 warriors. There are two tribes of this name, the one of the river of St Joſeph, and the other of Huron. They were lately hoſtile; but at the treaty of Greenville, Auguſt 3, 1795, they ceded lands to the United States; who in return paid them a ſum in hand, and engaged to pay them in goods to the value of 1000 dollars a year forever.—*ib.*

PUTNEY, a thriving town in Windham county, Vermont, on the weſt ſide of Connecticut river, ſouth of Weſtminſter. Inhabitants 1848.—*ib.*

PYRAMIDOID, is ſometimes uſed for the parabolic ſpindle, or the ſolid formed by the rotation of a ſemiparabola about its baſe or greateſt ordinate. See *Parabolic Spindle.*

PYRITES. See Mineralogy in this *Suppl.*—In the third volume of Mr Nicholſon's Philoſophical Journal, we have a method of making artificial pyrites, which we ſhall give in the words of the author.

"I impregnated water (ſays he) very ſtrongly with carbonic acid, and introducing ſome iron filings, I continued the impregnation for a day or two, and afterwards allowed the water to ſtand in a well corked bottle for ſome days, till the acid had taken up as much iron as poſſible. I then poured it into an aerating apparatus; threw up the hepatic gas from ſulphuret of potaſh and ſulphuric acid; and after having agitated the water till it had got a good doſe of the gas, I poured the water into a large baſon: this was in the evening, and next morning when I looked at it I found it covered with a pretty thick film of a moſt beautiful variegated pyrites. I had ſo little of it, that the only proof I had of its being this ſubſtance was, that it was ignited on its being placed on a hot poker."

Q.

QUADRAS *Iſles*, on the N. W. coaſt of N. America, lie between Pintard's Sound and the Straits de Fuca. Nootka Sound lies among theſe iſlands. In 1792, two Spaniſh ſchooners, and his Britannic Majeſty's ſhip Diſcovery, and brigantine Chatham, paſſed through this channel; but the former firſt; hence Capt. Ingraham called the iſles by the name of the Spaniſh commander.—*Morſe.*

QUADRATURE, in geometry (ſee that article, and likewiſe Fluxions, *Encycl.*), has employed the time and ingenuity of ſome of the moſt eminent mathematicians both of ancient and of modern times. Dr Halley's method of computing the ratio of the diameter of the circle to its circumference, was conſidered by himſelf, and other learned mathematicians, as the eaſieſt the problem admits of. And although, in the courſe of a century, much eaſier methods have been diſcovered, ſtill a celebrated mathematician of our own times has expreſſed an opinion, that no other aliquot part of the circumference of a circle can be ſo eaſily computed by means of its tangent as that which was choſen by Dr Halley, viz. the arch of 30 degrees. Without taking upon him to determine whether this opinion be juſt or not, the Rev. John Hellins has ſhewn how the ſeries by which Dr Halley computed the ratio of the diameter to the circumference of the circle may be transformed into others of ſwifter convergency, and which, on account of the ſucceſſive powers of $\frac{1}{10}$ which occur in them, admit of an eaſy ſummation. We ſhall give the memoir in the author's own words.

"1. The propoſed transformation is obtained by means of different forms in which the fluents of ſome fluxions may be expreſſed; and to proceed with greater clearneſs, "I will here (ſays Mr Hellins) ſet down the fluxion in a general form, and its fluent, in the two ſeries which are uſed in the following particular inſtance, and may be applied with advantage in ſimilar caſes.

"2. The fluent of $\frac{x^{m-1}\dot{x}}{1-x^n}$ is $= \frac{x^m}{m} + \frac{x^{m+n}}{m+n} + \frac{x^{m+2n}}{m+2n} + \frac{x^{m+3n}}{m+3n}$, &c. which ſeries, being of the ſimpleſt form which the fluent ſeems to admit, was firſt diſcovered and probably is the moſt generally uſeful. But it has alſo been found, that the fluent of the ſame fluxion may be expreſſed in ſeries of other forms, which, though leſs ſimple than that above written, yet have their particular advantages. Amongſt thoſe other forms of ſeries which the fluent admits of, that which ſuits my preſent purpoſe is $\frac{x^m}{m.\overline{1-x^n}} - \frac{nx^{m+n}}{m.\overline{m+n}.\overline{1-x^n}|^2} + \frac{n.2n.x^{m+2n}}{m.\overline{m+n}.\overline{m+2n}.\overline{1-x^n}|^3} - \frac{n.2n.3n.x^{m+3n}}{m.\overline{m+n}.\overline{m+2n}.\overline{m+3n}.\overline{1-x^n}|^4}$ + &c. which, to ſay nothing of other methods, may eaſily be inveſtigated by the rule given in p. 64 of the third edition of *Emerſon's Fluxions*; or its equality with the former ſeries may be proved by algebra.

"3. On account of the ſign — before x^n, in the laſt ſeries, it may be proper to remark, that its convergency, by a geometrical progreſſion, will not ceaſe till $\frac{x^n}{1-x^n}$ becomes $= 1$, or x becomes $= \sqrt[n]{\frac{1}{2}}$; and that when x is a ſmall quantity, and n a large number, this ſeries will converge almoſt as ſwiftly as the former. For inſtance, if x be $= \sqrt{\frac{1}{3}}$, and $n = 8$, which are the values in the following caſe, the former ſeries will converge by the quantity $x^n = \overline{\sqrt{\frac{1}{3}}}|^8 = \frac{1}{81}$, and this ſeries by the quantity $\frac{x^n}{1-x^n} = \frac{\frac{1}{81}}{1-\frac{1}{81}} = \frac{1}{80}$; where the difference in convergency will be but little, and the diviſions by 80 eaſier than thoſe by 81.

"4. With reſpect to the indices m and n, as they are here ſuppoſed to be affirmative whole numbers, and will be ſo in the uſe I am about to make of them, the reader need not be detained with any obſervations on the caſes in which theſe fluents will fail, when the indices have contrary ſigns.

"5. It may be proper further to remark, that by putting

putting $\frac{x^n}{1-x^n}=z$, and calling the firſt, ſecond, third, &c. terms of the ſeries $\frac{x^m}{m.\overline{1-x^n}}-\frac{nx^{m+n}}{m.m+n.\overline{1-x^n}|^2}+\frac{n.2nx^{m+2n}}{m.m+n.m+2n.\overline{1-x^n}|^3}+$ &c. A, B, C, &c. reſpectively, the ſeries will be expreſſed in the conciſe and elegant notation of Sir Iſaac Newton, viz. $\frac{x^m}{m.\overline{1-x^n}}-\frac{nzA}{m+n}+\frac{2nzB}{m+2n}-\frac{3nzC}{m+3n}+$ &c. which is well adapted to arithmetical calculation.

"6. I come now to the transformation propoſed, which will appear very eaſy, as ſoon as the common ſeries, expreſſing the length of an arch in terms of its tangent, is properly arranged.

"If the radius of a circle be 1, and the tangent of an arch of it be called t, it is well known that the length of that arch will be $=t-\frac{t^3}{3}+\frac{t^5}{5}-\frac{t^7}{7}+\frac{t^9}{9}-\frac{t^{11}}{11}+$ &c. Now, if the affirmative terms of this ſeries be written in one line, and the negative ones in another, the arch will be

$$=\left\{\begin{array}{l} t+\frac{t^5}{5}+\frac{t^9}{9}+\frac{t^{13}}{13}+\frac{t^{17}}{17}+\text{\&c.} \\ -\frac{t^3}{3}-\frac{t^7}{7}-\frac{t^{11}}{11}-\frac{t^{15}}{15}-\frac{t^{19}}{19}-\text{\&c.} \end{array}\right.$$

And if, again, the firſt, third, fifth, &c. term of each of theſe ſeries be written in one line, and the ſecond, fourth, ſixth, &c. in another, the ſame arch will be expreſſed thus:

$$=\left\{\begin{array}{l} +\left\{\begin{array}{l} t+\frac{t^9}{9}+\frac{t^{17}}{17}+\frac{t^{25}}{25}+\frac{t^{33}}{33}+\text{\&c.} \\ \frac{t^5}{5}+\frac{t^{13}}{13}+\frac{t^{21}}{21}+\frac{t^{29}}{29}+\frac{t^{37}}{37}+\text{\&c.} \end{array}\right. \\ \hline -\left\{\begin{array}{l} \frac{t^3}{3}+\frac{t^{11}}{11}+\frac{t^{19}}{19}+\frac{t^{27}}{27}+\frac{t^{35}}{35}+\text{\&c.} \\ \frac{t^7}{7}+\frac{t^{15}}{15}+\frac{t^{23}}{23}+\frac{t^{31}}{31}+\frac{t^{39}}{39}+\text{\&c.} \end{array}\right. \end{array}\right.$$

All which ſeries are evidently of the firſt form in article 2. and therefore their values may be expreſſed in the ſecond form there given, or more neatly the Newtonian notation mentioned in art. 5. In each of theſe ſeries the value of n is 8:

$$\text{And the value of } m, \left\{\begin{array}{l} \text{in the firſt ſeries, is 1;} \\ \text{in the ſecond ſeries, is 5;} \\ \text{in the third ſeries, is 3;} \\ \text{in the fourth ſeries, is 7.} \end{array}\right.$$

"If now we take $t=\sqrt{\frac{1}{3}}$, the tangent of 30°, which was choſen by Dr Halley, we ſhall have the arch of 30°

$$=\left\{\begin{array}{l} +\left\{\begin{array}{l} \frac{1}{\sqrt{3}}\times:1+\frac{1}{9.81}+\frac{1}{17.81^2}+\frac{1}{25.81^3}+\frac{1}{33.81^4},\ \text{\&c.} \\ \frac{1}{9\sqrt{3}}\times:\frac{1}{5}+\frac{1}{13\,81}+\frac{1}{21.81^2}+\frac{1}{29.81^3}+\frac{1}{37.81^4},\ \text{\&c.} \end{array}\right. \\ \hline -\left\{\begin{array}{l} \frac{1}{3\sqrt{3}}\times:\frac{1}{3}+\frac{1}{11.81}+\frac{1}{19.81^2}+\frac{1}{27.81^3}+\frac{1}{35.81^4},\ \text{\&c.} \\ \frac{1}{27\sqrt{3}}\times:\frac{1}{7}+\frac{1}{15.81}+\frac{1}{23.81^2}+\frac{1}{31.81^3}+\frac{1}{39\,81^4},\ \text{\&c.} \end{array}\right. \end{array}\right.$$

Six times this quantity will be = the ſemicircumference when radius is 1, and = the whole circumference when the diameter is 1. If therefore we multiply the laſt ſeries by 6, and write $\sqrt{12}$ for $\frac{6}{\sqrt{3}}$, and expreſs their value in the form given in art. 5. we ſhall have the circumference of a circle whoſe diameter is 1,

$$=\left\{\begin{array}{l} +\left\{\begin{array}{l} \frac{81\sqrt{12}}{80}-\frac{8A}{9.80}+\frac{16B}{17.80}-\frac{24C}{25.80}+\frac{32D}{33.80},\ \text{\&c.} \\ \frac{81\sqrt{12}}{5.9\,80}-\frac{8A}{13.80}+\frac{16B}{21.80}-\frac{24C}{29.80}+\frac{32D}{37.80},\ \text{\&c.} \end{array}\right. \\ \hline -\left\{\begin{array}{l} \frac{81\sqrt{12}}{3\,3.80}-\frac{8A}{11.80}+\frac{16B}{19.80}-\frac{24C}{27.80}+\frac{32D}{35.80},\ \text{\&c.} \\ \frac{81\sqrt{12}}{7.27.80}-\frac{8A}{15.80}+\frac{16B}{23.80}-\frac{24C}{31.80}+\frac{32D}{39\,80},\ \text{\&c.} \end{array}\right. \end{array}\right.$$

"7. All theſe new ſeries, it is evident, converge ſomewhat ſwifter than by the powers of 80. For in the firſt ſeries, which has the ſloweſt convergency, the coefficients $\frac{8}{9}$, $\frac{16}{17}$, $\frac{24}{25}$, &c. are each of them leſs than 1; ſo that its convergency is ſomewhat ſwifter than by the powers of 80.

"8. But another advantage of theſe new ſeries is, that the numerator and denominator of every term except the firſt, in each of them, is diviſible by 8; in conſequence of which, the arithmetical operation by them is much facilitated, the diviſion by 80 being exchanged for a diviſion by 10, which is no more than removing the decimal point. Theſe ſeries, then, when the factors which are common to both numerators and denominators are expunged, will ſtand as below (each of which ſtill converging ſomewhat quicker than by the powers of 80), and we ſhall have the circumference of a circle whoſe diameter is 1,

$$=\left\{\begin{array}{l} +\left\{\begin{array}{l} \frac{81\sqrt{12}}{80}-\frac{A}{9.10}+\frac{2B}{17.10}-\frac{3C}{25.10}+\frac{4D}{33.10},\ \text{\&c.} \\ \frac{9\sqrt{12}}{400}-\frac{A}{13.10}+\frac{2B}{21.10}-\frac{3C}{29.10}+\frac{4D}{37.10},\ \text{\&c.} \end{array}\right. \\ \hline -\left\{\begin{array}{l} \frac{9\sqrt{12}}{80}-\frac{A}{11.10}+\frac{2B}{19.10}-\frac{3C}{27.10}+\frac{4D}{35.10},\ \text{\&c.} \\ \frac{3\sqrt{12}}{7.80}-\frac{A}{15.10}+\frac{2B}{23.10}-\frac{3C}{31.10}+\frac{4D}{39.10},\ \text{\&c.} \end{array}\right. \end{array}\right.$$

"By which ſeries the arithmetical computation will be much more eaſy than by the original ſeries."

Quadrature Lines, or *Lines of Quadrature*, are two lines often placed on Gunter's ſector. They are marked with the letter Q, and the figures 5, 6, 7, 8, 9, 10; of which Q denotes the ſide of a ſquare, and the figures denote the ſides of polygons of 5, 6, 7, &c. ſides. Alſo S denotes the ſemidiameter of a circle, and 90 a line equal to the quadrant or 90° in circumference.

QUADRIPARTITION, is the dividing by 4, or into four equal parts. Hence *quadripartite*, &c. the 4th part, or ſomething parted into four.

QUADRUPLE, is four-fold, or ſomething taken four times, or multiplied by 4; and ſo is the converſe of quadripartition.

QUAMPEAGAN *Falls*, at the head of the tide on Newichwanock river, which joins Piſcataqua river 10 miles from the ſea. The natives give the Falls this name, becauſe fiſh were there taken with nets. At theſe falls are a ſet of ſaw and other mills; and a landing place, where great quantities of lumber are raiſed on ſcows. Here the river has the Engliſh name of Salmon Falls river, from the plenty of ſalmon there caught. In the memory of people who lived 50 years ago, theſe fiſh were ſo plenty as to be ſtruck with ſpears on the rocks; but none now alive remember to have ſeen any there. The ſaw-mills where the dam croſſes the ſtream are the ſure deſtruction of that ſpecies of fiſh. Tom-cod, or froſt-fiſh, ſmelts and alewives abound here. The place called Salmon Falls is covered with uſeful mills. Above theſe we meet with the Great Falls, where ſaw-mills are continued to great advantage. On many places from Quampeagan to the pond, from whence it iſſues, are mills for boards and corn.—*Morſe.*

QUAKER *Town*, in Buck's county, Pennſylvania, lies 25 miles N. W. of Newtown, and 33 N. N. W. of Philadelphia.—*ib.*

QUAREQUA, a place ſituated in the Gulf of Darien. Here Vaſques Nunez met with a colony of negroes; but how they had arrived in that region, or how long they had reſided in it, are not recorded by the Spaniſh hiſtorians.—*ib.*

QUART, a meaſure of capacity, being the quarter or 4th part of ſome other meaſure. The Engliſh quart is the 4th part of the gallon, and contains two pints. The Roman quart, or quartarius, was the 4th part of their congius. The French, beſides their quart or pot of two pints, have various other quarts, diſtinguiſhed by the whole of which they are quarters; as *quart de muid*, and *quart de boiſſeau*.

QUARTILE, an aſpect of the planets when they are at the diſtance of three ſigns or 90° from each other; and is denoted by the character □.

QUEECHY, a river of Vermont, which empties into Connecticut river at Hartland.—*Morſe.*

QUEEN ANNE, a ſmall town of Prince George county, Maryland, ſituated on the W. ſide of Patuxent river, acroſs which a wooden bridge is built. The town is ſmall, but is laid out in a regular plan, at the foot of a hill. Here are a few ſtores and two warehouſes for the inſpection of tobacco. It is about 22 miles E. N. E. of the city of Waſhington, 13 S. W. of Annapolis, and 39 S. by W. of Baltimore.—*ib.*

QUEEN ANN's, a county of Maryland, bounded weſterly by Cheſapeak Bay, and N. by Kent county. It contains 15,463 inhabitants, including 6,674 ſlaves. Chief town, Centerville. Kent Iſland belongs to this county; 14 miles in length, from N. to S. and 6½ in breadth, from E. to W. It is low, but fertile land, and its eaſtern ſide is bordered with ſalt marſh.—*ib.*

QUEEN *Charlotte's Iſlands*, on the N. W. coaſt of N. America, extend from lat. 51 42, to 54 18 N. and from long. 129 54 to 133 18 W. from Greenwich. They are named *Waſhington iſles* by American navigators.—*ib.*

QUEEN's, the middle county of Long-Iſland, New-York. Lloyd's Neck, or Queen's Village, and the iſlands called the Two Brothers and Hallett's Iſlands, are included in this county. It is about 30 miles long, and 12 broad, and contains 6 townſhips, and 16,014 inhabitants, including 2,309 ſlaves. Jamaica, Newtown, Hampſtead, in which is a handſome court-houſe, and Oyſter Bay, are the principal towns in this county. The county court-houſe is 8 miles from Jamaica, 10 from Jericho, and 20 from New-York.—*ib.*

Queen's, a county of Nova-Scotia, comprehending a part of the lands on the cape, on the S. ſide of the Bay of Fundy. The ſettlements are as follows: Argyle, on the ſouth ſide of the Bay of Fundy, where a few Scotch and Acadians reſide; next to this, is Yarmouth, ſettled chiefly by emigrants from New-England; Barrington, within the iſland called Cape Sable, ſettled originally by Quakers from Nantucket. Beſides theſe are Port Raiſoir, ſo called by the French, and originally ſettled by the North Iriſh; Liverpool and Port Roſeway, ſettled and inhabited by emigrants from New England.—*ib.*

QUEENSBURY, a townſhip in Waſhington county, New-York, bounded eaſterly by Weſtfield and Kingſbury, and ſoutherly by Albany county. It contains 1,080 inhabitants, of whom 122 are electors.—*ib.*

QUEENSTOWN, in Queen Ann's county, Maryland, a ſmall town on the eaſtern ſide of Cheſter river, 6 miles ſouth-weſt of Centerville, and nearly 20 E. of Annapolis.—*ib.*

Queenstown, in upper Canada, lies on the weſt ſide of the Straits of Niagara, near Fort Niagara, and 9 miles above the falls.—*ib.*

QUELPAERT, an iſland lying in the mouth of the channel of Japan, and ſubject to the king of Corea (See that article *Encycl.*) Till the laſt voyage of La Perouſe, this iſland was known to Europeans only by the wreck of the Dutch ſhip Sparrow-hawk in 1635. On the 21ſt of May 1787, the French Commodore made this iſland, and determined the ſouth point of it to be in Lat. 33° 14′ north, and in Lon. 124° 15′ eaſt from Paris. He ran along the whole ſouth eaſt ſide, at ſix leagues diſtance, and ſays that it is ſcarcely poſſible to find an iſland which affords a finer aſpect; a peak of about a thouſand toiſes, which is viſible at the diſtance of eighteen or twenty leagues, occupies the middle of the iſland, of which it is doubtleſs the reſervoir; the land gradually ſlopes towards the ſea, whence the habitations appear as an amphitheatre. The ſoil ſeemed to be cultivated to a very great height. By the aſſiſtance of glaſſes was perceived the diviſion of fields; they were very much parcelled out, which is the ſtrongeſt proof of a great population. The very varied gradation of colours, from the different ſtates of cultivation, rendered the view of this iſland ſtill more agreeable. Unfortunately, it belongs to a people who are prohibited from all communication with ſtrangers, and who detain in ſlavery thoſe who have the misfortune to be ſhipwrecked on theſe coaſts. Some of the Dutchmen of the ſhip Sparrow-hawk, after a captivity of eighteen years there, during which they received many baſtinadoes, found means to take away a bark, and to croſs to Japan, from which they arrived at Batavia, and afterwards at Amſterdam.

QUEUE D'ARONDE or *Swallow's Tail*, in fortification, is a detached or outwork, whoſe ſides ſpread or open towards the campaign, or draw narrower and cloſer towards the gorge. Of this kind are either ſingle or double tenailles, and ſome horn-works, whoſe ſides are not parallel, but are narrow at the gorge, and open at the head, like the figure of a ſwallow's tail. On the contrary, when the ſides are leſs than the gorge, the work is called *contre queue d'aronde.*

Queue d'aronde, in carpentry, a method of jointing, called alſo *dovetailing.*

QUIBBLETOWN, a village in Middleſex county, New-Jerſey, 6 miles north of New-Brunſwick.—*Morſe.*

QUIBO, an iſland in the mouth of the bay of Panama It is uninhabited; but affords wood and water to ſhipping.—*ib.*

QUILCA, a rich valley in Peru, on which ſtands the ancient city of Arequipa. The port of Quilca is in about lat. 17 8 ſouth, 10 leagues north-weſt of the ſmall river of Xuly, and 6 from the volcano of Arequipa.—*ib.*

QUILLOTA, a ſmall juriſdiction of Chili, in S. America.—*ib.*

QUINABAUG, a river formerly called *Mohegan*, which riſes in Brimfield, Maſſachuſetts, and is joined at Oxford by French river, which has its ſource in Sutton, Worceſter county. It runs a ſoutherly courſe, and empties into Shetucket, about three miles above Norwich Landing, in Connecticut.—*ib.*

QUINCY, a poſt-town of Maſſachuſetts, in Norfolk county, taken from Braintree, 10 miles ſoutherly of Boſton, 9 weſt of Hingham, and 360 north eaſt of Philadelphia.—*ib.*

QUINEPAUGE, or *Eaſt River*, in Connecticut, runs a ſoutherly courſe, and empties into the north-eaſt corner of New-Haven harbour.—*ib.*

QUINSIGAMOND, *Worceſter*, or *Long Pond*, is a beautiful piece of water in the form of a creſcent, about 4 miles in length and from 60 to 100 rods broad. It is ſituated on the line between the towns of Worceſter and Shrewſbury, but the greater part of it is in the latter. It is interſperſed with a number of iſlands, one of which is upwards of 200 acres in extent.—*ib.*

QUINTAL, the weight of a hundred pounds, in moſt countries: but in England it is the hundred weight, or 112 pounds. Quintal was alſo formerly uſed for a weight of lead, iron, or other common metal, uſually equal to a hundred pounds, at 6 ſcore to the hundred.

QUINTILE, in aſtronomy, an aſpect of the planets when they are diſtant the 5th part of the zodiac, or 72 degrees; and is marked thus, C or O.

QUISPICHANCHI, a juriſdiction in the dioceſe of Cuſco, and kingdom of Peru, beginning at the ſouth gates of Quito, and ſtretching from eaſt to weſt about 20 leagues. The lands of this juriſdiction belong, in general, to the gentry of Cuſco, and produce plenty of wheat, maize and fruits. Here are alſo manufactures of baize and coarſe woollen ſtuffs. Part of the juriſdiction borders on the foreſts inhabited by wild Indians, and produces great quantities of coca, an herb greatly uſed by the Indians working in the mines.—*Morſe.*

QUITAPAHILLA, a branch of the Swetara, which falls into the Suſquehannah at Middleton.—*ib.*

QUIVA, a province of California, thinly inhabited, and but little known.—*ib.*

QUIXOS, a diſtrict of Peru, in South-America.—*ib.*

R.

RABY, a ſmall townſhip of N. Hampſhire, in Hillſborough county, about 65 miles W. by S. of Portſmouth, and 47 N. W. of Boſton. It was incorporated in 1760, and contains 338 inhabitants.—*Morſe.*

RACE, *Cape*, the S E. point of New-foundland Iſland, in the N. Atlantic Ocean, 4 leagues ſouth of Cape Ballard. N. lat. 46 43, W. long. 52 49. The Virgin Rocks, much dreaded by mariners, are about 20 leagues to the S. E. of Cape Race.—*ib.*

RACE *Point*, the north-weſtern extremity of Cape Cod, Maſſachuſetts, a league N. W. of Provincetown. When within a mile of this point, with a fair wind and tide of flood, your courſe to Boſton is N. W. by W. diſtance 15 leagues. A number of huts are erected here on the looſe ſands by thoſe who come from Provincetown to fiſh in boats —*ib.*

RACHITIS, RICKETS (See MEDICINE-*Index Encycl.*), is a diſeaſe ſo formidable to children, that we believe no parent will think the following abſtract of *Bonhomme's* memoir on the nature and treatment of it too long even for this *Supplement*.

The change which the bones undergo in this diſorder, has long been attributed to the action of an acid on their ſubſtance; but this ſuppoſition was grounded on mere conjecture and remote analogy. Bonhomme holds the ſame opinion on better grounds; and the principal notions which conſtitute the baſis of his memoir are the following:

1. According to him, the nature of the rachitic diſorder ariſes, on the one hand, from the developement of an acid approaching in its properties to the vegetable acids, particularly the oxalic; and, on the other, from the defect of phoſphoric acid, of which the combination with the animal calcareous earth forms the natural baſis of the bones, and gives them their ſolidity. Whence it follows, that the indication reſulting from this propoſition, if once adopted, would be, that the treatment of rachitis muſt depend on two principal points, namely, to prevent the developement of the oxalic acid, and to re-eſtabliſh the combination of the phoſphoric acid with the baſis of the bones to which they owe their ſolidity.

2. The author proves, by experiments and obſervations, in the firſt place, that alkaline lotions of the parts affected with rachitis contribute to their cure; next, that the calcareous phoſphate taken internally is really tranſmitted by the lymphatic paſſages, and contributes to oſſification, and laſtly, that the internal uſe of calcareous phoſphate, whether alone or combined with the phoſphate of ſoda, powerfully contributes to reſtore the natural proportions in the ſubſtance of the bones, and accelerate the cure of rachitis.

With regard to the author's endeavours to prove that the calcareous acid is wanting in the bones of thoſe who

who are diſordered with rachitis, and that the developement of oxalic acid contributes to the diſeaſe, we muſt not conceal that his memoir contains views rather than abſolute proofs of theſe two poſitions. He declares, himſelf, he was not provided with the neceſſary means to eſtabliſh an exact and complete analyſis. He therefore preſents his ideas, in this reſpect, merely as conjectures approaching to the truth.

The effect of the action of acids upon bones was before known; that is to ſay, that when deprived of calcareous phoſphate, and reduced to the gelatinous parenchyma which forms one of their elements, they loſe their conſiſtence, and become flexible. Hence it was already conjectured by various phyſicians, that the rachitis was the effect of a peculiar acid.

A diſpoſition to aceſcence in the firſt paſſages is obſervable in all infants. The odour which characterizes this aceſcence is often manifeſt in their breath, and even their perſpiration. The bile corrects this diſpoſition; but in general the bile is wanting in rachitic infants. It does not colour their excrements, and the acids accordingly are developed in a very decided manner. They diſturb the circulation, and attack and ſoften the bones. As it is by defect of animalization that theſe acids develope themſelves, it follows that their character is analogous to the fermenteſcible vegetable acids, and more or leſs to the oxalic acid; and that, on the contrary, the animal acid or phoſphoric acid ceaſes to be formed, and to unite with the animal calcareous earth; whence they are deprived of the principle of their ſolidity. This is the theory of Citizen Bonhomme.

In order to eſtabliſh this doctrine upon preciſe experiments, it was requiſite to analyſe rachitic bones comparatively with thoſe of healthy individuals of the ſame age; and as it is known that the urine of rachitic ſubjects depoſits a great quantity of a ſubſtance of ſparing ſolubility and earthy appearance, it would have been advantageous to have joined a complete analyſis of this urine and its ſediment. Citizen Bonhomme, not being provided with the means ſufficient to make theſe analyſes, and being beſides of opinion that ſuch rachitic bones as are deſtroyed by this malady exiſt in a progreſſive ſtate of change, which might render their analyſis ſcarcely ſuſceptible of compariſon, limited himſelf to a collection of ſome of the moſt remarkable phenomena of the urine, of the aged, the adult, and infants in the healthy ſtate, of infants in the rachitic ſtate, and of patients after the perfect cure of this diſorder. From theſe obſervations he has deduced ſeveral important reſults.

It is known, that when the urine contains diſengaged phoſphoric acid, as happens to aged individuals, and in ſome peculiar circumſtances of the ſyſtem, if lime water be poured in, there is a ſpeedy depoſition of calcareous phoſphate. It is alſo known, that when a ſolution of the nitrate of mercury is poured to the freſh urine of adults, a roſe coloured precipitate is formed, which is a phoſphate of mercury produced by the decompoſition of the phoſphates contained in the urine. Theſe two proofs are therefore extremely proper to aſcertain the preſence of phoſphoric acid, whether free or combined, in a fluid which in its natural ſtate contains a remarkable proportion. Beſides this principle, the urine depoſits more or leſs of ſediment, either gelatinous or of an earthy appearance; and, laſtly, by evaporation, a ſaponaceous and ſaline extract, in greater or leſs abundance, is obtained by evaporation. By means of theſe four methods of examination, the author has aſcertained the following facts:

1. In the healthy ſtate, the ſediment naturally depoſited by urine is almoſt totally gelatinous in the infant and the adult, and in the aged individual it is ſurcharged with an abundant ſediment of an earthy appearance ſimilar to the earth of bones, which conſequently is calcareous phoſphate. 2. The quantity of brown ſaponaceous ſaline extract afforded by evaporation is greater in proportion to the age. 3. The preſence of diſengaged phoſphoric acid, as ſhewn by lime water, is none in the urine of infants, ſcarcely perceptible in that of adults, but very remarkable in that of old men. For two ounces of this laſt urine afforded by this means ten grains of phoſphate of lime. 4. The decompoſition of the phoſphates by nitrate of mercury is not ſeen in the urine of infants; an abundant precipitate of a light roſe-colour is produced in this way from the urine of adults; and in that of old men this precipitate is always of a grey colour, and very abundant. Hence Citizen Bonhomme concludes, that the phoſphoric acid, whether at liberty or combined, does exiſt in the urine of healthy individuals in proportion to the deſtruction of the ſolids by age, and that it increaſes with the age.

With regard to the urine of rachitic ſubjects, the moſt remarkable facts are, 1. The abundant and apparently earthy ſediment it depoſits (ſpontaneouſly) is different from that of old men, by its colour, which is grey, and does not reſemble phoſphate of lime, and alſo by its much greater quantity. For a pound of this urine let fall two gros, whereas the ſame quantity of the urine of old men depoſited only 45 grains. 2. The extract left by evaporation is likewiſe much more conſiderable than in other urine. It is one-third more in quantity than the extract afforded even by the urine of aged perſons.

From theſe two firſt obſervations it follows, that the ſolids in rachitic ſubjects are deſtroyed with much more rapidity than even in old men; and that they afford a much more abundant portion of waſte to the urine.

3. The light depoſition occaſioned by lime water in the urine of rachitic ſubjects is very ſmall in quantity, brown, gelatinous when freſh, and pulverulent when dry. It does not at all reſemble calcareous phoſphate. 4. The depoſition formed by the ſolution of mercurial nitrate is not abundant, neither of a roſe colour as in the urine of adults, nor grey like that of old men. It is always white, and conſequently has no external reſemblance to the phoſphate of mercury. The author affirms that it reſembles a mercurial oxalate. Laſtly, the urine of the ſame rachitic ſubjects when cured, exhibits again all the characters obſerved in the urine of healthy children. We ſhall not add to the reflections of the author. In effect, though theſe firſt obſervations are curious, they are incomplete. We offer them to phyſicians ſimply as the elements of an inveſtigation which it is of importance to continue and bring to perfection. We ſhall therefore proceed to the curative and experimental parts of the memoir.

One of the facts which it was of the utmoſt importance to eſtabliſh, was the tranſition of the calcareous phoſphate from the inteſtinal paſſages, into thoſe of circulation and ſecretion. Fourcroy had already well aſcertained

certained that the ſerum of milk contains this ſalt naturally. Vauquelin had proved its exiſtence, as well as that of pure ſoda, in the ſeminal fluid; but was it poſſible that it could paſs unaltered from the ſtomach and inteſtines into the veſſels which contain the blood and lymph? Could it by this means apply itſelf to the bones? This was to be aſcertained by experiments; and the following are the experiments made by Bonhomme for that purpoſe. We give them in a tranſlation of his own words.

"I cauſed (ſays he) ſeveral young fowls of the ſame incubation to be fed in different manners. Some received the uſual food without any mixture; others received daily a certain quantity of calcareous phoſphate mixed in the ſame paſte as formed the ſupport of the others; and, laſtly, one of them was fed with variations in the uſe of the mixture: the calcareous phoſphate was ſometimes given and ſometimes ſuſpended. When theſe fowls, after two months, had acquired their ordinary growth, I examined and carefully compared the ſtate of their bones. The progreſs of the oſſification in the epiphyſes was various according to the nature of the food the animal had received. The bones of the laſt fowl, which had received the phoſphate only from time to time, were rather more advanced than the bones of thoſe which had been fed without mixture. The bones of thoſe fowls which had been habitually fed with the mixture were evidently more ſolid, and their epiphyſes were much leſs perceptible. Simple inſpection was ſufficient to ſhew theſe differences when the bones were mixed together.

"I had fed ſeveral young fowls of the ſame incubation according to another plan. Some were fed on a ſimple paſte, without mixture; for others it was mixed with pulveriſed madder-root; and a third compoſition was made of this laſt paſte and calcareous phoſphate. This was alſo given habitually to other fowls. When after two months I examined the progreſs of oſſification in the bones of theſe different animals, I eaſily perceived the red traces of the madder in the oſſified parts of all thoſe which had uſed it; but I obſerved, that the oſſification was not more advanced by the ſimple mixture of this root than by the ordinary food: on the contrary, the bones of thoſe fowls which had ſwallowed the phoſphate mixed with madder were much more ſolid than the others. The red colour ſerved admirably to diſtinguiſh the extremities of the long bones from their epiphyſes. After an exact compariſon, there could be no doubt of the efficacy of calcareous phoſphate in favour of the progreſs of oſſification. The virtue of the madder ſeemed confined to that of giving colour to the oſſified parts."

From theſe experiments, it was natural to make the trial of calcareous phoſphate in addition to the remedies made uſe of in the treatment of rachitic ſubjects. Here follows what the author himſelf ſays of two remarkable inſtances in which the calcareous phoſphate was adminiſtered with ſucceſs:

"The daughter of Mr Ranchon watchmaker, aged two years and a half, walked with a feeble and tottering pace, and the extremities of all her bones preſented epiphyſes very prominent. In this ſituation ſhe exhibited the appearance of imperfect rachitis, or the firſt period of this diſorder. Alkaline lotions which I immediately adviſed, were attended with a good effect. Her ſleep became more firm; and as the firſt paſſages were in a good ſtate, I gave, without internal preparation, one ſcruple of a mixture of equal parts of phoſphate of lime and phoſphate of ſoda twice a day. In the courſe of three weeks her legs were perfectly reſtored; and this amiable infant has ever ſince had the ſatisfaction to run with ſpirit and agility.

"A female infant, of the name of Boiard, aged four years, had experienced from her birth the moſt decided ſymptoms of rachitis. The protuberance of the epiphyſes and tumefaction of the abdomen firſt indicated the diſeaſe. The impoſſibility of ſupporting herſelf and walking at the uſual age confirmed theſe unfortunate ſymptoms. By degrees the glands of the neck and of the meſentery became ſwelled; the teeth were blackened, became carious, and were not replaced. This ſituation became ſtill more afflicting by criſes almoſt periodical at an interval of three or four weeks. At theſe afflicting periods, a fever of conſiderable ſtrength, cardialgia, and even convulſions, particularly in the night, were obſerved. The termination of each paroxyſm was announced or aſcertained by abundant ſtools, and the evacuation of urine ſtrongly charged with an earthy ſediment. The imprudent exhibition of a purge at the beginning of one of theſe criſes had nearly deprived the patient of her life. In this ſtate it was that I beheld her for the firſt time in the month of January 1791. The alkaline lotion was the only remedy the mother adopted in the firſt inſtance, and it produced a remarkable effect. After eight days the infant was ſo much better as to be able to ſupport herſelf. The remedy was then laid aſide, and eight days afterwards the child was incapable of ſtanding without ſupport. The uſe of the alkaline ſolution being renewed, was attended with the ſame ſucceſs, and its diſcontinuance was again followed by the complete return of all the ſymptoms. In the firſt days of March, the other remedies I had adviſed were exhibited. The conſtipation which had always exiſted became leſs, and the following criſis was effected without pain. And at length the convulſions, the pains, and the criſes diſappeared; but the impoſſibility of walking ſtill remained. At this time, namely on the ſecond of May, I gave the child the phoſphate of ſoda and calcareous phoſphate mixed together, in the doſe of half a dram twice a-day. At the end of the month ſhe was able to ſtand upright, leaning againſt a chair, and the ſwellings began to diminiſh. She continued for a long time afterwards to take the mixture of the phoſphates. I likewiſe gave her occaſionally one grain of the extract of bile, prepared with ſpirit of wine; and at length in the month of July I had the pleaſure to ſee the patient run and play in the middle of the ſtreet with the other children of her own age, &c.

The author gives other inſtances of this medicine being adminiſtered with complete ſucceſs to rachitic children, and one in which it was attended with the beſt effects in a caſe of incurvated ſpine. Theſe it is needleſs to inſert, becauſe we truſt that none of our leſs learned readers will have recourſe to the medicine without the advice of a phyſician; and to him an enumeration of caſes could ſerve no purpoſe. It may be proper, however, as alkaline lotions and their beneficial effects are mentioned, to give here the author's account of the lotion which he uſed.

"In ordinary caſes of rachitis, particularly at the commencement of the diſorder, it is of advantage to uſe a ſimple ſolution of pot-aſh to waſh the parts affected. This ſolution is made by diſſolving from half an ounce to an ounce of purified pot-aſh in a pound of diſtilled or very pure ſpring water. When it is to be uſed, the ſkin muſt firſt be rubbed with a dry cloth or a piece of fine flannel. After this precaution, the diſeaſed extremities are to be waſhed carefully with the warm ſolution, and at length wiped, ſo as to leave no trace of moiſture. This practice and waſhing muſt be repeated at leaſt twice a-day. I can affirm, from repeated trials, that it will ſoon be attended with ſucceſs."

In a note on this paſſage, M. Hallé, who analyſed the memoir at the deſire of the Society of Medicine at Paris, juſtly obſerves, that as pure potaſs, or the vegetable alkali, is a moſt powerful cauſtic, it cannot be uſed in theſe proportions: adding, that he found one-eighth part of the ſalt here indicated to form too ſtrong a lotion for the ſkin of an infant. M. Bonhomme, upon enquiry being made, informed him, that the potaſs which he uſed was that of the ſhops, which is very far from being pure; and Mr Nicholſon conjectures that it was the common ſalt of tartar of our ſhops. This, we think, extremely probable, eſpecially as M. Bonhomme aſſures us that even a lixium of wood aſhes, ſuch as is uſed for waſhing fine linen, may anſwer the purpoſe extremely well.

For a fuller account of this intereſting memoir our readers are referred to the 17th volume of the *Annals de Chimie*, or to the firſt volume of *Nicholſon's Philoſophical Journal*.

RADNOR, a ſmall pleaſant town of Delaware county, Pennſylvania. This place was originally called *Amſtel*, by the Dutch, who began to build here.—*Morse.*

RADNOR, a town of S. Carolina, 10 miles S. W. of Edmondſbury, and 32 N. E. of Puryſburg.—*ib.*

RAGGED *Harbour*, on the eaſt coaſt of Newfoundland, is a part of Catalina Bay. Many craggy rocks lie about the entrance of it, both within and without; ſo that it is very dangerous to enter. It is 2 leagues northward of Catalina harbour. There is good water at the head of the harbour.—*ib.*

RAIMOND, a cape on the ſouth ſide of the ſouth peninſula of the iſland of St Domingo; 2 leagues weſt of Point Baynet and 11 weſt of Cape Marechaux. It has the cove Petite Anſe on the eaſt, and that of Breſiliere on the weſt.—*ib.*

RAINY *Iſland River*, a ſmall river of the N. W. Territory; having a north-weſt courſe, and empties into Illinois river, about half way between the Little Rocks and Illinois Lake, and 255 miles from the Miſſiſſippi. It is 15 yards wide, and is navigable 9 miles to the rocks.—*ib.*

RAINY, or *Long Lake*, lies eaſt of the Lake of the Woods, and weſt of Lake Superior. It is ſaid to be nearly 100 miles long, and in no part above 20 miles wide.—*ib.*

RAJA, the *ray fiſh*. See *Encyclopædia*, where is is ſaid that the *oxyrinchus* or ſharp noted ray, is ſuppoſed to be the *bos* of the ancients; but if there be any truth in the following narrative, which we confeſs has much the air of fiction, this is probably a miſtake. It is the narrative of Vaillant, and we ſhall give it in his own words.

"In the latitude 10° 15′ north, and longitude 355°, an enormous flat fiſh of the ray genus (ſays he), came and ſwam round our veſſel. It differed from the common ray, however, in the ſhape of its head, which, inſtead of being pointed, formed a creſcent, and from the extremities of the ſemicircle iſſued two arms as it were, which the ſailors called horns. They were two feet wide at the baſe, and only five inches at the extremity. This monſter they told me was called the *ſea-devil*.

"A few hours after, we ſaw two others with this, one of which was ſo extremely large, that it was computed by the crew to be *fifty* or *ſixty* feet wide. Each ſwam ſeparately, and was ſurrounded by thoſe ſmall fiſh which uſually precede the ſhark, and which are therefore called by ſeamen *pilot-fiſh*. Laſtly, all three carried on each of their horns a white fiſh, about the ſize of a man's arm, and half a yard long, which appeared to be ſtationed there on duty.

"You would have ſaid they were two ſentinels placed to keep watch for the ſafety of the animal, to inform him of any approaching danger, and to guide his movements. If he approached too near the veſſel, they quitted their poſts, and, ſwimming briſkly before, led him away. If he roſe too high above the water, they paſſed backward and forward over his back till he had deſcended deeper. If, on the contrary, he ſwam too low, they diſappeared, and we ſaw no more of them, becauſe, no doubt, they were paſſing underneath, as in the preceding inſtance they had paſſed above him. Accordingly we found him re-aſcend towards the ſurface, and then the two ſentinels reaſſumed their poſts, each on his horn."

Theſe manœuvres continued three days; and to give our author the better opportunity of obſerving them, the ſhip moſt fortunately was becalmed the whole time. He was naturally very deſirous of catching one of them that he might examine it at leiſure; and, by bribing the ſeamen with a dozen of bottles of wine, he accompliſhed his object. One of the fiſh was ſtruck with twelve or fifteen harpoons; ſeveral halſers were paſſed round his body, and he was hoiſted on board.

"This (ſays our author) was the leaſt of the three, being only *eight-and-twenty* feet in its extreme breadth, and *one-and-twenty* in length from the extremity of the horns to that of the tail. The tail, which was thick in proportion to the body, was *twenty two inches* long. The mouth, placed exactly like that of the ray, was wide enough to ſwallow a man with eaſe. The ſkin was white under the belly, and brown on the back, like that of the ray. We reckoned the animal to weigh not leſs, certainly, than a ton."

We think it was fortunate that they chanced to ſtrike the ſmalleſt fiſh; for an addition of eight or ten ton weight, which the largeſt ray muſt have weighed, as certainly as the ſmalleſt weighed one ton, might have been very inconvenient on board a ſhip already loaded. We do not remember to have anywhere met with a deſcription of this ray before, and we think it ſhould be conſidered as a new ſpecies; but we ſhall not give it a name till its exiſtence be better aſcertained, when we ſubmit to the pupils of Linnæus, whether it may not be proper to give it the ancient name *bos*.

RAJAH. (See *Encyclopædia*.) We learn from Sir Charles Rouſe Boughton's *Diſſertation concerning the Landed Property of Bengal*, that this title is conferred upon

upon Hindoos by the emperor, and frequently given out of courteſy to the greater zemindars. It would appear therefore that the Rajahs can never be independent of the Mogul but by a ſucceſsful rebellion.

RALEIGH, the preſent ſeat of government of N. Carolina; ſituated in Wake county, about 10 miles from Wake court-houſe. In December, 1791, the general aſſembly of the State appropriated £10,000 towards erecting public buildings, and named it after the celebrated Sir Walter Raleigh, under whoſe direction the firſt ſettlement in N. America was made at Roanoke Iſland, in Albemarle Sound. The ſtate-houſe, a large handſome building, has been lately finiſhed, and coſt £6,000. Several other buildings have been erected, and a number of dwelling-houſes. The ſituation is healthy. Its remoteneſs from navigation is the greateſt diſadvantage. It is 61 miles north by eaſt of Fayetteville, 147 from Peterſburg in Virginia, and 448 ſouth-weſt of Philadelphia.—*Morſe.*

RAMADA, a maritime town of Granada, in S. America. Near it is a copper mine. N. lat. 11 10, W. long. 72 20.—*ib.*

RAMSAY's *Mills*, in N. Carolina, are ſituated at the confluence of Deep, with the north-weſt branch of Cape Fear river; about 35 miles ſouth-weſterly of Hillſborough, and 55 S. E. of Guildford court-houſe. —*ib.*

RANAI, one of the Sandwich Iſlands, in the North Pacific Ocean, north of Tahoorowa, and north-weſt of Mowee and Owhyhee. It has about 24,000 inhabitants. It abounds with yams, ſweet potatoes, and taro, but has few plantains or bread fruit trees.—*ib.*

RANCHEIRA, a town of Terra Firma, in the province of New Granada. N. lat. 11 34, W. long. 72.—*ib.*

RANCHENO, a ſmall iſland on the coaſt of New Mexico, in lat. 7 14 N. It is near the iſland of Quibo, and affords timber fit for maſts.—*ib.*

RANDOLPH, a townſhip of Maſſachuſetts, formed of the ſouth precinct of Braintree, in Norfolk county in the year 1793. It is 15 miles ſouth by eaſt of Boſton.—*ib.*

Randolph, a county of Hillſborough diſtrict, N. Carolina, bounded north-eaſt by Orange, and north-weſt by Guildford. It contains 7,276 inhabitants, including 452 ſlaves. Its court-houſe is 585 miles from Philadelphia.—*ib.*

Randolph, a county of Virginia, bounded north by Monongalia, and ſouth by Pendleton. It contains 951 inhabitants, including 19 ſlaves. Cheat river, the eaſtern branch of Monongahela river riſes here, on the north-weſt ſide of the Alleghany mountains.—*ib.*

Randolph, a townſhip in Orange county, Vermont, the fourth town weſt of Thetford on Connecticut river. It contains 892 inhabitants.—*ib.*

RANDOM, a townſhip in Eſſex county, Vermont, weſt of Brunſwick, granted in 1780.—*ib.*

RAPHAEL, a fertile and healthy canton, or diſtrict, the weſternmoſt in the Spaniſh part of the iſland of St Domingo. Its boundary to the north is formed in part of the French pariſh of Gonaives. The air round St Raphael is very cool and ſalubrious, but the town which is in a hollow, is very hot. It has a little garriſon which ſerved as a check on the ſmuggling trade with the French. Atalaye, (that is the centinel or diſcovery) the weſternmoſt town of all the Spaniſh colony, is 2½ leagues S. W. of the town of St Raphael, both which pariſhes are annexed to Hinche. The town of St Raphael is 10 leagues ſoutherly of Cape Francois, and 72 N. W. of St Domingo city, as the road runs.—*ib.*

Raphael, *Cape St*, at the eaſt end of the iſland of St Domingo is the ſouth-eaſt limit of Samana Bay, 7½ leagues diſtant in that direction from Cape Samana or Cape Rezon, which laſt is ſituated in lat. 19 15 40 N. and long. 71 33 30 W. from Paris. From Cape Raphael, or Cape of the Round Mountain, to Punta Eſpada, the ſouth-eaſt point of the iſland, the country is level 16 leagues, by a breadth nearly equal.—*ib.*

RAPHOE, a townſhip in Lancaſter county, Pennſylvania.—*ib.*

RAPID *Ann*, a ſmall river of Virginia, which joins the Rappahannock, about 10 miles above Frederickſburg.—*ib.*

RAPID *River*, a water of Hudſon's Bay.—*ib.*

RAPPAHANNOCK, a large navigable river of Virginia, which riſes in the Blue Ridge, and runs about 130 miles from north-weſt to ſouth-eaſt, and enters into Cheſapeak Bay between Windmill and Stingray points. It waters the towns of Falmouth, Frederickſburg, Port Royal, Leeds, Tappahannock and Urbanna. It affords 4 fathoms water to Hobbs's Hole, and 2 from thence to Frederickſburg, 110 miles from its mouth. It is 1½ leagues from Gwin's Iſlands, and 6 northward of New Point Comfort. A ſingle lump of gold ore has been found near the falls of this river, which yielded 17dwt. of gold of extraordinary ductility. No other indication of gold has been diſcovered in its neighbourhood.—*ib.*

RARITON *River*, in New-Jerſey, is formed by two conſiderable ſtreams, called the N. and S. branches; the ſource of the one is in Morris county, that of the other in Hunterdon county. It paſſes by Brunſwick and Amboy, and mingling with the waters of the Arthur Kull Sound, helps to form the fine harbour of Amboy. At Rariton Hills, through which this river paſſes, is a ſmall caſcade, where the water falls 15 or 20 feet, very romantically between two rocks. Oppoſite to Brunſwick, the river is ſo ſhallow, that it is fordable at low water for horſes and carriages; but a little below it deepens ſo faſt, that a 20 gun ſhip may ride ſecurely at any time of tide. The tide riſes ſo high, that large ſhallops uſed to paſs a mile above the ford; ſo that it was no uncommon thing to ſee veſſels of conſiderable burthen riding at anchor, and a number of large river craft lying above, ſome dry, and others on their beam-ends for want of water, within gun ſhot of each other. Copper ore has been found on the upper part of this river; and in the year 1754, the ore of this mine ſold for £62 ſterling per ton, being of inferior quality to that on Paſſaik river.—*ib.*

Rariton, a town ſituated between the mouth of the north branch of the above river, and Boundbrook, 5 miles weſt-north-weſt of Boundbrook, and 12 north-weſt of Brunſwick.—*ib.*

RAYEI-ul-mulk, in the language of Bengal, the uſage of the country, the common law.

RATIO (See *Encyclopædia*) has been defined by

Euclid, in the 5th book of his Elements, in terms to which many mathematicians have objected; and his definition of proportion, which is ſo ultimately connected with it, is ſtill more objectionable. The Rev. Abraham Robertſon of Oxford, in a ſmall tract publiſhed in 1789, demonſtrates the truth of the two definitions in queſtion in ſeven propoſitions, of which the ſubſtance is as follows. He firſt lays down theſe four definitions:

"1. Ratio is the relation which one magnitude has to another, of the ſame kind, with reſpect to quantity.

"2. If the firſt of four magnitudes be exactly as great when compared to the ſecond, as the third is when compared to the fourth, the firſt is ſaid to have to the ſecond the ſame ratio that the third has to the fourth.

"3. If the firſt of four magnitudes be greater, when compared to the ſecond, than the third is when compared to the fourth, the firſt is ſaid to have to the ſecond a greater ratio than the third has to the fourth.

"4. If the firſt of four magnitudes be leſs, when compared to the ſecond, than the third is when compared to the fourth, the firſt is ſaid to have to the ſecond a leſs ratio than the third has to the fourth."

He then demonſtrates, by reaſoning ſtrictly geometrical, the following propoſitions:

Prop. 1. If the firſt of four magnitudes have to the ſecond, the ſame ratio which the third has to the fourth; then, if the firſt be equal to the ſecond, the third is equal to the fourth; if greater, greater; if leſs, leſs.

Prop. 2. If the firſt of four magnitudes be to the ſecond as the third to the fourth, and if any equimultiples whatever of the firſt and third be taken, and alſo any equimultiples of the ſecond and fourth; the multiple of the firſt will be to the multiple of the ſecond as the multiple of the third to the multiple of the fourth.

Prop. 3. If the firſt of four magnitudes be to the ſecond as the third to the fourth, and if any like aliquot parts whatever be taken of the firſt and third, and any like aliquot parts whatever of the ſecond and fourth, the part of the firſt will be to the part of the ſecond as the part of the third to the part of the fourth.

Prop. 4. If the firſt of four magnitudes be to the ſecond as the third to the fourth, and if any equimultiples whatever be taken of the firſt and third, and any whatever of the ſecond and fourth; if the multiple of the firſt be equal to the multiple of the ſecond, the multiple of the third will be equal to the multiple of the fourth; if greater, greater; if leſs, leſs.

Prop. 5. If the firſt of four magnitudes be to the ſecond as the third is to a magnitude leſs than the fourth, then it is poſſible to take certain equimultiples of the firſt and third, and certain equimultiples of the ſecond and fourth, ſuch, that the multiple of the firſt ſhall be greater than the multiple of the ſecond, but the multiple of the third not greater than the multiple of the fourth.

Prop. 6. If the firſt of four magnitudes be to the ſecond as the third is to a magnitude greater than the fourth, then certain equimultiples can be taken of the firſt and third, and certain equimultiples of the ſecond and fourth, ſuch, that the multiple of the firſt ſhall be leſs than the multiple of the ſecond, but the multiple of the third not leſs than the multiple of the fourth.

Prop. 7. If any equimultiples whatever be taken of the firſt and third of four magnitudes, and any equimultiples whatever of the ſecond and fourth; and if when the multiple of the firſt is leſs than that of the ſecond, the multiple of the third is alſo leſs than that of the fourth; or if when the multiple of the firſt is equal to that of the ſecond, the multiple of the third is alſo equal to that of the fourth; or if when the multiple of the firſt is greater than that of the ſecond, the multiple of the third is alſo greater than that of the fourth: then, the firſt of the four magnitudes ſhall be to the ſecond as the third to the fourth.

RATIONAL, in arithmetic, &c. the quality of numbers, fractions, quantities, &c. when they can be expreſſed by common numbers; in contradiſtinction to irrational or ſurd ones, which cannot be expreſſed in common numbers.

RATTLE-SNAKE *Iſlands* lie at the weſtern end of Lake Erie.—*Morſe.*

RAWDON, a town of Nova-Scotia, 40 miles from Halifax, containing about 50 or 60 houſes.—*ib.*

RAWAY, or *Bridgetown*, a lively commercial village of Middleſex county, New-Jerſey, on Raway river, 4 or 5 miles ſouth-weſt of Elizabeth-Town, and 75 from Philadelphia. It contains a preſbyterian church, and about 50 or 60 houſes.—*ib.*

RAYMOND, a townſhip of New-Hampſhire, in Rockingham county, 12 or 14 miles weſterly of Exeter, and 32 from Portſmouth. It was incorporated in 1764, and contains 727 inhabitants.—*ib.*

RAYMOND, or *Raymondtown*, a ſettlement in Cumberland county, Diſtrict of Maine, 142 miles N. N. E. of Boſton, and contains 345 inhabitants. A ſtream from Songo Pond, after paſſing through part of Greenland, Waterford and Ottisfield, falls into the north-eaſterly part of Sebago lake in this ſettlement. The land is generally level, except one large hill, name Rattleſnake Hill, from its abounding with theſe reptiles. Here are ſome ſwells of good land, but the greater part of the growth is pine and white-oak, and the land is hard to ſubdue.—*ib.*

RAYNAL (William Thomas), commonly called the Abbé Raynal, was educated among the Jeſuits, and had become one of the order. The learning of that Society is univerſally known, as well as the happy talents which its ſuperiors poſſeſſed, of aſſigning to each member his proper employment. Raynal, however, after having acquired among them a taſte for literature and ſcience, had probably become refractory, for he was expelled from the order; and the cauſe of his expulſion, according to the Abbé Barruel, was his impiety.

With the real cauſe of his expulſion M. Barruel is ſurely much better acquainted than we can pretend to be: but we have a ſtrong ſuſpicion that his impieties had not then reached farther than to call in queſtion the ſupreme authority of the church; for our author himſelf aſſures us, that he did not utter his atrocious declarations againſt Chriſtianity till he had ceaſed to be a member of the order of Jeſuits. He then aſſociated himſelf with Voltaire, D'Alembert, and Diderot, and was by them employed to furniſh the theological articles for the *Encyclopédie*. But though his religious opinions were certainly lax, and his moral principles very exceptionable. he could not even then be what, in a Proteſtant country, would be deemed a man remarkable for impiety; for he employed the Abbé Yvon, whom M. Barruel calls an odd metaphyſician, but an inoffenſive and upright man, to write the articles which he was engaged to furniſh. In the conducting of this tranſaction, he ſhewed, indeed, that he poſſeſſed not a proper ſenſe of honour; for he paid poor Yvon with twenty-five louis d'ors for writing theological articles, for which he received himſelf ſix times that ſum. This trick was diſcovered, Raynal was diſgraced, and compelled to pay up the balance to Abbé Yvon; but tho' he had thus ſhewn himſelf to be without honour, it is difficult to believe that he had yet proceeded ſo far as to blaſpheme Chriſt, ſince he had employed a Chriſtian divine to ſupply his place in the *Encyclopédie*.

His firſt work of eminence, and that indeed upon which his fame is chiefly built, is his "Political and Philoſophical Hiſtory of the European Settlements in the Eaſt and Weſt Indies." That this hiſtory is written in an animated ſtyle, and that it contains many juſt reflections, both political and philoſophical, is known to all Europe; for it has been tranſlated into every European language. Its beauties, however, are deformed by many ſentiments that are irreligious, and by ſome that are impure. It was followed, we think, in 1780, by a ſmall tract entitled "The Revolution of America;" in which the author pleads the cauſe of the revolted coloniſts with a degree of zeal, cenſures the conduct of the Britiſh government with a keenneſs of aſperity, and diſplays a knowledge of the principles and intrigues of the different factions which at that period divided the Engliſh nation, that ſurely was not natural to the impartial pen of a philoſophic foreigner. Hence he has been ſuppoſed to have been incited to the undertaking, and to have been furniſhed with part of his materials, by that deſperate faction which uniformly oppoſed the meaſures of Lord North, and ſecretly fomented the oppoſition in America. Be this as it may, he propagated, both in this tract and in his hiſtory, a number of licentious opinions reſpecting government and religion, of which he lived to regret the conſequences.

A proſecution was inſtituted againſt him by the French government on account of his hiſtory of the Eaſt and Weſt Indies; but it was conducted with ſo little ſeverity, that he had ſufficient time to retire to the dominions of the King of Pruſſia, who afforded him the protection he ſolicited, although his Majeſty's character was treated by the author in his book with no great degree of veneration. Raynal alſo experienced the kindneſs of the Empreſs of Ruſſia; and it is not a little remarkable of this ſingular perſonage, that, although he was always ſevere in diſcuſſing the characters of princes, yet the moſt deſpotic among theſe heaped upon him many marks of favour and generoſity. The Abbé alſo received a very unuſual mark of reſpect from a Britiſh Houſe of Commons. It was once intimated to the ſpeaker that Raynal was a ſpectator in the gallery. The buſineſs was immediately ſuſpended, and the ſtranger conducted to a more convenient and honourable ſituation. How different was the conduct of Dr Johnſon, who, when a friend advanced to him with our author, ſaying, "Will you give me leave, Doctor, to introduce to you the Abbé Raynal!" turned on his heel, and vociferated, "No, Sir!" We are far from wiſhing to vindicate the rudeneſs of the ſage; but it was perhaps as proper as the politeneſs of the Houſe of Commons.

The great trait of Raynal's character was a love of liberty, which, in his earlier writings, he did not properly define; but when he lived to ſee ſome of the conſequences of this, in the progreſs of the French Revolution, he made one glorious effort to retrieve his errors. In the month of May 1791, he addreſſed to the conſtituent aſſembly one of the moſt eloquent, argumentative, and impreſſive letters that ever was written on any ſubject: a letter which, if the majority of them had not been intoxicated with their newly acquired conſequence, muſt have given ſome check to their mad career. After complimenting them upon what they had done, he proceeds thus: "I have long dared to ſpeak to kings of their duty; ſuffer me now to ſpeak to the people of their errors, and to their repreſentatives of the dangers which threaten us. I am, I own to you, deeply afflicted at the crimes which plunge this empire into mourning. Is it true that I am to look back with horror at myſelf for being one of thoſe who, by feeling a noble indignation againſt arbitrary power, may perhaps have furniſhed arms to licentiouſneſs? Do then religion, the laws, the royal authority, and public order, demand back from philoſophy and reaſon the ties which united them to the grand ſociety of the French nation, as if, by expoſing abuſes, and teaching the rights of the people and the duties of princes, our criminal efforts had broken thoſe ties? But no!—never have the bold conceptions of philoſophy been repreſented by us as the ſtrict rule for acts of legiſlation.

"You cannot juſtly attribute to us what could only be the reſult of a falſe interpretation of our principles. Alas! now that I ſtand on the brink of the grave; now that I am about to quit this immenſe family, whoſe happineſs I have ardently deſired, what do I ſee around me? Religious troubles, civil diſſenſions, conſternation on the one hand, tyranny and audacity on the other; a government the ſlave of popular tyranny; the ſanctuary of the laws ſurrounded by unruly men, who alternately dictate or deſpiſe thoſe laws; ſoldiers without diſcipline; leaders without authority; miniſters without means; a king, the firſt friend of his people, plunged into bitterneſs, inſulted, menaced, ſtripped of all authority; and the public power no longer exiſting but in clubs, in which ignorant and rude men dare to decide all political queſtions."

He then proceeds to prove, which he does very completely, that it was not the buſineſs of the aſſembly to aboliſh every ancient inſtitution; that the genius of the French people is ſuch, that they never can be happy or proſperous but under a well-regulated monarchical government; and that, if they wiſhed not the nation to fall under the worſt kind of deſpotiſm—the deſpotiſm of a low faction, they muſt increaſe the power of the king. "Alas! (continues he) what are my ſufferings, when in the heart of the capital, in the centre of knowledge, I ſee this miſguided people welcome, with a ferocious joy, the moſt criminal propoſitions, ſmile at the recital of murder, and celebrate their crimes as conqueſts!"

He had then ſeen comparatively but little; but he lived to ſee more—to ſee his countrymen celebrate, as virtues, crimes, compared with which the atrocities of 1790 appear almoſt as harmleſs. Being ſtripped of all his property, which was large, by the robbers of the revolution, he died in poverty in March 1796, and in the 84th year of his age.

Beſides the works which we have already mentioned, he wrote "A Hiſtory of the Parliament of England,"

and a “ Hiſtory of the Stadholderate;” but theſe are both of them more remarkable for a ſpecious ſtyle and loftineſs of invention than for uſeful obſervation or ſolid argument. He wrote likewiſe “ The Hiſtory of the Divorce of Catharine of Arragon by Henry the Eighth,” which is not ſo much a recital of, and commentary upon, the fact from which he takes the title, as it is an able picture of univerſal Europe at that period, of the views, intereſts, and power, of all the different potentates. At the time of his death he was preparing a new edition of all his works, in which were to be made many alterations; and he is ſaid to have left among his manuſcripts a “ Hiſtory of the Revocation of the Edict of Nantes,” in four volumes; but it is alſo very certain, that, during the ſanguinary reign of Robeſpierre, he burnt a great part of his papers.

RAYNHAM, a townſhip of Maſſachuſetts, in Briſtol county, taken from Taunton, and incorporated in 1731. It contains 1094 inhabitants. A conſiderable part of the town lies upon a circular bend of Taunton river, which is between 7 and 8 rods wide, and affords great plenty of herrings and other fiſh, but ſo unfavourable is it, in this place, to ſeining or fiſhing, that the excluſive privilege of fiſhing is annually ſold for leſs than twelve ſhillings; whilſt the ſame privilege, in Bridgewater and Middleborough, (towns which bound this; the former on the eaſt, the latter on the north) is annually ſold for £250. Beſides the great river, there are ſeveral uſeful ſtreams, upon which are 6 ſaw-mills, 3 griſt-mills, 1 furnace, a forge, and fulling-mill. There are numerous ponds in this townſhip, of which Nippaniquit or Nippahonſet is 2 miles long, and one in breadth. Here alewives, in millions, annually reſort and leave their ſpawns. An excellent kind of iron ore, and various kinds of fiſh are found here. Beſides the uſual buſineſs of huſbandry and mechanics, numbers are here employed in the manufactories of bar-iron, hollow ware, nails, iron for veſſels, iron ſhovels, potaſh, ſhingles, &c. The firſt forge ſet up in America was introduced into this town by James and Henry Leonard, natives of England, in 1652. This forge was ſituated on the great road, and is ſtill in employ by the family of Leonards of the 6th generation; a family remarkable for longevity, promotion to public office, and a kind of hereditary attachment to the iron manufacture. King Philip's hunting-houſe ſtood on the northern ſide of *Fowling Pond*, which is $1\frac{1}{4}$ miles from the forge. In the winter ſeaſon the Indian monarch reſided at Mount Hope, probably for the benefit of fiſh. Philip and the Leonards lived on ſuch good terms, and ſuch was Philip's friendſhip and generoſity, that, as ſoon as the war broke out in 1675, which ended in the death of the king and the ruin of his tribe, he gave out ſtrict orders to all his Indians, never to hurt the Leonards. Before Philip's war, *Fowling Pond* was two miles long, and $\frac{3}{4}$ths of a mile wide. Now, the water is almoſt gone, and the large tract it once covered, is grown up to a thick ſet ſwamp of cedar and pine. The ſoil of this pond has alſo a prolific virtue in generating ore. Copious beds of ore, in this part of the country, are uſually found in the neighbourhood of pine ſwamps, or near to ſoils natural to the growth of pine or cedar. In this place there has been almoſt an inexhauſtible fund of excellent ore, from which the forge has been ſupplied and kept going for more than 80 years, beſides great quantities carried to other works, and yet here is ore ſtill. Though, like other things in a ſtate of youth, it is weak and incapable of being wrought into iron of the beſt quality.—*Morſe*.

RAZOIR, *Port*, at the S. W. extremity of the coaſt of Nova-Scotia, and N. E. of Cape Negro.—*ib.*

RAZOR *Iſland* is 4 leagues S. of the mouth of Rio Janeiro Bay, or Santa Cruz Point, on the coaſt of Brazil, S. America.—*ib.*

READFIELD, a townſhip in Lincoln county, Diſtrict of Maine, 8 miles from Hallowell, which bounds it on the E. and the eaſtern branch of Androſcoggin river ſeparates it from Sterling on the W. It is N. of Winthrop, and was joined with it in the enumeration of 1790. It is 190 miles N. E. of Boſton. —*ib.*

READING, a townſhip of Connecticut, Fairfield county, S. of Danbury, adjoining.—*ib.*

Reading, a large townſhip of Maſſachuſetts, in Middleſex county, 14 miles N. of Boſton. It was incorporated in 1644, and contains 1802 inhabitants. —*ib.*

Reading, a townſhip of Vermont, Windſor county, W. of Windſor, adjoining. It contains 747 inhabitants.—*ib.*

Reading, a poſt-town, and the capital of Berk's county, Pennſylvania; ſituated on the N. E. ſide of Schuylkill river, 40 miles S. W. of Bethlehem, 28 E. of Lebanon, (where the canal commences which joins the waters of the Swetara Creek with thoſe of Schuylkill river) and 54 N. W. of Philadelphia. It is a flouriſhing town, regularly laid out, and inhabited chiefly by Germans. It contains about 600 houſes. The public buildings are a ſtone gaol, a court-houſe, an elegant church for German Lutherans, erected in 1793, a church for Calviniſts, one for Roman Catholics, a meeting-houſe for Friends, and a large edifice for the public offices. In the vicinity of the town is a remarkable ſpring, 100 feet ſquare, and 140 feet deep, with a ſtream iſſuing from it ſufficient to turn a mill. The water is clear and tranſparent, and affords abundance of fiſh. In the neighbourhood are 10 fulling-mills and ſeveral iron-works. In the whole county of Berk's are 5 furnaces, and as many forges. In November, 1795, £12,000 was voted by the county for building a ſtone arched bridge over the Schuylkill at this town, on the high road to Harriſburg, 53 miles diſtant to the weſt by ſouth.—*ib.*

Reading, a townſhip in York county, Pennſylvania.—*ib.*

READINGTOWN, or *Riddentown*, in Hunterdon county, New-Jerſey, 17 miles N. W. by W. of New-Brunſwick, and about 11 eaſtward of Lebanon.—*ib.*

READ's *Bay*, a road for ſhips in the iſland of Barbadoes, about half way between Hole-Town and Speight's Town. It is about half a mile over, but more in depth. Ships may anchor here in ſafety, in from 6 to 12 fathoms water, the ground ſoft ooze, and defended from all winds, except the W. which blows right into the bay. N. lat. 13 7, W. long. 59 47 —*ib.*

REALEGO, a town in the province of Nicaragua, New Spain; ſituated on a plain, on the eaſtern bank of of a river of its name, near its mouth, 30 miles N. W. of Leon, to which it ſerves as a harbour. It has 3 churches, and an hoſpital, ſurrounded by a very fine garden; but the place is ſickly, by reaſon of the neighbouring ſwamps. Its chief trade is in pitch, tar and cordage. N. lat. 12 17, W. long. 87 36.—*ib*.

REAPING, the well known operation of cutting corn either by the ſickle or by the ſcythe. Reaping by the ſickle is by much the moſt common practice, and that which, we believe, prevails univerſally in Scotland; yet the other method, where it is practicable, is certainly the leaſt laborious, and by much the moſt expeditious. To the ſcythe, as an inſtrument of reaping, many objections are urged.

It is ſaid that it ſhakes the ear, ſo that many of the grains are loſt; that it lets the corn fall, after cutting it, in a confuſed and ſcattered ſtate, ſo that either much of it is loſt, or a great deal of time is conſumed in gathering it together; that it can only be made uſe of in land which is very even and free from ſtones; that it does not leave ſufficient length of ſtubble in the ground to lay the corn on when cut; that it mixes bad weeds with the corn, the ſeeds of which are ſown the next year; and, laſtly, that the uſe of the ſcythe is prejudicial to the health of the reaper.

Theſe objections, however, are either of no weight, or they are made by thoſe who are not acquainted with the ſcythes which have been adapted to this purpoſe, and with the proper manner of uſing them. With a good ſcythe, properly managed, the corn, after being cut remains at firſt upright, and then falls very gently upon the rake fixed to the ſcythe, without any ſhake or jolt; or at leaſt with leſs than that which it receives when reaped with the ſickle. With reſpect to the loſs of grain, that proceeds chiefly from the corn being too dry; conſequently it ſhould be reaped only upon proper days, and proper times of the day, which is much more eaſily done with the ſcythe than with the ſickle, becauſe the work is ſo much ſhorter. The ſtalks, kept together by the rake, may be laid upon the ground, or rather againſt the corn not yet cut, in ſo regular and collected a ſtate, that thoſe who gather and tie the ſheaves, whether they are women or children, have nothing but their own negligence to accuſe if any thing is left behind. When land is properly ploughed and harrowed, it is ſufficiently even; and in ſuch as is ſtony, the only precaution neceſſary is to keep the ſcythe a little higher in uſing it, that it may not ſtrike againſt the ſtones. If the ſtubble left in the ground be ſhort, the ſtraw which is cut off will be the longer; and the latter is certainly of more value than the former, which only ſerves to incommode the cattle which afterwards go to feed in the field.

Theſe conſiderations, and others of a like nature, induced the patriotic ſociety of Milan to ſend, ſome years ago, to thoſe parts in which ſcythes are made uſe of for reaping; and having procured a model of a ſcythe from Sileſia, they cauſed one to be made of a proper ſize. It was firſt tried upon corn, and afterwards upon millet; and although the firſt ſcythe was not accurately made, and the reaper had never before made uſe of ſuch an inſtrument, yet it was found that nearly half the uſual time was ſaved, and that the labour and fatigue were much diminiſhed; the corn alſo was cut without receiving any ſhock that could be hurtful to it, and fell in an even and regular ſtate, ſo that it was afterwards eaſily bound up in compact ſheaves. They were afterwards preſented with a ſcythe ſomewhat different from the Sileſian, which is very generally uſed in Auſtria.

Plate XLII.

Theſe inſtruments are ſo ſimple, that the figure of one of them renders the deſcription of either almoſt unneceſſary. In fig. 1. is ſhewn the Sileſian ſcythe tried by the Society; the difference between that and the Auſtrian one we ſhall mention in our deſcription. The firſt, or Sileſian ſcythe, differs very little from the ſcythe we commonly uſe for mowing graſs, except that the blade is rather ſmaller; to it are added four teeth of wood, parallel to the blade, fixed and ſecured in a proper manner, and intended to keep the corn together after being cut, ſo that inſtead of its falling in a confuſed ſtate, the reaper may lay it down in a regular and compact one. The ſecond, or Auſtrian ſcythe, is ſimilar to the former, except that the blade is larger; conſequently the wooden teeth, of which there are five, are longer; the handle is alſo more flat, and rather crooked.

In the *firſt*, the handle *a b* (ſee fig. 1.) is two Milaneſe braſſes (A), and nine inches and a half in length; the blade *b c* is one braſs three inches and a half; the piece of wood in which the teeth are fixed, one braſs one inch and a half. In the *ſecond*, the handle is two braſſes, and ſeven inches long; the blade, one braſs eleven inches; the piece in which the teeth are fixed, eleven inches and a quarter. The proportions of the other parts may be conceived from the figure.

The difference in the conſtruction of theſe two ſcythes makes it requiſite to uſe them in a different manner; but that will be better acquired in practice than by precept. Such of our countrymen as are accuſtomed to the uſe of the common ſcythe will very ſoon find out the moſt convenient and advantageous manner of uſing theſe new kinds of ſcythe, and of laying down the corn properly when cut.

It ſhould, however, be obſerved, that in mowing graſs the feet are kept almoſt parallel to each other, whereas in reaping corn they ſhould be kept upon a line, one behind the other, thruſting the right foot forward, and drawing the left towards it. This is neceſſary, becauſe when graſs is mowed it is left to fall juſt where it is cut; but when corn is cut, it is to be carried and laid in a proper manner againſt that which is not yet cut, and which is at the left hand of the reaper; and if the feet were kept parallel to each other, the reaper would be obliged to extend and turn his body in a very inconvenient manner.

After having made public theſe obſervations, the ſociety made farther experiments upon the ſubject; in which it was found, that when, on account of very wet weather, the ſtalks of the corn are bent down, the wooden teeth of the forementioned ſcythes are apt to lay hold of ſome ears, to the ſtalks of which the iron does not reach, and conſequently not being cut below, they are pulled ſo that the grain is ſcattered. This happens

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(A) One hundred Milaneſe *braſſes* are equal to fifty-eight Engliſh yards and a half.

happens chiefly when the reapers, not being yet ſufficiently accuſtomed to that kind of ſcythe, do not know how to adapt it to particular circumſtances.

To remedy this inconvenience, it occurred to an ingenious blackſmith to add to the common ſcythe a *gatherer* or *collector* made of cloth, as may be ſeen at fig. 2. where *a b c* is a common ſcythe; *c d m l o f n e* is the gatherer; which at *c d e* is compoſed of a thin plate of iron, having at its extremity a hollow for receiving the point of the blade. At *e d* are holes for ſewing in the cloth, which is coarſe, light, and of low price; it is alſo fixed to two thick iron wires, of which the upper one is continued to *f*, where it terminates in a hole in the handle; the other is fixed to the back of the blade. The manner of fixing this gatherer to the blade of the ſcythe will be better underſtood by referring to fig. 3. which repreſents one of the irons which, by means of a ſcrew, are faſtened to the back of the ſcythe. Theſe irons proceed from and make part of, the upright irons *m n*, *l o*, which ſerve to keep the gatherer extended.

This is a very ſimple and cheap contrivance; but an attempt was made to render it ſtill more ſimple, by ſubſtituting for the gatherer two iron hoops, which are ſhown in fig. 2. by the dotted lines *h g*, *k i*, with a croſs piece *p* which connects them. Experience, however, has ſhewn, that the gatherer is in general preferable to theſe hoops, as it does not leave an ear of corn behind.

RECEIF, a harbour on the coaſt of Brazil, and is the ſtrongeſt place on all that coaſt. S. lat. 8 10, W. long. 35 35.—*Morſe*.

RECOVERY, *Fort*, in the N. W. Territory, is ſituated on a branch of the Wabaſh river, about 23 miles from Greenville, and 98 N by W. of Cincinnati. It conſiſts of two block-houſes and barracks with curtains, and contains 60 men.—*ib.*

RECTIFICATION OF ETHER, a proceſs for depriving ether of its ſulphureous acid (See CHEMISTRY, *Index* in this *Suppl.*) It has been uſual to add an alkali for this purpoſe; but Dizé has found it much more advantageous to add a ſubſtance which might afford the requiſite quantity of oxygen to convert the ſulphureous into the ſulphuric acid; in which ſtate it is not diſpoſed to riſe and come over. Various metallic oxyds were tried, among which the black oxyd of manganeſe proved the beſt and the cheapeſt. His proceſs is as follows:

The ſulphureous acid contained in unrectified ether being neutralized with oxyd of manganeſe, the fluid is decanted into a pewter veſſel of the capacity of fifty ounces, which is placed on a water bath. To this veſſel a head and worm are adapted, the latter of which paſſes through a refrigeratory conſtantly ſupplied with water in a ſtream from below, which cauſes the heated water to flow off above. The diſtillation is then performed by raiſing the bath to a temperature of 36° (113° Fahrenheit, if the decimal thermometer be here meant). The rectification by this treatment uſually requires a day to complete it. The flavour of the ether is of the beſt kind, and the product about one-ſixth more than in the uſual method with retort and receiver. Dizé has practiſed this method with ſucceſs for three years.—*Journal de Phyſique, April*, 1798.

RECTIFICATION, in geometry, is the finding of a right line equal to a curve. The rectification of curves is a branch of the higher geometry, a branch in which the uſe of the inverſe method of fluxions is eſpecially uſeful.

TURKEY-RED, *Levant-Red*, and *Adrianople-Red*, the names indifferently given to that beautiful red dye which diſtinguiſhes the cotton manufactured in the Ottoman empire, and at *Aſtracan* in the dominions of Ruſſia. We have two accounts of the proceſs of communicating this dye to the ſtuffs; one by Profeſſor Pallas as he ſaw it practiſed at Aſtracan; the other in the 92d number of the *Annales de Chimie* by Citizen Felix. As every thing relating to uſeful manufactures is of general importance, we ſhall give pretty copious extracts from both papers.

According to Dr Pallas, the dye-ſtuffs employed at Aſtracan are, madder, ſumach, gall-nuts, alum, an inferior kind of ſoda, and fiſh-oil. The proceſs of dyeing is as follows:

The roots of the madder, when freſh gathered, are placed above each other in a ſtove, or in a pit dug in viſcous earth which has been ſtrongly heated. Earth is then thrown over the madder, and it muſt ſweat until the ſtove or pit becomes cold; when the roots, the ſecond or third day, are taken from it, and either ſpread out or hung up to dry. When it is thoroughly dried in the ſun, the madder is ground to a very fine powder, as are likewiſe the round leaves of the ſumach (*rhus cotinus*). The fiſh oil is boiled from the entrails of the ſturgeon and other large fiſhes; and the proof of its being proper for dyeing is, that when mixed with a lixivium of ſoda, it muſt immediately aſſume a milky appearance. Should that not be the caſe, it cannot be uſed by the dyers.

The cotton to be dyed red is firſt waſhed exceedingly clean in running water; and when the weather is clear, hung up on poles to dry. If it does not dry before the evening, it is taken into the houſe, on account of the ſaline dews ſo remarkable in the country around Aſtracan, and again expoſed to the air next morning. When it is thoroughly dry it is laid in a tub, and fiſh-oil is poured over it till it is entirely covered. In this ſtate it muſt ſtand all night; but in the morning it is hung up on poles, and left there the whole day; and this proceſs is repeated for a week, ſo that the cotton lies ſeven nights in oil, and is expoſed ſeven days to the atmoſphere, that it may imbibe the oil, and free itſelf from all air. The yarn is then again carried to a ſtream, cleaned as much as poſſible, and hung up on poles to dry.

After this preparation a mordant is made of three materials, which muſt give the grounds of the red colour. The pulveriſed leaves of the ſumach are firſt boiled in copper kettles; and when their colouring matter has been ſufficiently extracted, ſome powdered galls are added, with which the liquor muſt be again boiled; and by theſe means it acquires a dark dirty colour. After it has been ſufficiently boiled the fire is taken from under the kettle, and alum put into the ſtill hot liquor, where it is ſoon diſſolved. The proportion of theſe three ingredients cannot be aſcertained, as the dyers vary that proportion at pleaſure. The powder of the ſumach leaves is meaſured into the kettle with ladles; the water is poured in according to a gauge, on which marks are made to ſhew how high the water muſt

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muſt ſtand in the kettle to ſoak ſix, eight, ten, &c. puds of cotton yarn. The galls and alum are added in the quantity of five pounds to each pud of cotton. In a word, the whole mordant muſt be ſufficiently yellow, ſtrong, and of an aſtringent taſte.

As ſoon as the alum is diſſolved, no time muſt be loſt in order that the mordant may not be ſuffered to cool. The yarn is then put into hollow blocks of wood ſhaped like a mortar, into each of which ſuch a quantity of the mordant has been poured as may be ſufficient to moiſten the yarn without any of it being left. As ſoon as the workman throws the mordant into the mortar, he puts a quantity of the yarn into it, and preſſes it down with his hand till it becomes uniformly moiſtened, and the whole cotton yarn has ſtruck. By this it acquires only a pale yellow colour, which, however, is durable. It is then hung up on poles in the ſun to dry; again waſhed in the ſtream, and afterwards dried once more.

The next part of the proceſs is to prepare the madder dye. The madder, ground to a fine powder, is ſpread out in large troughs, and into each trough is poured a large cupful of ſheep's blood, which is the kind that can be procured with the greateſt facility by the dyers. The madder muſt be ſtrongly mixed in it by means of the hand, and then ſtand ſome hours in order to be thoroughly ſoaked by it. The liquor then aſſumes a dark red appearance, and the madder in boiling yields more dye.

After this proceſs water is made hot in large kettles, fixed in brickwork; and as ſoon as it is warm, the prepared red dye is put into it, in the proportion of a pound to every pound of cotton. The dye is then ſuffered to boil ſtrongly; and when it is enough, which may be tried on cotton threads, the fire is removed from under the kettle, and the prepared cotton is depoſited near it. The dyer places himſelf on the edge of the brickwork that incloſes the kettle; dips the cotton yarn, piece by piece, into the dye; turns it round backwards and forwards; preſſes it a little with his hands; and lays each piece, one after the other, in pails ſtanding ready for the purpoſe. As ſoon as all the cotton has received the firſt tint, it is hung up to dry; as the red, however, is ſtill too dull, the yarn, which has been already dyed once, and become dry, is put once more into the dyeing-kettle, and muſt be left there to ſeethe for three hours over a ſtrong fire; by which it acquires that beautiful dark red colour which is ſo much eſteemed in the Turkey yarn. The yarn is now taken from the dye with ſticks; the ſuperfluous dye which adheres to it is ſhaken off; the hanks are put in order, and hung up, one after another, to dry. When it is thoroughly dry, it is waſhed in the pure ſtream, and again dried.

In the laſt place, the above mentioned ſoda is diſſolved with boiling water in tubs deſtined for that purpoſe, and it is uſual at Aſtracan to allow 20 pounds of ſoda to 40 pounds of cotton, or half the weight. Large earthen jars, which are made in Perſia of very ſtrong clay, a yard and a half in height, almoſt five ſpans wide in the belly, and ending in a neck a ſpan and a half in diameter, incloſed by means of cement in brickwork over a fire-place, in ſuch a manner that the necks only appear, are filled with the dyed cotton yarn. The ley of diſſolved ſoda, which is blackiſh and very ſharp, is then poured over it till the jars be filled; and ſome clean rags are preſſed into their mouths, that the uppermoſt ſkains of yarn may not lie uncovered. A fire is then made in the fire place below, and continued for 24 hours; and in the mean time the ſteam which ariſes from the jars is ſeen collected among the rags in red drops. By this boiling the dye is ſtill more heightened, and is made to ſtrike completely; every thing ſuperfluous is removed, and all the fat matter which ſtill adheres to the yarn is waſhed out. Nothing more is then neceſſary for completing the dye of the yarn but to rinſe it well ſeveral times in running water and then to dry it.

Turkey-
Red.

Cotton cloth is dyed with madder at Aſtracan in the ſame manner; but many purſue a fraudulent proceſs, by dyeing with red wood, and then ſell their cloth as that which has been dyed in the proper manner.

The proceſſes followed in the Grecian manufactories in the Levant, as deſcribed by M. Felix, varies in ſome particulars from this. The firſt proceſs is that of cleaning the cotton: for which purpoſe three leys are employed; one of ſoda, another of aſhes, and a third of lime. The cotton is thrown into a tub, and moiſtened with the liquor of the three leys in equal quantities: it is then boiled in pure water, and waſhed in running water.

The ſecond bath given to the cotton is compoſed of ſoda and ſheep's dung diſſolved in water. To facilitate the ſolution, the ſoda and dung are pounded in a mortar. The proportions of theſe ingredients employed, are one occa of dung, ſix of ſoda, and forty of water; each occa being equal to about fifty ounces. When the ingredients are well mixed, the liquor expreſſed from them is ſtrained; and being poured into a tub, ſix occas of olive oil are added to it, and the whole is well ſtirred till it becomes of a whitiſh colour like milk. The cotton is then beſprinkled with this water; and when the ſkains are thoroughly moiſtened, they are wrung, preſſed, and expoſed to dry. The ſame bath muſt be repeated three or four times, becauſe it is this liquor which renders the cotton more or leſs fit for receiving the dye. Each bath is given with the ſame liquor, and ought to continue five or ſix hours. It is to be obſerved that the cotton, after each bath, muſt be dried without being waſhed, as it ought not to be rinſed till after the laſt bath. The cotton is then as white as if it had been bleached in the fields.

It may be ſuppoſed that the dung is of no utility for fixing the colours; but this ſuppoſition would be raſh; for, as M. Felix obſerves, it is well known that this ſubſtance contains a great quantity of volatile alkali in a diſengaged ſtate, which has the property of giving a roſy hue to the red. It is therefore probable that it is to this ingredient that the red dyes of the Levant are indebted for their ſplendour and vivacity. This much, at any rate, is certain, that the Morocco leather of the Levant is prepared with dog's dung; becauſe it has been found that this dung is proper for heightening the colour of the lack.

The proceſs of galling, which follows the bath of dung, is performed by immerſing the cotton in a bath of warm water, in which five occas of pulveriſed gall-nuts have been boiled. This operation renders the cotton more fit for being ſaturated with the colour, and gives to the dye more body and ſtrength. After the galling comes aluming, which is performed twice, with an interval of two days, and which conſiſts in dipping the cotton into a bath of water in which five occas of alum have been infuſed, mixed with five occas of water alkaliſed by a ley of ſoda. The aluming muſt be performed with care, as it is this operation which makes the colouring particles combine beſt with the cotton, and which ſecures them in part from the deſtructive action of the air. When the ſecond aluming is finiſhed, the cotton is wrung; it is then preſſed, and put to ſoak in running water, after being incloſed in a bag of thin cloth.

The workmen then proceed to the dyeing. To compoſe the colours, they put in a kettle five occas of water, and 35 occas of a root which the Greeks call *ali-zari*, or painting colour, and which in Europe is known under the name of *madder*. The madder, after being pulveriſed, is moiſtened with one occa of ox or ſheep's blood. The blood ſtrengthens the colour, and the doſe is increaſed or leſſened according to the ſhade of colour required. An equal heat is maintained below the kettle, but not too violent; and when the liquor ferments, and begins to grow warm, the ſkains are then gradually immerſed before the liquor becomes too hot. They are then tied with packthread to ſmall rods placed croſſwiſe above the kettle for that purpoſe; and when the liquor boils well, and in an uniform manner, the rods from which the ſkains were ſuſpended are removed, and the cotton is ſuffered to fall into the kettle, where it muſt remain till two-thirds of the water is evaporated. When one third only of the liquor remains, the cotton is taken out and waſhed in pure water.

The dye is afterwards brought to perfection by means of a bath alkaliſed with ſoda. This manipulation is the moſt difficult and the moſt delicate of the whole, becauſe it is that which gives the colour its tone. The cotton is thrown into this new bath, and made to boil over a ſteady fire till the colour aſſumes the required tint. The whole art conſiſts in catching the proper degree: a careful workman, therefore, muſt watch with the utmoſt attention for the moment when it is neceſſary to take out the cotton; and he will rather burn his hand than miſs that opportunity.

It appears that this bath, which the Greeks think of ſo much importance, might be ſupplied by a ley of ſoap; and it is probable that ſaponaceous water would give the colour more brightneſs and purity.

M. Felix ſeems doubtful whether the ali-zari of the Greeks be the ſame plant with the European madder. If it be, its ſuperiority muſt ariſe from the mode in which it is cultivated, and the method employed to dry it. The ali-zari is not collected till the fifth or ſixth year of its growth, when it has acquired its full ſtrength; and as it is the woody part of the roots which affords the greateſt quantity of colouring particles, this muſt give it an obvious ſuperiority over madder, which is collected before it has arrived at maturity. The mode of deſiccation contributes alſo, in the opinion of our author, to improve the quality of the ali-zari. The Levantines dry it in the open air; and this operation is eaſy in a country where great dryneſs prevails in the atmoſphere, while in our damp climates we are obliged to dry the madder by ſtoves. Hence it happens that the ſmoke, which mixes itſelf with the cold air, and penetrates the roots, impregnates them with fuliginous particles, which alter the colouring ſubſtance; an accident which does not take place when the madder is dried without the aſſiſtance of fire.

For the philoſophical principles of theſe proceſſes of dyeing, ſee *Animal and Vegetable* Substances in this *Supplement*.

RED, a river of the State of Tenneſſee, a water of Cumberland river, with which it mingles its waters at the north bend, about 2 miles N. W. of Clarkſville. It is boatable a conſiderable diſtance.—*Morſe*.

Red, a principal branch of Kentucky river, which heads and interlocks with a main branch of Licking river, and flows, in a S. W. courſe, into Kentucky river, about 9 miles above Boonſborough. It is 60 yards wide at the mouth.—*ib.*

Red, a weſtern branch of the Miſſiſſippi river, in lat. 31 N. Here, it is ſaid, Ferdinando de Soto died, at a place called Guacoyi, May 21, 1542.—*ib.*

RED *Bank*, on the S. E. ſide of Delaware river, in the town of Woodbury, in Glouceſter county, New-Jerſey. The ſituation is elevated, and the fort built here during the war, ſtood 1900 yards from Fort Iſland, and about 7 miles ſouth of Philadelphia. It coſt the Britiſh 400 men, killed and wounded, before they could reduce the garriſon in 1777.—*ib.*

RED *Hook*, in Dutcheſs county, New-York, where a poſt-office is kept, is on the eaſt bank of Hudſon's river, 21 miles S. of Hudſon, and 116 N. of New-York.—*ib.*

REDINTEGRATION, is the taking or finding the integral or fluent again from the fluxion. See Fluxions, *Encycl.*

REDONDO, a rock between Montſerrat and Nevis Carribbee Iſlands. It is about a league in circuit, of a round form, where is neither culture nor inhabitants. N. lat. 17 6, W. long. 61 35.—*ib.*

REEDSBOROUGH, or *Readſborough*, the ſouth-eaſternmoſt townſhip of Bennington county, Vermont. It contains 64 inhabitants.—*Morſe*.

REEDY *Iſland*, in Delaware river, 50 miles below Philadelphia. It is 20 miles from Bombay Hook, and is the rendezvous of outward bound ſhips in autumn and ſpring, waiting for a favourable wind. The courſe from this to the ſea is S. S. E. ſo that a N. W. wind, which is the prevailing wind in theſe ſeaſons, is fair for veſſels to put out to ſea. There is a ſecure harbour here, at Port Penn, where piers have been erected by the State of Pennſylvania. The iſland is about 3 miles long, and not more than one-fourth of a mile wide. It was formerly banked in, but is now under cultivation, and is overflowed in high tides. There is a channel on each ſide of the iſland; but veſſels, eſpecially large ones, chooſe to keep the eaſtern ſide.—*ib.*

REELFOOT, a ſmall navigable river of the State of Tenneſſee, which empties into the river Miſſiſſippi, about 35 miles ſouth of the Ohio. It is 30 yards wide 7 miles from its mouth. One of its branches riſes on the borders of Kentucky.—*ib.*

REEMSTOWN, or *Reamſtown*, a ſmall town of Lancaſter county, Pennſylvania; ſituated on a ſtream which empties into Calico Creek, a water of Coneſtoga, which falls into the Suſquehannah. It contains about 40 houſes, and is 16 miles N. E. of Lancaſter, and 62 N. W. by N. of Philadelphia.—*ib.*

REFLECTOR for a light-house, is compoſed of a number of ſquare plane glaſs mirrors, ſimilar to thoſe with which Archimedes is ſaid to have ſet fire to the Roman fleet at the ſiege of Syracuſe (See Burning, *Encycl.*) Each of theſe mirrors is about an inch ſquare; and they are all diſpoſed cloſe to each other in the concave of a parabolic ſegment, formed of ſtucco or any other proper bed. Stucco has been found to anſwer the purpoſe beſt; and is accordingly employed in all the reflectors of the light-houſes erected by Mr Thomas Smith tinplate worker, Edinburgh, at the expence, and by the authority, of government. This ingenious and modeſt man ſeems to have conceived the idea of illuminating light-houſes by means of lamps and reflectors inſtead of coal-fires, without knowing that ſomething of the ſame kind had been long uſed in France; he has therefore all the merit of an inventor, and what he invented he has carried to a high degree of perfection.

His parabolic moulds are from three to five or ſix feet in diameter; and in the centre or apex of each is placed a long ſhallow lamp of tin-plate, filled with whale oil. In each lamp are ſix cotton wicks, almoſt contiguous to each other, which are ſo diſpoſed as to burn without trimming for about ſix hours. The light of theſe is reflected from each mirror ſpread over the concave ſurface, and is thus multiplied, as it were, by the number of mirrors. The ſtucco moulding is covered on the back with tin-plate, from which a tube, immediately over the lamp, proceeds to the roof of the light room, and ſerves as a funnel, through which the ſmoke eſcapes without ſullying the faces of the mirrors. The light-room is a cupola or lantern of from eight to twelve ſides, compoſed entirely of glaſs, fixed in caſt-iron frames or ſaſhes, and roofed with copper. On circular benches paſſing round the inſide of this lantern, at about eighteen inches from the glaſs frames, are placed the reflectors with their lamps, ſo as that the concave ſurfaces of two or three of the reflectors front every point of the compaſs, and throw a blaze of light in all directions. In the roof immediately over the centre of the room is a hole, through which paſs all the funnels already mentioned, and which ſerves likewiſe to admit freſh air to the lamps. This light-room is firmly fixed on the top of a round tower ſo as to be immoveable by the weather; and the number of the reflectors, and the height of the tower, are leſs or greater according as it is the intention that the light ſhould be ſeen at a leſs or a greater diſtance.

A man judging from mere theory would be very apt to condemn light-houſes of this kind; becauſe the firmeſt building ſhakes in a violent ſtorm, and becauſe ſuch ſhaking, he might think, would ſometimes throw the whole rays of light into the air, and thus miſlead the bewildered ſeaman. This opinion, we know, was actually entertained of them by one of the profoundeſt philoſophers and moſt ſcientific mechanicians of the age. Experience, however, has convinced him, as well as the public at large, that ſuch apprehenſions are groundleſs, and that light-houſes with lamps and reflectors are, in every point of view, preferable to thoſe with fires burning in the open air. They are ſupported at much leſs expence; their light is more brilliant, and ſeen at a greater diſtance, whilſt it can never be obſcured by ſmoke, or beaten down on the lee-ſide by a violent guſt of wind; and what is perhaps of ſtill greater importance, the reflectors with their lamps may be ſo variouſly placed, that, as Mr Smith obſerves, one light-houſe cannot be miſtaken for another. If we add to all this, that the lamps do not ſtand in need of trimming ſo often as open fires require fuel, and that the light man is never expoſed either to cold or to wet by attending to his duty, we muſt be convinced that light-houſes with reflectors are much leſs liable to be neglected in ſtormy weather than thoſe with open fires, and that this circumſtance alone would be enough to give the former a preference, almoſt incalculable, over the latter.

It has been propoſed to make the concave ſurface of the parabola one ſpeculum of metal, inſtead of covering it over with a multitude of plain glaſs mirrors; or to diminiſh the ſize of each mirror, if they are to be retained in preference to the metallic ſpeculum. To every man who has but dipped into the ſcience of optics, it muſt be obvious, that either of theſe alterations would be wrong. The brighteſt metal does not reflect ſuch a quantity of light as well foliated clear glaſs; and were the ſize of the mirrors to be diminiſhed, the number of joinings would be increaſed, in each of which ſome light is loſt, not merely in the ſeam, but from its being almoſt impoſſible to foliate glaſs perfectly at its edge.

REFLEXITY, a word employed by Mr Brougham to denote a property of light which cauſes the different rays to be acted upon by bodies, and to begin to be refracted, reflected, inflected, and deflected, at different diſtances. This property follows the ſame law that the other optical properties of light follow: the red ray having moſt reflexity, and the violet leaſt (See *Philoſophical Tranſactions*, 1797, p. 360.) Mr Brougham has denoted this property by the three words, *refrangity*, *reflexity*, and *flexity*; but as the power is the ſame, there is no occaſion for different names. Some philoſophers have refuſed to admit this as a new property; we have not verified it by experiment.

REFRACTION of altitude, is the arc or portion of a vertical circle, by which the altitude of a ſtar is increaſed by the refraction of light.

Refraction of Aſcenſion and Deſcenſion, is an arc of the equator, by which the aſcenſion and deſcenſion of a ſtar, whether right or oblique, is increaſed or diminiſhed by the refraction.

Refraction of Declination, is an arc of a circle of declination, by which the declination of a ſtar is increaſed or diminiſhed by refraction.

Refraction of Latitude, is an arc of a circle of latitude, by which the latitude of a ſtar is increaſed or diminiſhed by the refraction.

Refraction of Longitude, is an arc of the ecliptic, by which the longitude of a ſtar is increaſed or diminiſhed by means of the refraction.

Terreſtrial Refraction, is that by which terreſtrial objects appear to be raiſed higher than they really are, in obſerving their altitudes. The quantity of this refraction is eſtimated by Dr Maſkelyne at one tenth; by Le Gendre at one-fourteenth; by De Lambre at one-eleventh; and by others at a twelfth of the diſtance of the object obſerved, expreſſed in degrees of a great circle. But it is obvious that there can be no fixed quantity of this refraction, ſince it depends upon the ſtate of the atmoſphere, which is extremely variable. Hence ſome very ſingular effects of it are related, of which the following is worthy of notice. It is taken from the Philoſophical Tranſactions of London 1798;

being an extract of a letter, dated Haſtings, Auguſt 1. 1797.

"On Wedneſday, July 26, about five o'clock in the afternoon, while I was ſitting in my dining room at this place, which is ſituated upon the Parade, cloſe to the ſea ſhore, nearly fronting the ſouth, my attention was excited by a number of people running down to the ſea-ſide. Upon enquiring the reaſon, I was informed that the coaſt of France was plainly to be diſtinguiſhed by the naked eye. I immediately went down to the ſhore, and was ſurpriſed to find that, even without the aſſiſtance of a teleſcope, I could very plainly ſee the cliffs on the oppoſite coaſt; which, at the neareſt part, are between 40 and 50 miles diſtant, and are not to be diſcerned, from that low ſituation, by the aid of the beſt glaſſes. They appeared to be only a few miles off, and ſeemed to extend for ſome leagues along the coaſt. I purſued my walk along the ſhore eaſtward, cloſe to the water's edge, converſing with the ſailors and fiſhermen upon the ſubject. They at firſt could not be perſuaded of the reality of the appearance; but they ſoon became ſo thoroughly convinced, by the cliffs gradually appearing more elevated, and approaching nearer, as it were, that they pointed out and named to me the different places they had been accuſtomed to viſit; ſuch as the Bay, the Old Head or Man, the Windmill, &c. at Boulogne; St Vallery, and other places on the coaſt of Picardy: which they afterwards confirmed when they viewed them through their teleſcopes. Their obſervations were, that the places appeared as near as if they were ſailing, at a ſmall diſtance, into the harbours."

The writer of this extract was W. Latham, Eſq; F. R. S. and A. S. who adds, that the day was extremely hot, that it was high water at Haſtings about two o'clock P. M. and that not a breath of wind was ſtirring the whole day.

REGIS (Peter Sylvain), a French philoſopher, and great propagator of Carteſianiſm, was born in Agenois 1632. He cultivated the languages and philoſophy under the Jeſuits at Cahors, and afterwards divinity in the univerſity of that town, being deſigned for the church. He made ſo uncommon a progreſs, that at the end of four years he was offered a doctor's degree without the uſual charges; but he did not think it became him to accept of it till he had ſtudied alſo in the Sorbonne at Paris. He went thither, but was ſoon diſguſted with theology; and as the philoſophy of Des Cartes began at that time to make a noiſe through the lectures of Rohault, he conceived a taſte for it, and gave himſelf up entirely to it. He frequented theſe lectures; and becoming an adept, went to Toulouſe in 1665, and read lectures in it himſelf. Having fine parts, a clear and fluent manner, and a happy way of making himſelf underſtood, he drew all ſorts of people; the magiſtrates, the learned, the eccleſiaſtics, and the very women, who now all affected to abjure the ancient philoſophy. In 1680 he returned to Paris; where the concourſe about him was ſuch, that the ſticklers for Peripateticiſm began to be alarmed. They applied to the archbiſhop of Paris, who thought it expedient, in the name of the king, to put a ſtop to the lectures; which accordingly were diſcontinued for ſeveral months. The whole life of Regis was ſpent in propagating the new philoſophy. In 1690 he publiſhed a formal ſyſtem of it containing logic, metaphyſics, phyſics, and morals, in 3 vols 4to, and written in French. It was reprinted the year after at Amſterdam, with the addition of a diſcourſe upon ancient and modern philoſophy. He wrote afterwards ſeveral pieces in defence of his ſyſtem; in which he had diſputes with M. Huet, Du Hamel, Malebranche, and others. His works, though abounding with ingenuity and learning, have been diſregarded, in conſequence of the great diſcoveries and advancement in philoſophic knowledge that have been ſince made. He died in 1707. He had been choſen member of the academy of ſciences in 1699*.

REGOLETS, the name of the paſſage from the northern part of the Gulf of Mexico into Lake Pontchartrain, which has communication, through Maurepas Lake and the Gut of Ibberville, with Miſſiſſippi river; or the general name of the iſles in the inner part of the channel into that lake. The diſtance from Lake Pontchartrain through the Regolets is 10 miles, and between 3 and 400 yards broad, and lined with marſhes on each ſide. On the S. ſide of the Regolets, and near to the entrance from the gulf, there is a large paſſage into the Lake Borgne, or Blind Lake; and by ſome creeks that fall into it, ſmall craft may go as far as the plantations on the Miſſiſſippi, and there is a paſſage between the Lakes Borgne and Pontchartrain; but either by this, or that of the Regolets, 6 and ſometimes 7 feet is the deepeſt water through. Near the entrance at the eaſt end of the Regolets, and on the north ſide, are the principal mouths of Pearl river. From the Regolets to the Bay of St Louis is 18 miles.—*Morſe*.

REGULAR BODY, called alſo *Platonic Body*, is a body or ſolid comprehended by like, equal, and regular plane figures, and whoſe ſolid angles are all equal.

The plane figures by which the ſolid is contained are the faces of the ſolid; and the ſides of the plane figures are the edges, or linear ſides of the ſolid.

There are only five regular ſolids, viz.

The tetrahedron, or regular triangular pyramid, having four triangular faces;

The hexahedron, or cube, having ſix ſquare faces;

The octahedron, having eight triangular faces;

The dodecahedron, having twelve pentagonal faces;

The icoſahedron, having twenty triangular faces.

Beſides theſe five, there can be no other regular bodies in nature. See PLATONIC *Body*, Suppl.

REGULUS, in aſtronomy, a ſtar of the firſt magnitude, in the conſtellation Leo; called alſo, from its ſituation, *Cor Leonis*, or the *Lion's Heart*; by the Arabs, *Alhabor*: and by the Chaldeans, *Kalbeleced*, or *Karbeleceid*; from an opinion of its influencing the affairs of the heavens.

REHOBOTH, a townſhip of Maſſachuſetts, in Briſtol county, on a branch of Providence river, a few miles from Providence, in Rhode-Iſland, and 44 miles N. by W. of Boſton. It was called *Saconet* by the Indians; was incorporated in 1645, and contains 4,710 inhabitants.—*Morſe*.

REID (Thomas, D. D.), ſo well known to the public by his moral and metaphyſical writings, was the ſon of the Rev. Lewis Reid, miniſter of the pariſh of Strachan, in the county of Kincardine, North Britain. His mother was the daughter of David Gregory, Eſq; of Kinardie, of whom ſome account has been given in this *Supplement*, and ſiſter to David, James, and Charles Gregories,

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* *Biog. Dict.* new edit.

Gregories, who were at the ſame time profeſſors of aſtronomy, or mathematics, in the univerſities of Oxford, Edinburgh, and St Andrews.

He was born at the parſonage-houſe of Strachan in April 1710, and received the rudiments of his education at the pariſh ſchool of Kincardine-oniel. At that period the parochial ſchools of Scotland were very ſuperior to what they are now; and young men went from them to the univerſity well furniſhed with philological learning. The progreſs of young Reid muſt have been rapid; for he was removed from ſchool to the Mariſchal College, Aberdeen, when not more than twelve years of age; and we have never heard that he was admitted into the univerſity before he was qualified to profit by the lectures of the profeſſors. On the contrary, he ſoon diſplayed the genius of his mother's family, and ſhone conſpicuous among the ſtudents of mathematics in a college where that ſcience has been at all times cultivated with ardour and ſucceſs.

After the uſual courſe of four years employed in the ſtudy of Latin, Greek, Mathematics, and Philoſophy, he probably took his degree of M. A. which at that period, and for a long time ſubſequent to it, was the univerſal practice in the univerſity of Aberdeen, and then commenced the ſtudy of theology. In due time he was licenſed to preach the goſpel according to the forms of the church of Scotland; but continued to reſide for ſome years in Aberdeen, cultivating his favourite ſcience, mathematics.

The mathematical chair in Mariſchal College was then filled by Mr John Stuart, a man of great eminence in his profeſſion; but who, like many other profound mathematicians, was not happy in his mode of communicating ſcience, at leaſt to the duller part of his pupils. Mr Reid occaſionally read lectures for the profeſſor; and a friend of ours, by no means dull, has often been heard to expreſs great ſatisfaction that Mr Stuart was kept a whole winter from the ſchools, when he was a ſtudent, and that the claſs was taught by Mr Reid. "Had it not been for this circumſtance (ſaid he) I ſhould never have underſtood more of mathematics than the firſt ſix books of Euclid's elements; but Mr Reid had the faculty of making every thing intelligible to the ſtudents which he clearly apprehended himſelf."

He could not, however, ſpend his life in the ſtudy of mathematics, and in reading barren lectures for other men. He had been educated for the church; and it was in the church only that he had the proſpect of gaining a livelihood. He was accordingly preſented, we know not in what year, to the church of *New Machar* in Aberdeenſhire, at a time when the good people of Scotland were very far from being reconciled to the rights of patronage; and the conſequence was, that his ſettlement met with much popular oppoſition. Even a little riot took place in the church at his ordination; but he ſoon gained the affections of his flock by his good ſenſe, his acknowledged worth, and his unwearied attention to all their wants, which he was ever ready to relieve to the utmoſt extent of his abilities. So deeply rooted indeed was their regard for him at laſt, that, though it is now almoſt half a century ſince his relation to the pariſh of New Machar ceaſed, his memory continues to be revered in that pariſh even at the preſent day; and the following anecdote evinces that it is not revered without reaſon.

A man who, from being in decent circumſtances, and a member of the kirk-ſeſſion (See PRESBYTERIANS, *Encycl.*), when Dr Reid was miniſter, had become, in his old age, poor and infirm, obſerved to the then miniſter of the pariſh, that if he were able to go to Glaſgow, and make his caſe known to his old friend and paſtor, he was ſure that he would get ſomething done for him. This obſervation was reported to the Doctor, who inſtantly recollected the man, though, in all probability, he had not thought of him for thirty years; and he ſettled upon him an annual penſion of ten pounds, which was punctually paid as long as they both lived. The pride of ſcience had not from the mind of this great man eradicated the amiable ſympathies of humanity, nor had his philoſophic fame made him overlook the unaſpiring duties of the Chriſtian paſtor.

In the year 1751, about the beginning of the ſeſſion or annual term, one of the profeſſors of philoſophy in King's College, Aberdeen, died; and his death being unexpected, preſented to the other members of that learned body ſome difficulty in carrying on the uſual courſe of education for that year. At this our readers will not be ſurpriſed, when they reflect on the mode in which ſcience was taught in that univerſity; for he who could with propriety be placed in the vacant chair, muſt have been qualified, without much previous preparation, to read lectures on LOGIC, ONTOLOGY, PNEUMATICS, MORALS, POLITICS, MATHEMATICS, and NATURAL PHILOSOPHY (See GERARD, in this *Suppl.*). In ſuch a place as Aberdeen, it is hardly to be ſuppoſed that there was a ſingle man unemployed, ſo completely maſter of all theſe branches of ſcience, as to take up the claſs where it was dropt by the deceaſed profeſſor, and carry it ſucceſsfully through that ſcience, whatever it might be, in which at his death, he chanced to be lecturing. It occurred, however, to the principal, and ſome of the profeſſors, that the miniſter of New Machar was fully equal to the taſk; and the late Dr John Gregory, then profeſſor of medicine, and the Rev. Dr Macleod, the preſent ſubprincipal of King's College, were deputed to viſit Mr Reid, and requeſt his immediate acceptance of the vacant profeſſorſhip. He yielded to the requeſt not without ſome heſitation, and was admitted profeſſor of philoſophy on the 22d of November.

He was now in the very ſituation for which Nature ſeemed to have intended him. He had not only an opportunity, but it was his duty to cultivate the ſcience to which his attachment was ſo ſtrong; and the duties of his office made him turn his attention more cloſely than he had hitherto done to another ſcience, in which he was deſtined to make a more conſpicuous figure than he ever made even in his favourite mathematics.

It was during his profeſſorſhip in the univerſity of Aberdeen that he wrote his "Eſſay on Quantity," which was publiſhed in the 45th volume of the Philoſophical Tranſactions, and is perhaps the fineſt ſpecimen of metaphyſical mathematics, if we may uſe ſuch an expreſſion, that is extant in our own or in any other language (See QUANTITY, *Encycl.*). It was during the ſame period that he publiſhed his "Inquiry into the Human Mind on the principles of Common Senſe;" a work of unqueſtionable merit, which has contributed more than any other work whatever to give a rational turn to metaphyſical ſpeculations. It was about this period that the degree of D. D. was conferred upon him by his mother-college.

The well-earned fame of Dr Reid attracted the attention of the univerſity of Glaſgow to him as the fitteſt perſon to ſucceed the celebrated Dr Adam Smith; and he was admitted profeſſor of moral philoſophy in that univerſity on the 11th of June 1764. There his attention was not diſtracted by a multitude of ſciences, which it was his duty to teach; and he had leiſure to improve his metaphyſical ſyſtem, though he continued through life to amuſe himſelf occaſionally with mathematical ſpeculations.

In the year 1773 appeared, in Lord Kames's "Sketches of the Hiſtory of Man, a brief Account of Ariſtotle's Logic: with remarks by Dr Reid." It would ſeem that he had entered upon this taſk rather reluctantly, and merely in compliance with the ſolicitations of his friend, the author of the Sketches. "In attempting (ſays he) to give ſome account of the analytics, and of the topics of Ariſtotle, ingenuity requires me to confeſs, that though I have often purpoſed to read the whole with care, and to underſtand what is intelligible, yet my courage and patience always failed before I had done. Why ſhould I throw away ſo much time and painful attention upon a thing of ſo little uſe? If I had lived in thoſe ages when the knowledge of Ariſtotle's Organon intitled a man to the higheſt rank in philoſophy, ambition might have induced me to employ upon it ſome years of painful ſtudy: and leſs, I conceive, would not be ſufficient. Such reflections as theſe always got the better of my reſolution, when the firſt ardour began to cool. All I can ſay is, that I have read ſome parts of the different books with care, ſome ſlightly, and ſome perhaps not at all. I have glanced over the whole often; and when any thing attracted my attention, have dipped into it till my appetite was ſatisfied."

Notwithſtanding this modeſt acknowledgement, we are not ſure that any one of Dr Reid's publications does him greater honour than his very perſpicuous view of this ſtupendous ſyſtem. Having ourſelves occaſionally looked into the writings of Ariſtotle, we ſhould not heſitate to ſay, that it is by much the beſt analyſis of theſe writings that we have any where met with, even though we could not corroborate our own opinion by that of other men much more converſant than we are with the oracular language of the Stagyrite. But when it is known that the late Dr Doig of Stirling, to whom Greek was as familiar as his mother tongue, and an equally learned Doctor of Oxford, who has been reading Ariſtotle ever ſince he was fourteen years of age, agreed in opinion, that a more accurate view of his logic could not be given in the ſame compaſs than had been given by Dr Reid, we may ſurely affirm, with ſome degree of confidence, that this ſmall work adds much to the fame of our celebrated countryman.

Though Dr Reid's health continued good, and his mental faculties unimpaired, till a very ſhort time before his death, he ceaſed for ſome years to read lectures from his profeſſorial chair, employing that time in preparations for eternity, and in fitting his lectures for the preſs. Theſe were publiſhed in two volumes 4to: the firſt in 1785, under the title of "Eſſays on the Intellectual Powers of Man," dedicated to his friends Dr Gregory and Profeſſor Stewart, both of the univerſity of Edinburgh; and the ſecond in 1788, under the title of "Eſſays on the Active Powers of Man," without any dedication or preface. He continued to enjoy the fame acquired by this work, as well as the affection of his friends and the reverence of the public, for eight years, dying at Glaſgow in the end of September, or the beginning of October 1796, in the 87th year of his age. He had been married, and he left behind him one daughter.

To do juſtice to the biography of ſuch a man as this, we ſhould here attempt to draw his intellectual character, and to appreciate the merits of his works; but to perform this taſk in a manner at all worthy of him, or we hope of ourſelves, would require more room than our limits permit us to allot to any article of the kind; and our readers will be pleaſed to learn, that they may confidently expect an account of his life, with a critique on his works by a man better qualified to do juſtice to both, than the writer of this ſhort ſketch pretends to be. His works are in the hands of the ſpeculative public; and by that public will be duly valued, as long as ſound ſenſe ſhall be preferred to impious jargon. How long that may be, God only knows; but if any thing can guard the minds of our youth againſt that ſophiſtry of which the object is to attribute real agency to material fluids, and to repreſent the elective attractions of chemiſtry as perfectly ſimilar to human volitions, it will be the unbiaſſed ſtudy of Dr Reid's "Eſſays on the Intellectual and Active Powers of Man." They will there find metaphyſics diveſted of myſtery, and the profoundeſt ſpeculations rendered intelligible by the conſtant uſe of words in one determined ſenſe. We think, indeed, that in this conſiſts the Doctor's chief merit; for except when treating of our notions of power, he ſeems not to have added much to what certainly *may be* found in the writings of Locke.

Let not our readers ſuppoſe, that by this obſervation we wiſh to detract in the ſmalleſt degree from our author's fame, or to leſſen him by compariſon with the Engliſh philoſopher. If on mere topics of ſpeculative ſcience, he appears to us to have thought as Locke thought, it is on the other hand certain, that the greater part of Locke's doctrines may be gleaned from the logical and metaphyſical writings of Bacon, Hobbes, and Des Cartes. Nor need this ſurpriſe any one; for he who reflects a moment on the ſubject, muſt perceive that ſuch a coincidence of thought in metaphyſical ſcience is among men of eminence almoſt inevitable. Of mind and its powers—the ſubject of that ſcience—we neither know, nor can know any thing, but by patiently attending to the operations of our own minds, when we ſee, hear, feel, think, reaſon, and will, &c.: and it is obvious, that every man who is capable of ſuch patient attention, and does not labour under the bias of ſome prejudice, muſt view theſe operations in the ſame way. The great ſuperiority of Dr Reid over his predeceſſors, in this department of ſcience, appears to have been this, that he apprehended the operations of his own mind with a clearneſs, which gave to his language a preciſion and perſpicuity which the language of Locke certainly does not poſſeſs.

In the Eſſay on the Human Underſtanding, the term *idea* ſometimes ſignifies a material ſubſtance, ſometimes the qualities of that ſubſtance, ſometimes the conception of theſe qualities, ſometimes the power or faculty of of the mind by which we conceive a thing, ſometimes a perception of ſenſe, and ſometimes an intellectual notion. Hence the ambiguity of terms which runs thro' the whole of that immortal work, has furniſhed both the author's friends and his enemies with an opportunity of attributing to him pernicious doctrines, which we are perſuaded he did not maintain, and which, we think, a patient analyſis of the eſſay muſt *convince every man* that he did not maintain. From this ambiguity the writings of Dr Reid are perfectly free. His doctrines, whether well or ill-founded, can never be miſunderſtood by him who is deſirous to underſtand them; and he who knows how much perſpicuity of ſtyle depends upon accuracy of thinking, will not deem us enemies to his fame for having ſaid that his chief merit conſiſts in the preciſion of his language.

He has been much cenſured by ſome, and much applauded by others, for introducing the phraſe *common ſenſe* into ſpeculative philoſophy, as the proper name of that faculty of the mind by which we apprehend firſt truths; but he is on this account entitled neither to praiſe nor to cenſure. He adopted the phraſe from others; and has proved, by the moſt unexceptionable authorities, both ancient and modern, that it may with great propriety be uſed as he has uſed it. Whether the adopting of it into works of ſcience was neceſſary, is another queſtion, on which we have given our opinion elſewhere; it is ſufficient in this place to vindicate his uſe of it, eſpecially in his latter works, from ambiguity.

Candour obliges us to acknowledge, that he has advanced ſome doctrines which we cannot admit as true. Though not in general partial to Locke, he has adopted his notions reſpecting our power of abſtraction with hardly any other variation than the ſubſtituting of the term *conceptions* for Locke's favourite phraſe *ideas*. He has likewiſe endeavoured to prove, that we may diſtinctly conceive what cannot poſſibly exiſt. Theſe miſtakes, for ſuch they appear to us, we have pointed out elſewhere (See Metaphysics, Part I. Chap. iii. and iv. *Encycl.*); but they are infinitely more than counterbalanced by his clear, accurate, and ſatisfactory diſquiſitions on our notions of active power. Had Dr Reid never written a ſentence but the eſſay which treats of this delicate and important ſubject, he would have been entitled to a place in the very firſt rank of uſeful metaphyſicians; for, previous to the appearance of his works, we had nothing written directly on *power* but contradictory and unintelligible jargon. We recommend the ſerious peruſal of this eſſay, the firſt in his ſecond volume, to ſuch of our readers as fancy that they diſtinctly conceive the powers of chemical agents, and that intelligence and volition may reſult from any mechanical organization, or any combination whatever of matter and motion.

REISKE (John James), a moſt profound ſcholar and ſagacious critic, was born in 1706 at a ſmall town of the duchy of Anhalt. After ſtruggling with ſome difficulties in his ſchool education, in which, however, he, by perſeverance, obtained conſiderable advantages, he went, in 1733, to Leipſic; where he continued, for the ſake of ſtudy, five years. Here he accompliſhed himſelf in Arabic, and tranſlated and publiſhed a book from that language. In order to proſecute his ſtudy of Arabic with greater effect, he travelled on foot, and with many difficulties, to Leyden. Here he was employed in arranging the Arabic manuſcripts, for which, however, he received a very ſcanty compenſation; and here alſo he tranſlated from the German and French, into Latin, various eſſays ſent him by Dorville, whom he had viſited in his journey, and who afterwards inſerted theſe Papers in the *Miſcellanea Critica*. Dorville was ſo well pleaſed with his ſkill and diligence, that he employed him in more important concerns. At his deſire, Reiſke tranſlated the whole of the Chariton from the Greek, and the Geography of Abulfeda from the Arabic, into Latin. At Leyden he continued for the ſpace of eight years; where a ſtorm of jealouſy and calumny, excited againſt him by the younger Burman, finally induced him to change his reſidence. This was principally owing to the freedom he uſed with reſpect to the edition of Petronius, edited by the younger Burman at Leyden; however, before he quitted it, he took the degree of doctor of phyſic, which was given him in a manner which did him the higheſt honour. He then viſited different parts of Germany, till he at length ſettled at Leipſic a ſecond time. Here, for twelve years, notwithſtanding he was made profeſſor of Arabic, he experienced all the inconveniences of poverty, and was obliged to undergo a great deal of drudgery for bookſellers, and the editors of periodical publications, to procure a ſubſiſtence; at this period, in particular, the *Acta Eruditorum* were greatly indebted to him. Amidſt all theſe hardſhips, however, he found opportunity to write and to publiſh, his *Animadverſiones in Auctores Græcos*, in five volumes: a work of extraordinary learning and merit. In 1758, by the death of Haltauſius, he obtained a ſituation at once honourable and lucrative, which placed him above want, and enabled him to follow his favourite purſuits at eaſe. He was made rector of the academy at Leipſic, in which office he continued till the time of his death. In 1764, he married Erneſtina Chriſtina Muller, a woman of wonderful attainments, whoſe knowledge was hardly inferior to his own, and particularly in Greek literature. She aſſiſted him in all his literary labours, and eſpecially in his immortal work of the "Edition of the Greek Orators." Thus, in the manner moſt grateful to himſelf, Reiſke conſumed the remainder of his life, which continued till 1774, when he died poſſeſſed of the higheſt reputation. The number of works which he ſuperintended and publiſhed is very great, but it will be ſufficient to name thoſe which are moſt ſought after and eſteemed. Theſe are, the "Remarks upon Greek Authors," before mentioned. An "Edition of the Greek Orators," in 12 vols. 8vo, which was finiſhed by his widow. "Dionyſius Halicarnaſſenſis," in 7 vols. "Plutarch's Works," in 9 vols. "Theocritus, &c. &c." This John James Reiſke muſt not be confounded with *John Reiſke*, rector of the college of Wolfenbuttel, who was alſo a learned man, and publiſhed various works*.

REISTERSTOWN, in Baltimore county, Maryland, 10 miles ſouth-eaſt of Weſtminſter, and nearly 16 north-weſterly of Baltimore.—*Morſe.*

REMONSTRANTS, in church hiſtory, a title given to the Arminians (See that article, *Encycl.*) by reaſon of the remonſtrance which, in 1610, they made to the States of Holland, againſt the ſentence of the ſynod of Dort, which condemned them as heretics. Epiſcopius and Grotius were at the head of the *Remonſtrants*,

* *Biog. Dict.* new edit.

monſtrants, whoſe principles were firſt openly patroniſed in England by Archbiſhop Laud. In Holland, the patrons of Calviniſm preſented an addreſs in oppoſition to the remonſtrance of the Arminians, and called it a counter-remonſtrance. Hence the Dutch Calviniſts were termed *Counter remonſtrants*. Much controverſy was carried on by theſe rival ſects, which, on the ſide of the Calviniſts, was extremely illiberal.

REMORA, or SUCKING FISH, a ſpecies of ECHENEIS (See *Encycl.*), M. Vaillant found, upon different parts of his enormous *ray* (See RAJA in this *Suppl.*) about twenty ſmall ſucking fiſh, or *remoras*, faſtened ſo firmly, that they did not drop off when he was hoiſted on board. Some naturaliſts have ſaid, that the head of the ſucking fiſh is viſcous on the lower part, and furniſhed with rough points ſimilar to the teeth of a file; and according to them, it is by means of theſe two qualities, its roughneſs and viſcoſity, that it is enabled to adhere to other fiſh.

"Figure to yourſelf (ſays one of them) a row of nineteen ſharp-edged and dentated laminæ, placed croſswiſe, and iſſuing immediately from the rim of the lower jaw, and you will have a juſt idea of the part with which the remora makes itſelf faſt."

This deſcription (ſays Vaillant) is exact as far as relates to the figure and number of the dentated laminæ; but it places them on the lower part of the head, whereas they are, in reality, on the upper. Accordingly, when the remora fixes itſelf, it is obliged to turn upon its back, with its belly upward.

If the two white fiſh, however, that poſted themſelves on the arms of the *ray* and ſerved him as pilots, be of the remora ſpecies, as he is inclined to think, the laminæ by which that variety adheres to other fiſhes muſt be on the lower part of the body, ſince the two pilots continued in their natural poſition, and had no occaſion to turn over to fix themſelves at their poſt.

RENOWE's *Harbour*, on the eaſt coaſt of Newfoundland Iſland, is about 21 miles from Cape Race. Its entrance is rather dangerous, but it is a good harbour to fiſh in; and is much frequented by boats and ſhallops, in the fiſhing ſeaſon. Half a league from the S. point is a high rock, called Renowe's Point; which may be ſeen, in a clear day, 3 leagues off.—*Morſe.*

RENSSELAER, a county of the State of New-York, bounded north by Waſhington county, ſouth by Columbia, eaſt by part of the States of Maſſachuſetts and Vermont, and weſt by Hudſon's river. It contains eight townſhips, viz. Troy, Greenbuſh, Schodack, Stephentown, Peterſburg, Hoſick, Pittſtown, and Schactecoke. In 1796, there were 3500 of the inhabitants qualified electors.—*ib.*

RENSSELAERVILLE, or *Renſſlaerwick*, a townſhip of Albany county, New-York, bounded ſoutherly by Columbia county, and weſterly by Hudſon's river. In 1790, it contained 2771 inhabitants; in 1796, it had 548 inhabitants who were electors. In this town, nearly oppoſite to the city of Albany, is a medicinal ſpring, which combines moſt of the valuable properties of the celebrated waters of Saratoga.—*ib.*

REPETEND, in arithmetic, denotes that part of an infinite decimal fraction, which is continually repeated *ad infinitum.* Thus in the numbers 2·13 13 13 &c. the figures 13 are the repetend, and marked thus $\dot{1}\dot{3}$.

REPUBLICANS, the name given by Vaillant, with ſome propriety, to a kind of birds which were obſerved in South Africa, both by him and Paterſon, to inhabit apparently the ſame enormous neſt. Cutting one of theſe neſts in pieces with a hatchet, he perceived that the principal and fundamental piece conſiſted of a maſs of ſtrong coarſe graſs (called by the Hottentots *Boſhmen's graſs*), without any mixture, but ſo compact and firmly knit together as to be impenetrable to the rain. This nucleus is the commencement of the ſtructure; and each bird builds and applies to it its particular neſt. But theſe cells are formed only beneath and around the maſs; the upper ſurface remains void, without, however, being uſeleſs; for as it has a projecting rim, and is a little inclined, it ſerves to let the water run off, and preſerves each dwelling from the rain. Figure to yourſelf a huge irregular maſs, the ſummit forming a kind of roof, and all the other parts of the ſurface completely covered with cells ſqueezed one againſt another, and you will have a tolerably accurate idea of theſe ſingular edifices.

Each cell is three or four inches in diameter, which is ſufficient for the bird. But as they are all in contact with one another through the greater part of the ſurface of the maſs, they appear to the eye to form but one building, and are diſtinguiſhable from each other only by a little external aperture, which ſerves as an entrance to the neſt; and even this is ſometimes common to three different neſts, one of which is ſituated at the bottom, and the other two at the ſides.

The neſt which he examined contained 320 inhabited cells, which, ſuppoſing a male and female to each, announce a ſociety of 640 individuals. Such a calculation, however, would not be exact; for whenever our author fired at a flock of theſe birds, he always killed four times as many females as males. "For the reſt (ſays he), theſe birds have nothing very remarkable in their plumage. It is an uniform brown grey, diverſified by a few black ſpots on the ſides, and a large patch of the ſame colour on the throat. The male is a little larger than the female; in other reſpects they exactly reſemble each other."

RESIDUAL ANALYSIS, a calculus propoſed by the inventor, Mr Landen, as a ſubſtitute for the method of fluxions. The object of this ſubſtitution was to avoid introducing the idea of motion, and of quantities infinitely or indefinitely ſmall, into mathematical inveſtigation. The reſidual analyſis accordingly proceeds, by taking the difference of the ſame function of a variable quantity in two different ſtates of that quantity, and expreſſing the relation of this difference to the difference between the two ſtates of the ſaid variable quantity itſelf. This relation being firſt expreſſed generally, is then conſidered in the caſe when the difference of the two ſtates of the variable quantity is = 0; and by that means it is evident, that the ſame thing is done as when the fluxion of a function of a variable quantity is aſſigned by the ordinary methods.

The evolution of the functions, conſidered in this very general view, requires the aſſiſtance of a new theorem, diſcovered by Mr Landen, and remarkable for its ſimplicity, as well as its great extent. It is, that if x and v are any two variable quantities, $\frac{x^{\frac{m}{n}} - v^{\frac{m}{n}}}{x - v}$

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$$= x^{\frac{m}{n}-1} \times \frac{1+\frac{v}{x}+\frac{v^2}{x^2}+\frac{v^3}{x^3}+\cdots(m)}{1+\left(\frac{v}{x}\right)^{\frac{m}{n}}+\left(\frac{v}{x}\right)^{\frac{2m}{n}}+\left(\frac{v}{x}\right)^{\frac{3m}{n}}\cdots(n)}$$

where m and n are any integer numbers.

This theorem is the baſis of the calculus; and from the expreſſions $x^{\frac{m}{n}} - v^{\frac{m}{n}}$, and $x - v$ having the form of what algebraiſts call *reſiduals*, the ingenious inventor gave to his whole method the name of the *reſidual analyſis*.

The firſt account of this method was publiſhed by Mr Landen in 1758, under the title of a *Diſcourſe concerning the Reſidual Analyſis*. The firſt book of the Reſidual Analyſis itſelf was publiſhed in 1764; and contained an explanation of the principles of the new calculus, with its application to ſeveral of the moſt conſiderable problems belonging to the direct method of fluxions. The ſecond book was intended to give the ſolution of many of the moſt difficult problems that belong to the inverſe method of fluxions, or to the integral calculus; but it has never been publiſhed: a circumſtance which every one, who has taken the trouble to ſtudy the firſt part of the work, will very much regret.

If we eſtimate the value of the reſidual analyſis from the genius, profound knowledge, and extenſive views required to the diſcovery of it, it will rank high among works of invention: but if, on the other hand, we eſtimate its value by its real practical utility, as an inſtrument of inveſtigation, we muſt rate it much lower. When compared with the fluxionary calculus, which it was intended to ſuperſede, its principles, though in appearance more rigorous, are much leſs eaſily apprehended, much leſs luminous, and leſs direct in their application; and therefore, as a means of extending the bounds of mathematical ſcience, it muſt ever be regarded as vaſtly inferior to the latter (A).

RESOLUTION *Bay*, or *Madre de Dios*, is under the higheſt land on the W. ſide of St Chriſtina, one of the Marqueſas Iſlands. S. lat. 9 52, W. long. 139 9. —*Morse*.

RESOLUTION *Iſland*, a ſmall iſland, one of the Society Iſles; ſo called from the ſhip Reſolution. S. lat. 17 24, W. long. 141 15.—*ib.*

RETICULA, or RETICULE, in aſtronomy, a contrivance for meaſuring very nicely the quantity of eclipſes, &c. This inſtrument, introduced ſome years ſince by the Paris Academy of Sciences, is a little frame, conſiſting of 13 fine ſilken threads, parallel to, and equidiſtant from, each other, placed in the focus of object-glaſſes of teleſcopes; that is, in the place where the image of the luminary is painted in its full extent. Conſequently the diameter of the ſun or moon is thus ſeen divided into 12 equal parts or digits: ſo that, to find the quantity of the eclipſe, there is nothing to do but to number the parts that are dark, or that are luminous. As a ſquare reticule is only proper for the diameter of the luminary, not for the circumference of it, it is ſometimes made circular, by drawing ſix concentric equidiſtant circles, which repreſent the phaſes of the eclipſe perfectly. But it is evident that the reticule, whether ſquare or circular, ought to be perfectly equal to the diameter or circumference of the ſun or ſtar, ſuch as it appears in the focus of the glaſs; otherwiſe the diviſion cannot be juſt. Now this is no eaſy matter to effect, becauſe the apparent diameter of the ſun and moon differs in each eclipſe; nay, that of the moon differs from itſelf in the progreſs of the ſame eclipſe. Another imperfection in the reticule is, that its magnitude is determined by that of the image in the focus; and of conſequence it will only fit one certain magnitude. See MICROMETER, *Encycl.*

Revel's,
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Revivification.

REVEL's, a ſmall iſland in the Atlantic Ocean, cloſe to the eaſt coaſt of Northampton county, Virginia.—*Morse.*

REVETEMENT, in fortification, a ſtrong wall built on the outſide of the rampart and parapet, to ſupport the earth, and prevent its rolling into the ditch.

REVIVIFICATION, in phyſiology, the recalling to life of animals apparently dead. There are many kinds of inſects which may be revivified, after all the powers of animation have been ſuſpended for a conſiderable time. Common flies, ſmall beetles, ſpiders, moths, bugs, &c. after being drowned in ſpirit of wine, and continuing apparently dead for more than a quarter of an hour, have been reſtored to life merely by being thrown among wood-aſhes ſlightly warm.

While Dr Franklin reſided in France, he received from America a quantity of Madeira wine which had been bottled in Virginia. In ſome of the bottles he found a few dead flies, which he expoſed to the warm ſun, it being then in the month of July; and in leſs than three hours theſe apparently dead animals recovered life which had been ſo long ſuſpended. At firſt they appeared as if convulſed; they then raiſed themſelves on their legs, waſhed their eyes with their fore feet, dreſſed their wings with thoſe behind, and began in a little time to fly about.

But the moſt extraordinary inſtance of revivification that we ever heard of, is the following: In the warmer parts of France there is an inſect very deſtructive to rye, which ſeems to begin its operations at the root of the plant, and gradually to proceed upwards to the ear. If the plant be completely dried while the inſect is in the root or ſtem, the animal is irrecoverably killed; but after it has reached the grain, the caſe is very different. There have been inſtances, which are noticed in the Academy of Sciences, of theſe inſects being brought to life in a quarter of an hour, by a little warm water, after the grains, in which they were lodged, had been kept dry for 30 years.

What is the metaphyſician to think of theſe phænomena, or what concluſion is he to draw from them with reſpect to the mind or ſentient principle? If he be a ſober man, he will draw no concluſion; and for this very good reaſon, that of the ſentient principle of inſects, and indeed of every animal but man, he knows nothing.

(A) For this view of the *Reſidual Analyſis*, we are obliged to Mr Playfair profeſſor of Mathematics in the Univerſity of Edinburgh.

nothing. He is conſcious that it is the ſame individual being, which, in himſelf, thinks, and wills, and feels; he knows, that part of his thought is not in one place and part of it in another; and therefore he rationally concludes that this thinking being is not matter, whilſt experience teaches him that it quits the material ſyſtem as ſoon as that ſyſtem becomes completely unfit to diſcharge its functions, and that when it has once taken its flight, it cannot be recalled. Experience teaches him, on the other hand, that the ſentient principle of theſe inſects does not quit the material ſyſtem as ſoon as that ſyſtem ſeems unfit for its functions; and hence he ought to infer, that the minds of men and of inſects (if we may uſe ſuch language), though probably both immaterial, are very different ſubſtances; and that the bond which unites the material and immaterial parts of an inſect, is certainly different from that which unites the mind and body of man. This is the only inference which can be legitimately drawn from theſe phenomena; and he who makes them the baſis of materialiſm, muſt have his judgment warped by ſome paſſion or prejudice.

216 Narrative continued. REVOLUTION OF FRANCE. We formerly preſented to our readers a conciſe ſtatement of the commencement and progreſs of this extraordinary event (See REVOLUTION, *Encycl.*). The ſingularity of its nature, and the important place which it muſt hereafter occupy in the moral and political hiſtory of mankind, require that we ſhould now reſume and continue the detail of its wide-waſting career. We left the ſubject towards the commencement of the year 1795, at the cloſe of that wonderful campaign, during which the armies of the Republic had exerted themſelves with ſuch unparalleled ſucceſs in every direction. On the one ſide they had croſſed the Pyrenees, and ſhaken the Spaniſh monarchy to its centre; while on the other they had driven the united forces of Auſtria, Pruſſia, and Britain, from the walls of Landrecies acroſs the Rhine, at all points from Hageneau to the ſea, and had finally cloſed their efforts by the conqueſt of Holland. At that period, though a prolongation of hoſtilities was threatened, we ſcarcely expected that Europe was ſo ſoon to witneſs, or we to record, a ſucceſſion of military enterpriſes of a ſtill more romantic and extraordinary nature, the ſcene of which was even to extend into barbarous countries, where the opinions and the quarrels of the European nations had hitherto remained unknown.

217 Diminiſhed energy of the Convention, The campaign of 1794, however, was not immediately followed by any important military exertions. The Britiſh troops were recalled home, Pruſſia had been gradually withdrawing from the coalition, and the Auſtrian armies remained upon the defenſive. Neither was the French Government in a ſituation which could enable it to renew its enterpriſes with vigour, or to give much trouble to the allies. The Convention ſtill exiſted; but it was no longer that terrible aſſembly which, under Robeſpierre and his aſſociates, had, in the ſhort period of fifteen months, reduced two-thirds of France under its dominion, and ſent forth armies which the combined ſtrength of the reſt of Europe ſeemed unable to reſiſt. While its authority remained almoſt concentrated in one man, and while the fear of foreign invaſion, and the new born enthuſiaſm for freedom, induced the people to ſubmit to every meaſure of government, however oppreſſive or arbitrary, the power of the Convention, and the number of its armies, were unbounded. The dreadful price, however, which they had paid for liberty, and the facility with which they ſaw it might be loſt, had now diminiſhed the political zeal of all claſſes of citizens. The removal of the foreign armies had diſpelled the dread of invaſion, and the death of Robeſpierre, by diſſolving the unity of its efforts, and ſuffering it to fall into contending factions, had greatly weakened the authority of the Convention, and diminiſhed its efficiency as a government.

218 And diſcredit of the Jacobins,

The fall of Robeſpierre had been accompliſhed by two ſeparate conſpiracies. At the head of one of theſe were Barrere, Billaud Varennes, and Collot d'Herbois, who had been members of the Committee of public ſafety. The other conſpiracy conſiſted of members of the Convention who did not belong to the committees, and had no immediate ſhare in the adminiſtration. Among theſe, Tallien, Bourdon de l'Oiſe, and Lecointre of Verſailles, were conſpicuous. After the deſtruction of their mutual tyrant, a conteſt for power took place between theſe parties. The popularity of Robeſpierre had once been ſo conſiderable, and all men had ſubmitted ſo tamely to his dominion, that both parties accounted it neceſſary, in their ſpeeches and writings, to juſtify to the nation the ſhare they had taken in accompliſhing his ruin. It was eaſy to be eloquent upon ſuch a topic; but its diſcuſſion naturally operated to the diſcredit of the members of the committee, and of the more violent Jacobins, who had been the immediate inſtruments for carrying into effect his ſanguinary meaſures. They nevertheleſs retained poſſeſſion, for ſome time, of a conſiderable portion of power. The current of public opinion, however, ran ſo ſtrongly againſt them, and the reſtoration to their ſeats in the Convention of the ſeventy-one impriſoned members of the Girondiſt party, added ſo much to the ſtrength of their antagoniſts, that they gradually loſt their influence, and were threatened to be brought to trial for their conduct.

As early as Auguſt 1794, Lecointre of Verſailles had denounced the members of the old committee of ſafety; but his accuſation at that time produced little effect. Towards the end of that year, however, their approaching fall became evident. On the 26th of December the Convention ordered, on the motion of Clauzel, that the committees ſhould immediately report upon the conduct of the repreſentatives denounced by Lecointre and all France. Accordingly, on the following day, Merlin of Douay reported, in the name of the committees, that there was no cauſe for inquiry into the conduct of Vouland, Amar, and David; but that there was room for examining the conduct of Barrere, Billaud Varennes, Collot d'Herbois, and Vadier.

219 Whoſe leaders were acc ſed, In conſequence of this report, a committee of twenty-one members was appointed to make the enquiry. On the 2d of March this year (1795), Saladin preſented the report of the commiſſion; in which theſe four deputies were accuſed of having participated, as members of the governing committee, in the tyranny and atrocious meaſures of Robeſpierre. Their trial commenced before the Convention on the 22d of March; but previous to that period, Vadier had made his eſcape. The others remained, and reſted their defence upon this ground, that although members of the committee of ſafety, they had no power to reſiſt Robeſpierre, and that they were not more culpable in having acquieſced in

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in his tyranny than the other members of the Convention, who had all been overpowered for the time by the knowledge that inſtant deſtruction awaited every man who ſhould dare to oppoſe his meaſures. Except in the caſe of the cruelties committed by Collot d'Herbois at Lyons, this defence was probably by no means deſtitute of foundation. It had much weight with the nation at large; in whoſe eyes it tended, not to exculpate the three perſons now accuſed, but to criminate and degrade the character of the whole Convention.

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Carnot, Lindet, Cambon, Duhem, and the other members of what was now called the *Jacobin party*, defended their leaders with conſiderable ability, and with much vehemence. Nor was the party leſs active without doors than within the hall of the Convention. For ſome time they had drawn their friends to the capital from all quarters of the country; and in the morning ſitting of the firſt of April, they commenced their operations by an open inſurrection. An immenſe multitude having aſſembled in the ſuburbs, proceeded to the hall of the Convention. A real or fictitious ſcarcity exiſted at the time. Taking advantage of this circumſtance, they pretended they were going to petition for bread; and this pretence drew numbers along with them who had no ſhare in their deſigns.

Boiſſy d'Anglas, a conſpicuous member of the moderate party, was addreſſing the Convention upon the means of removing the preſent ſcarcity when the inſurgents arrived, drove the centinels from their poſts, and ſuddenly filled the hall. They tumultuouſly demanded "Bread, and the Conſtitution." The Jacobin party ſupported the inſurgents; and one of the multitude, in a vehement harangue, exclaimed, "We are men of the 14th of July, of the 10th of Auguſt, and of the 31ſt of May." He demanded that the Convention ſhould change its late meaſures, that the people ſhould no longer be the victims of mercantile rapacity, and that the accuſed patriots ſhould not be ſacrificed to the paſſions of their antagoniſts. The Convention ordered the tocſin to be rung, and the people of Paris to be called to arms. General Pichegru was in Paris at the time; and, upon the motion of Barras, he was appointed to the command of the military force.

221 ich is lled by hegru.

The citizens of Paris, who remembered with horror the domination of Robeſpierre and his adherents, and now ſaw themſelves menaced with its return, inſtantly called each other to arms, and aſſembled, by ſix in the evening, for the protection of the Convention, to the amount of 20,000 men. Till that time the aſſembly had remained under no ſmall diſquietude, ſurrounded by the inſurgents, and liſtening to the addreſſes of their orators, and the ſpeeches of the Jacobin minority in their favour. The majority was now reſcued from this ſtate of conſtraint; and, on the motion of Dumont, without proceeding farther in the trial, it was decreed that Barrere, Collot d'Herbois, and Billaud Varennes, ſhould immediately be tranſported to Guiana.

222 tory of Con- tion.

During the following day the inſurgents were completely ſubdued; and the majority of the Convention, taking advantage of their victory, decreed the arreſt and confinement, in the caſtle of Ham in Picardy, of ſeveral of the moſt obnoxious of their antagoniſts. Among theſe were Leonard Bourdon, Duhem, Chaſles, Choudieu, Ruamps, Fouſſedoire, Huguet, Bayle, Lecointre, Cambon, Thuriot Maignet, Heutz, Craſſous, and Levaſſeur. By departing from the puniſhment of death, and adopting that of baniſhment on this occaſion, the Convention expected to diminiſh the ferocity of the contending factions in the ſtate, by rendering the reſult of a political defeat leſs fatal than formerly. The deſign was good; but in attempting to accompliſh it, they eſtabliſhed the pernicious precedent of inflicting puniſhment without a trial, which could ſcarcely fail to prove highly dangerous, if not ultimately fatal, to all their proſpects of a free and juſt government.

French Revolution 1795.

223 Propoſal for a new conſtitution.

The Convention now followed up its victory with the popular meaſure of preparing for its own diſſolution, by endeavouring to frame a fixed conſtitution for the Republic. The conſtitution which had been decreed in 1793, under the auſpices of Robeſpierre, was conſidered as impracticable, and a committee was appointed to report upon the meaſures which ought now to be adopted. It conſiſted of Sieyes, Cambaceres, Merlin of Douay, Thibaudeau, Mathieu, Le Sage of Eure and Loire, and Latouche. On the 19th of April, Cambaceres reported, that it was the opinion of this committee that a commiſſion ſhould be appointed to frame an entirely new conſtitution. The Convention accordingly appointed the following perſons to this important office, Le Sage, Louvet, Boiſſy d'Anglas, Creuze, Latouche, Bertier, Daunow, Baudin, Durand, Maillane, Languinais, La Reveillere Lepaux, and Thibaudeau. All other citizens of every deſcription were at the ſame time invited to communicate projects upon the ſubject, and the committee was required to order the beſt conceived of theſe to be printed.

The Convention farther gratified the feelings of the great majority of the nation, by bringing to trial Fouquier Jenville the preſident, and fifteen judges and jurors of the late revolutionary tribunal. They were convicted on the 8th of May, and executed on the following day, amidſt the execrations of a multitude of ſpectators.

224 New inſurrection of the Jacobins,

In the mean time, though defeated on the 1ſt and 2d of April, the Jacobins by no means conſidered themſelves as ſubdued. On the contrary, they were preparing a new and more extenſive inſurrection, which ſhould not, like the former, be confined to the capital. They fixed upon the 20th of May as the day of revolt. Thuriot, and Robeſpierre's financier Cambon, had found means to eſcape from the caſtle of Ham in Picardy, and to come to Paris. They concealed themſelves in the ſuburb St Antoine, and from thence gave counſel to their party, and urged them to action. The ſcarcity of bread had increaſed, and advantage was again taken of this circumſtance. For ſome days the walls were covered in various places of Paris with printed accuſations againſt the Convention of withholding bread from the people, and attempts were made to excite the troops in the city to join the diſaffected party. On the evening of the 19th, a paper was openly diſtributed in the different ſections, explaining the object of the approaching inſurrection. It declared inſurrection to be the moſt ſacred duty of the people, and called upon the citizens of Paris to proceed in a maſs to the Convention, to demand from it bread and the eſtabliſhment of Robeſpierre's conſtitution, together with a new election of national repreſentatives.

On the morning of the 20th, the tocſin was rung, and drums beat to arms in the ſuburb St Antoine, which had always been the quarter of the city in which

which the Jacobins poſſeſſed the greateſt ſtrength. Upon this alarm the Convention aſſembled; but although the intended inſurrection was no ſecret, and though the committee of public and general ſafety now made a report, in which they confeſſed their previous knowledge of it, yet it does not appear that any vigorous meaſures of precaution had been taken; for it was only at the inſtant when the inſurgents were actually approaching, that General Hoche was appointed to command the armed force, and was ſent forth to aſſemble the military and the citizens for the defence of the Convention. In the mean time, the multitude ſurrounded the hall. They ſoon overpowered the guards, and burſt into the midſt of the aſſembly. In all the turbulent days of the revolution, the women of Paris have never failed to act a conſpicuous part. On this occaſion they greatly augmented the crowd by their numbers, and the tumult by their cries of "Bread, and the conſtitution of 1793," which was the rallying exclamation of the party. After ſome fruitleſs efforts to reſtore tranquillity, Vernier the preſident, an old man, reſigned the chair to Boiſſy D'Anglas, who remained in it with much firmneſs during the day. The whole ſtrength of the inſurgents had not arrived at once; for the firſt party that approached, although they forced their way into the hall, were ſoon repulſed by the aid of a few ſoldiers and citizens, who came to the aſſiſtance of the Convention. A ſhort interval of tranquillity was thus obtained; but the attack was ſpeedily renewed with double fury by armed men, who ſubdued all oppoſition, and entered the hall with cockades, on which was written the inſcription, "Bread and the conſtitution of 1793." While things were in this ſtate, a citizen of the party of the Convention raſhly tore off the hat of one of the inſurgents, and was immediately aſſaulted with ſwords by the multitude. He fled towards the preſident's chair, and was killed at the ſide of it by a muſket ſhot. Ferand, one of the members, having attempted to reſcue him, was alſo attacked. He eſcaped into one of the paſſages, where he was alſo killed, and his head was brought into the Convention upon a pike. The greater number of the members now gradually departed, and left the hall in poſſeſſion of the inſurgents, who acted with ſome regularity, and propoſed a variety of laws favourable to their party, which were inſtantly decreed. Duroi, Duqueſnoi, Bourbotte, and Goujon, were the members who ſtood moſt openly forward on this occaſion, and appeared as chiefs of the inſurrection. But their triumph only laſted a few hours. Towards the evening a large body of citizens joined the military, and marched to the aid of the Convention. Having overcome the inſurgents, they entered the hall in great force, and reſtored the powers of the majority. The decrees that had been forced upon them were repealed as ſpeedily as they had been enacted, and the deputies who had propoſed or ſupported them were arreſted.

225
Who murder ſome of the Convention, and drive it from its

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vention.

The citizens of Paris, and even the members of the Convention, appear now to have fancied their victory complete; for they adopted no adequate meaſures to prevent a new diſturbance. But the Jacobins did not ſo eaſily give up their own cauſe. On the following day they once more aſſembled in the ſuburbs, and in the afternoon they returned to the attack. They took poſſeſſion of the Carouſal without oppoſition, and pointed ſome pieces of cannon againſt the hall of the Convention. This aſſembly was now unprotected, and attempted not to ſubdue, but to flatter, the inſurgents. A deputation of the members was ſent forth to fraterniſe with them, and to carry forth two decrees paſſed at that inſtant, which ordained that bread ſhould abound, and that Robeſpierre's conſtitution of 1793 ſhould immediately be put in force. The inſurgents, in return, ſent a deputation to the Convention, to expreſs their ſatisfaction with the decrees, to demand the releaſe of the impriſoned patriots, and the puniſhment of thoſe who preferred money to aſſignats. The Convention pretended to agree to all their demands, and the preſident was ordered to give to the deputation the fraternal embrace.

227
Its victo
over the
cobins;

The 22d, which was the third day of the inſurrection, appears to have been paſſed by both parties in a ſtrange degree of inaction. The Convention proceeded in its ordinary buſineſs; and the Jacobins, at their head quarters in the ſuburb St Antoine, were occupied in conſultations and preparations for new movements. But on the following day the citizens aſſembled at their ſections, and haſtened from thence to the Thuilleries to defend the Convention. Conſiderable bodies of the military were alſo collected, and the aſſembly at laſt reſolved to act upon the offenſive. A decree was paſſed, declaring, that if the ſuburb St Antoine did not inſtantly ſurrender its arms and cannon, together with the murderer of Ferand, it ſhould be conſidered as in a ſtate of rebellion. The conventional generals were at the ſame time ordered to reduce it by force. The inſurgents now found themſelves unequal to the conteſt, and were compelled to ſurrender without conditions by the inhabitants of the ſuburb, who dreaded the deſtruction of their property by military operations. Several ſoldiers being found among the priſoners, were put to death; and ſix members of the Convention were tried and condemned on this occaſion by a military commiſſion. Three of theſe periſhed by ſelf ſlaughter, and three were executed. The majority of the Convention, elated by their victory, ordered back Collot D'Herbois, Billaud Varennes, and Barrere to take their trial; but the two former had failed before the arrival of the courier. Barrere only remained, and he was brought back and impriſoned.

In the mean time, the Jacobins in the ſouth were not leſs active than their brethren at Paris. On the 20th of May they formed a vigorous inſurrection at Toulon. They ſeized the gates, and mounted them with cannon; they liberated ſuch of their aſſociates as had been impriſoned, and detained the fleet which was about to ſail. Having begun their operations in this ſucceſsful manner, they marched from Toulon towards Marſeilles. Their force amounted to three thouſand men and twelve pieces of cannon. They were encountered on their way, however, and defeated by Generals Charton and Pactod. Three hundred of them were carried priſoners to Marſeilles, and Toulon was ſpeedily retaken.

The party of the *Mountain*, as it had been called, or of the violent Jacobins, who wiſhed to revive the reign of terror and the meaſures of Robeſpierre, was now reduced very low both in the Convention and out of it. Thoſe who adhered to it were even in many places, and more eſpecially in the ſouth, expoſed to very violent rench olution 795.

lent perſecution. Aſſociations were formed, called Companies of *Jeſus* and of the *Sun*, for the purpoſe of avenging the crimes committed by them during the period of their power. At Lyons ſeveral of them were maſſacred in priſon, and many of them in all places periſhed by aſſaſſination. On conſidering the mercileſs character of the government of Robeſpierre and his aſſociates, and the perſecution which was ſuffered under it, not merely by the nobles and the rich, but by every man who was diſtinguiſhed by integrity, talents, or literature, it may appear ſurpriſing that it ſhould have obtained admirers, or that any number of individuals ſhould have been found willing to hazard their lives to procure its reſtoration. Accordingly, from the period of the fall of its leader, the party had gradually been forſaken by its adherents: and the more cloſely its conduct was conſidered, it loſt ground the more rapidly in the eſtimation of the public. After the unſucceſsful inſurrections of the 20th of May, it was treated with the utmoſt contempt, and its unpopularity was extreme. Still however, a party remained. It was ſmall, indeed, but its members compenſated the inferiority of their numbers by ſuperior enterpriſe and activity. They conſiſted of outrageous republicans, whoſe heated imaginations beheld royalty and ariſtocracy in every propoſal for ſober and regular government. In the conduct of Robeſpierre, they remembered only the energy of his meaſures, by which France was enabled to triumph over the combined efforts of the kings of Europe; and overlooked the atrocities by which he had brought diſgrace upon their cauſe, and rendered his party odious to their own countrymen, as well as to the neighbouring nations. Amidſt this univerſal odium, however, the Jacobins did not deſpair of riſing once more into power; and it is not a little ſingular, that we muſt date the revival of their ſtrength from the period of the unſucceſsful inſurrections which we have juſt recorded, and which ſeemed to have extinguiſhed their hopes for ever.

228 o ſtill in their it;

The unpopularity under which the Jacobins laboured ſoon began to affect the Convention itſelf. The tame ſubmiſſion of that body to the government of Robeſpierre was now remembered. It was recollected, that the majority of its members had been the inſtruments of his power, and had applauded, or at leaſt acquieſced in, his crimes. As the preſs was now free, and the reins of government unſteadily held, their conduct was repreſented to the public in the moſt odious colours. A celebrated ſong, *Le Reveil du Peuple*, became extremely popular, as the means of marking diſlike both to the Convention and to the Jacobins; and their conduct was canvaſſed with the utmoſt bitterneſs in a great variety of publications, but more eſpecially in a journal that at this time attracted much notice, and which was conducted by Freron, who had himſelf been a Jacobin, but had now abandoned his party.

229 d terri- the Con- ntion.

In this ſtate of things, the majority of the Convention ſpeedily began to repent of their late victory over the Jacobins. In the firſt efforts of their zeal, they had taken meaſures for the immediate formation and eſtabliſhment of a ſettled conſtitution to ſuperſede their own authority; but they now regretted their raſhneſs, when they perceived, from the temper the nation was in, that the men, the moſt avowedly hoſtile to their character and meaſures, would without doubt be elected as their ſucceſſors. They, and their friends, had ariſen to great diſtinction and wealth under the revolutionary government; and they now began to dread, not only the loſs of power, but alſo a ſevere inveſtigation of their conduct. Theſe conſiderations ſoon produced their natural effects. The decrees for forming and putting in force the conſtitution could not decently be recalled; but the majority of the Convention ſet about deviſing means for rendering them of little importance, ſo far as they themſelves were concerned.

French Revolution 1795.

230 New conſtitution, conſiſting of

On the 23d of June, Boiſſy D'Anglas preſented the report of the committee that had been appointed to prepare the plan of a conſtitution. It began, like the former conſtitutions, with a declaration of the rights of man; and in addition to this, conſiſted of fourteen chapters, upon the following ſubjects:—The extent of the territorial poſſeſſions of the Republic, the political ſtate of citizens, the primary aſſemblies, the electoral aſſemblies, the legiſlature, the executive power, the municipal bodies, the judicial authority, the public force, public inſtruction, the finances, foreign treaties, the mode of reviſing the conſtitution, and, laſtly, an enactment, that no rank or ſuperiority ſhould exiſt among citizens, excepting what might ariſe from the exerciſe of public functions.

The primary aſſemblies were to poſſeſs the right of electing the members of the electoral aſſemblies, and alſo the juſtices of the peace. The electoral aſſemblies were to nominate the judges and the legiſlators of the ſtate. The legiſlature was divided into two aſſemblies; the one of which conſiſted of 250 members, and was called the *Council of the Ancients*, as none but married men and widowers above 40 years of age could be members of it. The other aſſembly or council conſiſted of 500 members, and poſſeſſed the excluſive privilege of propoſing the laws; the Council of Ancients being only intitled to reject or approve, without power to alter the decrees preſented to it. To this rule there was one exception, which was afterwards employed as the means of overturning the whole fabric of the conſtitution; the Council of the Ancients might decree the removal of the legiſlature from its ordinary place of ſitting. To this decree the approbation of the Council of Five Hundred was not neceſſary; and when once enacted, it could not be reconſidered even by the Council of Ancients itſelf. One-third of the members of the two Councils was to be elected annually. A member might be once re-elected, but he could not be elected a third time till an interval of two years had elapſed.

231 Two Councils and an

232 Executive Directory

The executive power was intruſted to five perſons of forty years of age at leaſt, to be ſtyled the *Executive Directory*. Its members were elected by the two Councils; the Council of Five Hundred electing ten times the number of candidates that might be neceſſary to fill up the vacancies, and the Council of Two Hundred and Fifty nominating the directors from this liſt of candidates. One member of the Directory was to go out annually; ſo that the whole might be changed every five years. The Executive Directory had no vote in the enactment of laws; but it ſuperintended their execution, regulated the coining of money, and diſpoſed of the armed force. Foreign treaties made by it were not binding till ratified by the legiſlative body, nor could it make war without the authority of a decree of the two aſſemblies. The public functionaries were to receive ſalaries, and to appear dreſſed in an appropriated habit.

Each article of this conſtitution was ſeparately diſcuſſed; and on the 23d of Auguſt the whole was declared to be complete, and ordained to be tranſmitted to the primary aſſemblies for their approbation. Previous to this reſolution, however (that is, on the 22d of the ſame month), the majority of the Convention had brought forward the grand meaſure by which they meant to provide for their own ſafety, and the ſafety of their friends and adherents, againſt the change which the public opinion had undergone concerning them. They decreed, that at the approaching general election, the electoral bodies ſhould be bound to chooſe *two-thirds* of the new legiſlature from among the members of the preſent convention; and they afterwards decreed, that, in default of the election of two-thirds of the Convention, the Convention ſhould fill up the vacancies themſelves.

233
The Convention fetters the freedom of election.

Theſe decrees were tranſmitted, along with the Conſtitution, to the primary aſſemblies, to be accepted or rejected by them. Many of the primary aſſemblies, underſtood, that they could not accept of the conſtitution without accepting along with it the law for the re-election of the *two-thirds*. The point had, in all probability, been purpoſely left under a certain degree of ambiguity; and as the people were now weary of this Convention, they acquieſced in any conditions that gave them the proſpect of one day getting quit of it. But at Paris, and in the neighbouring departments, where the ſubject was more accurately inveſtigated, the public diſapprobation of the Convention diſplayed itſelf with great vehemence.

234
Conſequences of this conduct.

There was indeed ſomething extremely aukward in the decree about the re-election of two-thirds of the Convention. The body might if neceſſary, have continued its own exiſtence for ſome time longer, or it might have diſmiſſed one-third of its number by ballot or otherwiſe, and allowed a new election only to that extent; but a compulſory election was an abſurdity ſo new, and ſo obvious, that it gave their antagoniſts every advantage againſt them. Accordingly, at the meetings of the ſections of Paris, the laws for the re-election were rejected with contempt, and their abſurdity demonſtrated with much acrimony. In conſequence of the debates which took place at theſe meetings, the minds of men were gradually inflamed, and it became obvious that a political convulſion approached. On the one ſide, the Convention took care to publiſh daily the approbation of the decrees, along with the conſtitution, by the majority of the primary aſſemblies, by moſt of which the two had been confounded and accepted in the groſs. Its committees alſo called in the aid of the troops of the line for its protection. On the other hand, the language of the ſections became every day more violent. The whole Convention was repreſented as a band of tyrants and of murderers, the aſſociates of all the cruelty of Robeſpierre and the Mountain party. It was even propoſed to bring to trial every individual member of the aſſembly before a new revolutionary tribunal, and to puniſh him according to his demerits.

For ſome time much anxiety prevailed on both ſides. Numerous deputations were repeatedly ſent from the ſections to the Convention to remonſtrate againſt the obnoxious decrees. But the eagerneſs with which theſe remonſtrances were made, ſerved only to convince more ſtrongly the members of the Convention of the danger to themſelves as individuals which would attend a reſignation of their power, and confirmed the reſolution they had taken to retain it. The deputies of the ſections having obtained inſpection of the records of the convention, aſſerted, that the national majority, if rightly numbered, had rejected the decrees, as every aſſembly that voted in oppoſition to them was only numbered as one vote, however numerous its members might be; which enabled the primary aſſemblies of remote diſtricts to outvote the more populous ſections of Paris and other great towns. Whereas it was ſaid, that if the individual voters were counted, it would be found that the decrees were diſapproved of by a conſiderable majority. All this was diſregarded by the Convention, and the ſections prepared to decide the diſpute by arms. The firſt ſtep taken by them, however, was ill-concerted. A notion was propagated, that as ſoon as the primary aſſemblies or ſections had choſen the electors who were to chooſe the members of the new legiſlature, the national ſovereignty became veſted in theſe electors, and that they had a right to aſſume the government in their various diſtricts. Accordingly, about 100 of the electors of Paris aſſembled in the hall of the French theatre in the ſuburb St Germain, previous to the day of meeting appointed by the Convention. Having choſen De Nivernois (formerly the Duke de Nivernois) their preſident, they began their debates. The Convention was alarmed, and inſtantly ſent a body of the military to diſmiſs the meeting as illegal. This was eaſily accompliſhed, as the citizens had not been unanimous with regard to it, and no meaſures were taken for its protection,

Notwithſtanding this firſt advantage on the ſide of the Convention, the ſections regarded its power with contempt, and imagined themſelves ſecure of ultimate ſucceſs. In every political conteſt that had hitherto occurred ſince the commencement of the revolution, the immenſe population of the capital had given a deciſive ſuperiority to the faction whoſe ſide it eſpouſed. The citizens alſo regarded with indifference the armed force with which the Convention had ſurrounded itſelf, from a notion, which they fondly entertained, that the military would in no caſe be brought to act againſt the people. It would appear that the Convention itſelf entertained ſome jealouſy upon this head, and did not account itſelf entirely ſafe under the protection of the ſoldiers. On this occaſion, therefore, it had recourſe to a new ally, and beſought the aid of thoſe very Jacobins whom it had almoſt cruſhed on the 24th of May. The members of the Convention were odious to the ſections of Paris, on account of their participation in the revolutionary crimes and meaſures of Robeſpierre; but this very circumſtance endeared them to the Jacobins, whoſe character it was to imagine that they had never enough of war abroad or of revolution at home. It was eaſy therefore to bring about a reconciliation between the Convention and theſe men. Several hundreds of them were diſmiſſed from the priſons, where they had been confined ſince the two laſt inſurrections, and they were now put in requiſition to defend the legiſlative body.

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The Co
vention
courts th
Jacobins

When the ſections of Paris beheld the Convention ſurrounded

ſurrounded by thoſe Jacobins who had been the unrelenting agents of the government of Robeſpierre, and who were now denominated *terroriſts* and *men of blood*, their ardour for action became unbounded. They aſſembled in arms at their different ſections on the 12th Vendemaire (October 4th); but they do not ſeem to have acted with much concert, or upon any well digeſted plan of operations. The general deſign of their leaders was to ſeize the members of the Convention, and impriſon them in the church of the Quatre Nations till they could be brought to trial. As this would occaſion a vacancy or interregnum in the government it was reſolved that all affairs ſhould be conducted by committees of the ſections, till a new legiſlature could be elected. General Miranda, a Spaniard, a native of the Carraccas in South America, who had ſerved in the republican armies, was to be appointed to the chief command of the armed force after the overthrow of the Convention. This man, in his eagerneſs for preferment, had alternately courted all parties, and he now ſeems to have joined the Pariſians upon the ſuppoſition of their being the ſtrongeſt. As he entertained ſome doubts of their ſucceſs, however, he adopted the crooked and timid policy of avoiding the ſtorm by retiring from the city till the combat ſhould be finiſhed, reſolving to return immediately on its concluſion to ſhare the rewards and the triumph of victory.

The Convention in the mean time, reſolved to ſtrike the firſt blow. For this purpoſe they ſent General Menou to the ſection of Le Pelletier to diſperſe the citizens, whoſe greateſt force was aſſembled there. But this officer, diſliking the ſervice which he was employed to perform, inſtead of proceeding to action, began to negociate with the leaders of the ſections, and ſpent the evening of this day in fruitleſs conferences. The ſections on their ſide appointed General Danican, who had diſtinguiſhed himſelf in the war againſt the Royaliſts in La Vendee to act as their military leader. It would appear, however, that this officer, from the moment that he aſſumed the command, began to deſpair of the cauſe of the ſections. He found them totally deſtitute of cannon, whereas the Convention was ſurrounded by regular troops and a numerous artillery. This inequality in point of weapons appears to have been conſidered by him as a ſufficient reaſon for avoiding an engagement. Occupied in viſiting and arranging the different poſts, he was unacquainted with the diſaffection of the conventional generals. He therefore thought he had done much when he had prevented bloodſhed for another day, and thus the favourable moment for attack was loſt. Whether the ſections would have been ſucceſsful had they been inſtantly led to battle on this important occaſion, cannot now be known. Though the ſuperior officers of the Convention were unfaithful, yet the ſubalterns and the troops in general might have ſtood firm, confirmed as they were by the perſuaſion of their Jacobin auxiliaries. Even in this caſe, however, the fate of a battle might have at leaſt been doubtful. The battalions of Paris were very numerous, their contempt of danger was great, and their ardour unbounded. The mere poſſeſſion of cannon might not in a conteſt againſt ſuch men have afforded ſecurity to the Convention. But the firſt moments of popular enthuſiaſm were ſuffered to paſs away, and that diſtruſt and diſſenſion, which delay never fails to introduce among great and irregular aſſemblages of men, ſoon began to render the conduct of the ſections undecided and weak.

The conventional committees, during the night of the 12th Vendemaire (October 4th), diſmiſſed Generals Menou, Raffet, and ſome others, from their ſtations, and gave the command of the troops to Barras. He immediately collected around him a variety of able officers, among whom we find the names of Generals Brune and Bonaparte. With their aſſiſtance he began to provide for a moſt vigorous defence. Troops with cannon were ſtationed in all the avenues leading to the Thuilleries. In caſe any of theſe poſts ſhould be forced, maſked batteries were planted in more retired ſituations. Nor was this all; meaſures were taken for conveying the public magazines of proviſions and military ſtores to St Cloud, whither the Convention prepared to retreat if they ſhould ſuffer a defeat at Paris.

On the 13th Vendemaire (October 5th) from which the inſurrection was afterwards named, both parties remained for many hours upon the defenſive. At laſt, about three o'clock in the afternoon, General Danican made advances to an accommodation by a letter to the committee of public ſafety; in which he ſtated, that the only cauſe on account of which the citizens had taken arms was the dread of a maſſacre being intended by the armed terroriſts who ſurrounded the Convention, and that if theſe men were removed, tranquillity would immediately be re-eſtabliſhed. A civil meſſage was returned; but the Jacobin party in the Convention, being now more confident of victory, and wiſhing to ſtrengthen themſelves by the defeat and puniſhment of their antagoniſts, it was reſolved that the diſpute ſhould be decided by arms. It is not correctly known how the conteſt commenced, but the armed Jacobins are moſt generally underſtood to have begun the attack. The citizens on the ſouthern ſide of the river attempted to reach the Convention by the Quay de Voltaire, but were ſpeedily repulſed by the conventional cannon; but on the northern ſide of the river, near the Convention, the combat was extremely obſtinate. The cannon were repeatedly ſeized by the citizens, and repeatedly retaken by the troops and the armed Jacobins. It was not till after a conteſt of four hours that the ſections were repulſed and driven to the poſt of St Roch. This poſt was alſo taken after great ſlaughter, and the ſections were driven to their head quarters at the ſection of Le Pelletier. After a ſhort interval they were purſued thither by the troops of the Convention, who by midnight were maſters of the whole city.

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Subdues the citizens of Paris.

This inſurrection was aſcribed by the victorious party to the exertions of the Royaliſts. It is no doubt true, that by this time Royalty was become leſs unpopular even among the rabble of France than the extreme of Republicaniſm, as it had appeared in the conduct of the Mountain party. It is alſo probable, that the Royaliſts mingled in a conteſt that had the overthrow of the preſent Convention for its object; but the inſurgents in general ſeem neither to have avowed nor entertained any farther view than the diſarming of the Jacobins, and the obtaining an immediate election of new repreſentatives. The failure of the attempt had the effect of placing the Mountan party once more at the head of the ſtate. This party at firſt thought of adjourning the new conſtitution, and of renewing all the terrors of the revolutionary

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Mountain party, or the moſt violent Jacobins, again at the head of the ſtate.

ary government. This project, however, was oppoſed in the Convention with ſo much vehemence and ability by Thibaudeau, that it was renounced. Indeed it was become unneceſſary to the ſafety or aſcendency of the men who propoſed it, as the decrees for the re-election of two-thirds of the Convention enabled them to retain the full poſſeſſion of their power. A few members of the moderate party, ſuch as Boiſſy D'Anglas, Languinais, and Le Sage, were elected by almoſt every place in France, though they could only ſit for one place. Hence the Convention itſelf had the re-election of nearly two-thirds of its own members; and the Mountain party, which now commanded the majority, was thus enabled to fill the new legiſlature with its own leaders.

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Firſt ſitting of the new legiſlature.

On the 27th of October the Convention terminated its ſittings, and was ſucceeded by the new legiſlature as appointed by the Conſtitution. By its laſt decrees, a general amneſty was granted for all revolutionary crimes and proceedings. From this amneſty, however, were excepted the emigrants, the tranſported prieſts, and all perſons concerned in the laſt inſurrection; ſo that in fact it was merely a pardon granted by the Mountain party to its own friends for all the exceſſes they had committed. The members of the Convention, who had been impriſoned in the caſtle of Ham ſince the Jacobin inſurrection in May, were now ſet at liberty. The members of the revolutionary committees, and other agents of Robeſpierre in Paris and the departments, were all diſmiſſed from their priſons, and advanced to the moſt important offices under the new government.

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The Council of Five Hundred outwits the Council of Ancients.

As ſoon as the new legiſlature had divided itſelf into two councils, it proceeded to the election of an Executive Directory. Here the genius of the French nation for intrigue inſtantly diſplayed itſelf. The Council of Five Hundred was bound to preſent to the Council of Two Hundred and Fifty a liſt of ten times the number of candidates neceſſary for the office. It fulfilled this duty in the following manner. The majority of the Council of Five Hundred made out a liſt, conſiſting of the five following perſons, upon whom they wiſhed the election ultimately to fall: Sieyes, Barras, Rewbell, La Reveillere Lepaux, and Letourneur de la Manche. To complete the liſt, they added the names of 45 obſcure perſons, country juſtices, farmers, and even peaſants. Thus there was nothing left to the Council of Ancients but the mere form of an election; and from the want of other qualified candidates, they were under the neceſſity of nominating to the office of directors the five perſons at the head of the liſt preſented by the Council of Five Hundred. The crafty Sieyes, however, who had been the adviſer of all parties, but the oſtenſible agent of none, did not yet think fit to venture upon the poſſeſſion of power. He had diſapproved of the conſtitution which was now put in force, and had even framed one of his own in oppoſition to it, which, however, was rejected by the Convention. The moſt remarkable circumſtance in his plan of government was a national jury, upon which he propoſed to confer the power of diſmiſſing from their offices, without a cauſe being aſſigned, any of the public functionaries whom they might account dangerous to the ſtate. Sieyes having refuſed to accept the office of director, Carnot was elected in his ſtead. But on this occaſion the Council of Ancients was treated with a little, and but a little, more decency than formerly; as the name of Cambaceres, a man of conſiderable eminence, appeared along with that of Carnot in the liſt of candidates voted by the Council of Five Hundred.

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New government not popular.

The republican government that was now attempted to be eſtabliſhed promiſed little tranquillity to the nation. This great miſfortune attended it, that the chief offices in the ſtate were intruſted to men who were diſliked by the people. The members of the Executive Directory, with the exception of Reveillere Lepaux, had always belonged to the Mountain or moſt violent Jacobin party. As they now owed their power to that party, they employed its members in almoſt every official department. The government was therefore neceſſarily unpopular. Things might have been gradually altered, indeed, by ſucceſſive elections, which would in time bring other men into power: But, by the forms of the conſtitution, the executive power was more permanent than the legiſlative body, without poſſeſſing any influence over it. Hence it was to be feared that a conteſt for power might ſpeedily occur between a directory nominated by the Jacobin party and the new legiſlators appointed by the people, in which the Conſtitution might ſuffer ſhipwreck; an event which actually occurred.

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Treatme of the R public by foreign powers.

While the poſſeſſion of power continued to fluctuate in the manner we have already ſtated, between the Moderate and the Jacobin or Mountain parties, the armies of the ſtate were ſuffered to languiſh; but upon the credit of its former military ſucceſs, the Republic was treated with reſpect by ſome of the neighbouring powers. On the 10th of April, a treaty of peace with Pruſſia, which had been negociated by the committees through the medium of Barthelemi the French reſident at Baſle, was preſented to the Convention for ratification. By this treaty, it was ſtipulated, that the French troops ſhould immediately evacuate the Pruſſian territory on the right bank of the Rhine, but ſhould retain the territory belonging to that power on the left bank till a general peace. Priſoners of war were to be mutually reſtored, and the commerce of the two countries was to be placed on its ancient footing. Meaſures were alſo to be taken to remove the theatre of war from the north of Germany by treaties between France and thoſe princes for whom the king of Pruſſia might interpoſe.

During the ſame month of April, the French Republic was acknowledged by the king of Sweden; and Baron Stael his ambaſſador was received at Paris with great ſolemnity. In the month of May a ſecond treaty with Pruſſia was concluded. It chiefly regarded the line of neutrality. It is worthy of remark, that theſe treaties contained ſecret articles which were to be revealed only to a ſelect committee. By authoriſing this mode of procedure, the Convention ſufficiently demonſtrated its reſolution, that no form of popular government to be adopted in France ſhould ſtand in the way of the national aggrandiſement. The Swiſs cantons now followed the example of Sweden, and acknowledged the French Republic. A treaty of peace with Spain was alſo concluded at Baſle on the 22d of July. France, on this occaſion, relinquiſhed all the conqueſts ſhe had made in the territory of that country, and reſtored the ancient frontier. She received in return all the Spaniſh part of the iſland of St Domingo. The Dutch Republic was included in this treaty; and France

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agreed to accept of the king of Spain's mediation in favour of Portugal and the Italian princes.

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On the 9th of June, the Dauphin, ſon of the unfortunate Louis XVI. died in the priſon of the Temple, where he had been confined, along with his ſiſter, ſince the executions of his father, mother, and aunt. His death, which was probably produced by diſeaſes ariſing from long confinement, if not by more unjuſtifiable means, excited in the French nation ſuch a degree of intereſt in favour of his family, that the Convention found it neceſſary to liberate his ſiſter from impriſonment. The committee of public ſafety propoſed to the Emperor to exchange this princeſs for the members of the Convention whom Dumourier had delivered up to Auſtria, along with two ambaſſadors, Semonville and Maret, who had been ſeized on their way to Turkey. This propoſal was accepted, and the exchange took place at Baſle in Switzerland.

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On the ſide of Britain the war maintained its former character. The Britiſh retained their ſuperiority by ſea, and were unfortunate in their efforts on the continent. On the 14th of March the Britiſh fleet in the Mediterranean, under Admiral Hotham, engaged the French fleet, and took two ſail of the line, the Ca-Ira and the Cenſeur; but as the French fleet, four days before the engagement, had captured the Berwick, a Britiſh ſhip of the line, when detached from the fleet, and as the Illuſtrious, another Britiſh ſhip of the line, was ſo ſeverely injured in the action that ſhe run aſhore and was loſt at Avenza, the ſubſtantial loſs on both ſides was nearly equal. On the 23d of June another Britiſh fleet under Lord Bridport attacked the French off Port L'Orient, and took three ſhips of the line, the reſt of the fleet eſcaping into that port.

This evident ſuperiority of the Britiſh fleet in every conteſt, induced the government to take advantage of the command which it had of the ſea, to give aſſiſtance to the French Royaliſts in the weſtern departments. Theſe Royaliſts, hitherto unaſſiſted by foreign powers, had by repeated defeats, been reduced very low. The Convention had at laſt offered them a treaty, which was accepted and ſigned at Nantes on the 3d of March, on the one ſide by deputies from the Convention, and on the other by Charette, Sapineau, and other chiefs of the inſurgents of La Vendée, and by Cormartin, as repreſenting the party called *Chouans* or Night Owls. Stofflet, another chief, held out for ſome weeks longer; but at laſt, on the 20th of April, he too was under the neceſſity of ſubmitting by treaty to the Republic.

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In a ſhort time, however, the hopes of the Royaliſts were revived by the countenance of the Britiſh government, and theſe treaties were ill obſerved. In the beginning of June the Britiſh expedition was ready to ſail for the French coaſt. The troops to be employed conſiſted of emigrants in the pay of Great Britain, and many of them had been priſoners of war, who now agreed to join the royal cauſe. The command during the voyage, and the ſelection of the place of landing, were intruſted to the Count D'Hervilly. The command on ſhore was given to Puiſaye, who had been employed under the Girondiſts in the military ſervice of the Republic, but had now become a royaliſt. The Count de Sombreuil was afterwards ſent to join them with a ſmall reinforcement.

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On the 25th of June the expedition arrived in the Bay of Quiberon, and on the 27th 2500 emigrants made good their landing, after diſperſing a ſmall party of republican troops. The emigrant army ſoon after diſtributed itſelf into cantonments along the ſhore, and gave arms to the inhabitants of the country, who appeared to receive them with joy. It was ſoon found, however, that the Chouans, though well qualified for a deſultory warfare, could not be of much uſe to regular troops. They had little ſubordination. They were eaſily diſperſed, and never fought unleſs every advantage was on their ſide. When it was found that their unſteady aid could not be depended on, a reſolution was taken to withdraw the emigrant army within the peninſula of Quiberon. The fort of that name was taken on the 3d of July. Its garriſon conſiſted of five or ſix hundred men, and it was now occupied by the emigrants. A republican army, in the mean time, under General Hoche, advanced, and attacked all the poſts that had been left without the peninſula. Theſe were ſpeedily taken. The emigrants and Chouans eſcaped into the boats of the Britiſh fleet, or fled under the cannon of the fort of Quiberon. The republicans then began to conſtruct formidable works on the heights of St Barbe, at the entrance of the peninſula. To prevent their operations, a ſally was made from the fort on the 7th of July; but without ſucceſs. On the 15th, another ſally was attempted in greater force. The whole troops in the peninſula amounted to about 12,000, including Chouans. Out of theſe a detachment of 5000 was ſent to attack the heights of St Barbe. The republicans were entrenched in three camps. The two firſt of theſe were eaſily taken, and the detachment preſſed eagerly forward to attack the third. But here a maſked battery opened upon them with grape ſhot. A dreadful carnage enſued; and very few of the detachment could have eſcaped, had not the fire of the Britiſh ſhips ſoon compelled the republicans to deſiſt from the purſuit.

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Its failure.

It now became obvious that the expedition muſt ultimately fail. Deſertion became extremely common among the emigrants. Thoſe men in particular who had been priſoners of war, and received their liberty on condition of joining the expedition, ſeized every opportunity of going over to their countrymen; and a correſpondence ſeems even to have been eſtabliſhed between the republicans and the diſcontented troops in the fort of Quiberon. On the evening of the 20th of July the weather was extremely tempeſtuous, which produced a fatal ſecurity in the emigrant army. Suſpicious patroles were remarked; but as they repeated the watchword for the night, they were allowed to paſs. The republican troops were conducted in ſilence along an unguarded quarter of the ſhore, till they were enabled to ſurpriſe one of the poſts of the garriſon, where they found the artillery men faſt aſleep. Their matches were ſeized, and the lanthorn intended to give the alarm to the Britiſh fleet was extinguiſhed. The fort was ſpeedily in confuſion. Some regiments threw away their arms, and went over to the republicans; others even maſſacred their own officers. A conſiderable number, however, maintained a violent conflict for ſome time before they ſurrendered. Puiſaye eſcaped on board the fleet. The Count de Sombreuil was taken; and this accompliſhed young man was ſoon after put to death, along with the other emigrant officers and all the Chouans that were found in the fort. The biſhop of Dol was alſo put to death, with his clergy who accompanied him; but many of the private ſoldiers of the emigrant army made their peace with the republicans, by pretending they had been compelled to engage in the expedition.

The Britiſh fleet, with tranſports and troops, ſtill hovered upon the French coaſt, and made an unſucceſsful attempt upon the iſland of Noirmoutier. In conſequence of the ſeaſon of the year, however, it returned home in December, after evacuating a ſmall iſland called *L'Iſle Dieu*, which the troops had for ſome time occupied.

246 Succeſſes of the French in Germany.

On the ſide of Germany the fortreſs of Luxembourg ſurrendered on the 7th of June, after having been in a ſtate of blockade ſince the preceding campaign. The French were now in poſſeſſion of the whole left bank of the Rhine excepting the city of Mentz, which they attacked in vain, becauſe the Auſtrians could at all times throw ſuccours into it from Fort Caſſel on the oppoſite bank of the river. Finding the capture of Mentz impoſſible in theſe circumſtances, the French reſolved to croſs the Rhine, to inveſt the city on all ſides. The enterpriſe, however, was delayed for ſome time, till the reſult of the Britiſh expedition to Quiberon ſhould appear. In the month of Auguſt, General Jourdan forced the paſſage of the Rhine at Duſſeldorf, at the head of what was called the army of the Sambre and Meuſe. After driving before him three Auſtrian poſts upon the Lahn, he croſſed the Mein, and completely inveſted Mentz and Caſſel. Pichegru, in the mean time, croſſed the river, with the army of the Rhine and Moſelle, near Manheim, of which city he immediately took poſſeſſion.

247 They receive a check.

But the French generals ſoon found their forces inadequate to the undertaking in which they were engaged. A conſiderable detachment of Pichegru's army, after driving the Auſtrians under General Wurmſer from a poſt of ſome importance, began to plunder, and went into confuſion. The Auſtrians being informed of this circumſtance, returned to the charge, and defeated the French. General Clairfait alſo, having violated the line of neutrality, came upon the rear of Jourdan's army, and took a conſiderable part of his artillery. Both the French generals now retreated. Jourdan was rapidly purſued by Clairfait till he returned to Duſſeldorf, where he maintained his ground. Pichegru recroſſed the Rhine near Manheim, leaving a garriſon of 8000 men in that city. The Auſtrians advanced in all directions. Manheim was taken after a vigorous ſiege. The French were driven from the neighbourhood of Mentz. The Palatinate became the theatre of war, and the Auſtrians ſeized the country called the *Hundſruck*, ſouth of the Rhine as far as Landau and Treves. After various engagements, in which little more ground was loſt or won, the two parties entered into an armiſtice for three months.

248 Treaties with German princes.

On the 28th of Auguſt a treaty of peace was concluded between the French Republic and the Landgrave of Heſſe Caſſel, on condition that he ſhould lend no more troops to Great Britain for the proſecution of the war. It is not a little ſingular, that peace was concluded with the Elector of Hanover at this period upon ſimilar terms. The Duke of Wirtemberg, and ſome other princes of the empire, alſo began to treat; but the negociations were broken off in conſequence of the reverſe of fortune now experienced by the French.

The Directory, however, reſolved to continue the war with vigour, and vaſt preparations for the approaching campaign were made during the winter. The Mountain party being once more poſſeſſed of power, its members exerted themſelves with their uſual energy. Such, however, was the turbulent character of theſe men, that they could not long ſubmit peaceably to any government, and ſoon became weary of that Directory whom they themſelves had eſtabliſhed. They held clubs in all quarters, and were continually diſturbing the public tranquillity. For ſome time the government ſupported them. The Pariſians, after the 5th October, no longer dared to avow openly their diſlike to the Jacobins; but they were underſtood to expreſs this ſentiment by wearing green ſilk cravats, and by applauding with much vehemence at the public ſpectacles the air called *Le Reveil du Peuple*.

249 Ridicul conduct the Dir tory.

The Directory now prohibited, by an edict, as tokens of royaliſm, the wearing of green cravats, or the performing at any of the theatres the air now mentioned, though the ſentiments it contained were entirely republican. The Directory alſo ordered in its ſtead, that the Marſeillois hymn, and other popular ſongs, ſhould be performed every evening at all the theatres. The Pariſians ſhewed their diſapprobation of the Directory by maintaining a profound ſilence during the performance of theſe ſongs, which had never failed till that period to excite burſts of applauſe. The Directory ſoon became aſhamed of this ridiculous conteſt, and in a few weeks recalled their edict. Indeed they found it impoſſible to give countenance for any long period to the reſtleſs and innovating ſpirit of the Jacobins, who continually wiſhed and attempted to return to revolutionary, that is, to violent meaſures againſt their antagoniſts. In the ſouth, in particular, the preſent ſupremacy of the Jacobins produced very pernicious effects. Freron, who had deſerted them after the death of Robeſpierre, and became one of their moſt violent adverſaries, thought fit to return to their party before the 5th October, and was ſent to Toulon with full powers of adminiſtration. Here he diſmiſſed the municipality that had been elected by the people, reſtored the Jacobin clubs, and proceeded to impriſon all ſuſpected perſons as in the days of Robeſpierre. Theſe meaſures produced a violent reaction on the part of the enemies of the Jacobins. Aſſaſſinations became frequent, and many perſons began to leave the country. The directory was alarmed by the many complaints againſt the Jacobins or terroriſts that came from all quarters, and reſolved to aim at popularity by deſerting a ſet of men who could not be prevailed upon to act with moderation. Freron was recalled from Toulon, and more manageable men were ſought out to replace the more violent Jacobins, who were in general diſmiſſed from the ſervice of government.

250 Meaſur taken a gainſt t Jacobin

The Directory proceeded farther, and acknowledged, by a public reſolution, that its confidence had been abuſed. The miniſter of police was ordered to remove from Paris the members of former revolutionary tribunals, and others who now acted as leaders of the Jacobins, or *anarchiſts* as they were called. A body of troops, amounting to 10,000 men, called the *legion of police*, that had acted againſt the Pariſians on the 5th October,

October, and was now devoted to the Jacobins, was ordered by the Directory, with the authority of the legiſlature, to join the armies on the frontiers. Theſe men refuſed to obey the order; but they were reduced to ſubmiſſion by ſome troops that had been brought to the neighbourhood to provide againſt ſuch an event. The more violent Jacobins were enraged, but not intimidated, by theſe meaſures, and began to organize a plot for the overthrow of the Directory and of the majority of the councils, who had now deſerted them. They were not prepared for action, however, before the month of May, and by that time their deſigns were diſcovered and counteracted. On the 10th of that month the guards were increaſed, and bodies of cavalry ſtationed around the Luxembourg and the Thuilleries. The Directory at the ſame time informed the Council of Five Hundred, by a meſſage, that a dreadful conſpiracy was prepared to burſt forth on the following morning. At the ſound of the morning bell, which is every day rung, the conſpirators were to proceed in ſmall parties of three or four men to the houſes of ſuch perſons as they had marked out for deſtruction. After aſſaſſinating thoſe perſons, the whole parties were to unite, and to act againſt the Directory, whoſe guard they apprehended they could eaſily overpower. The conſpirators had appointed a new Directory and a new legiſlature, to conſiſt of the moſt violent of their own party. Among the leaders of this conſpiracy, who were now arreſted by order of the Directory, was Drouet the poſtmaſter of Varennes, whom we formerly mentioned as having arreſted the unfortunate Louis XVI. when attempting to eſcape to the frontiers. Along with him were Babeuf, Antonelle, Pelletier, Gaudet, Julien, General Roſſignol, Germain, D'Arthe, Laignelot, and Amar, who had been a member of the committee of general ſafety along with Robeſpierre. Vadier and Robert Lindet were alſo engaged in the conſpiracy, but they made their eſcape. Drouet alſo eſcaped by the connivance of the Directory, as was generally underſtood; but the reſt of the conſpirators were removed for trial to the high national court at Vendome, where they were condemned. At the period of their removal thither, a new attempt was made by their party for their reſcue. About 600 men entered the camp at Grenelle near Paris, and endeavoured to prevail with the ſoldiers to join them in an inſurrection. This attempt was altogether unſucceſsful. A few of the inſurgents were killed, and the reſt fled.

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The defeats of the Jacobins, and the diſcredit under which they were again brought, encouraged the moderate party in the two legiſlative councils to attempt to repeal the laſt decrees of the Convention, which had at once granted them an amneſty, and confirmed all the laws which, by confiſcating the property of emigrants, excluded their relations from the ſucceſſion. The diſcuſſion laſted many days; but the reſult was, that the law with regard to emigrants remained on the former footing; and the only point which the moderate party were yet able to carry was a modification of the decree to this extent, that thoſe terroriſts were declared incapable of holding public offices who owed their ſafety to the amneſty.

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The ſtate of the finances now began to occupy the French government in a very ſerious manner. During the government of Robeſpierre, while the credit of the aſſignats was preſerved by the influence of terror, or by the ſale of the church lands, and the property of emigrants, little attention was beſtowed upon this ſubject. When money was wanted, more aſſignats were fabricated; and as few or no taxes were demanded from the people, no enquiry was made about the public expenditure. But when the boundleſs extravagance of the agents of government had loaded the circulation with aſſignats till they became of little or no value, it became a very difficult queſtion how the public ſervice was hereafter to be ſupported. A new paper currency, called *reſcripts*, was firſt adopted. Theſe were orders on the treaſury for caſh, payable at certain periods. But their credit ſoon paſſed away, as the treaſury had no means of fulfilling its engagements. The Directory complained very bitterly, in a meſſage to the Councils, of its diſtreſſes, and of the want of funds to carry on the approaching campaign. In conſequence of this meſſage, a law was paſſed, on the 25th of March, authoriſing the ſale of the remainder of the national domains for the price that had been fixed upon them at an early period of the revolution, amounting to about twenty-two years purchaſe. A new paper currency, called *mandats*, was to be received in payment. But the credit of government was now gone. The mandats inſtantly loſt in all private tranſactions one-fourth of their value, and they ſoon fell ſtill lower. This, however, produced a great demand for national property, which was thus about to be ſold far below its value. To prevent this effect, the legiſlature broke its engagements, and decreed, that one-fourth of every purchaſe ſhould be paid, not in mandats, but in caſh. This decree put a ſtop both to the ſale of national property and to the circulation of mandats.

253
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agriculture.

Recourſe was next had to taxation; but this was attended with much difficulty. By the war, and the violent government of Robeſpierre, the French commerce had been in a great meaſure ruined. Induſtrious men, who poſſeſſed any capital, had therefore turned their attention to the cultivation of land. Many circumſtances led to this. By the emigration of the nobles, and the confiſcation of the church lands, the farmers were left with no landlord but the government; which, being ſupported by aſſignats, paid little attention to any other ſource of revenue. Hence they paid no rent, and ſpeedily roſe into opulence. The revolutionary government, which kept the inhabitants of the towns under dreadful bondage, was ſcarcely felt by the inhabitants of the country, who thus enjoyed the advantage of exciting no ſuſpicion in the rulers, and of paying neither rent nor taxes. The law which declared aſſignats to be a legal tender of payment, was a great ſource of profit to the cultivators of the ſoil. They contrived to ſell the produce of their farms only to ſuch as offered them ready ſpecie; while, at the ſame time, they paid their rents, where the landlord had not emigrated, in aſſignats, which they obtained at a trifling price. Hence it uſually happened, that while the tenant enjoyed affluence, his miſerable landlord was reduced to the neceſſity of ſelling his moveables to buy a portion of the grain that grew upon his own eſtate, or was tempted to ſell the eſtate itſelf, at an undervalue, to obtain the means of emigration. By theſe and other circumſtances, the whole induſtry of the French nation came to be directed towards agriculture.

Their country was accordingly well coltivated; but as the riches of agricultural nations are not eaſily ſubjected to taxation, the French Directory now found it impoſſible to carry on the ſchemes of ambition and of conqueſt, which they had already formed, without relying for reſources upon the plunder of the neighbouring ſtates, which ſpeedily rendered their armies odious in all thoſe quarters of Europe to which they penetrated.

254 National Inſtitute. Amidſt their preparations for the approaching campaign, the Directory attempted to increaſe their own reputation at home, by eſtabliſhing what is called the *National Inſtitute*; which is a ſociety of men of letters, under the protection of the government[*]. Into this body were collected the moſt celebrated literary characters in the nation that had eſcaped the fury of the Mountain Party. Among theſe were La Place, Lalande, Fourcroy, Bertholet, Volney, Dolomieu, and others, well known throughout Europe. The firſt public meeting of the Inſtitute was held, with great ſplendour, on the 4th of April, in the hall of the Louvre, called the *Hall of Antiques*. The ambaſſadors of Spain, Pruſſia, Sweden, Denmark, Holland, America, Tuſcany, Genoa, and Geneva, were preſent. The members of the Directory attended in their robes, and their preſident made a ſpeech of inſtallation, declaring the determination of the executive power to protect and encourage literature and the arts. Duſaulx, the preſident of the Inſtitute, replied, in a ſpeech in which he declared the reſolution of the members to labour to give luſtre to the republican government by their talents and productions. Fifteen hundred ſpectators applauded the ſpeeches with enthuſiaſm, and vainly imagined that all the evils of the revolution were terminated, and that their country was now entering upon a career of unexampled glory and proſperity.

255 Overtures of the Britiſh government At this period the Britiſh government made an approach towards a negociation with France. On the 8th of March Mr Wickham, the miniſter plenipotentiary to the Swiſs Cantons, tranſmitted to Barthelemy, ambaſſador from the French Republic to the Helvetic body, a note containing three queſtions. Whether France would be diſpoſed to ſend miniſters to a congreſs to negociate peace with his Britannic Majeſty and his allies? Whether France would be diſpoſed to communicate the general grounds on which ſhe would be willing to conclude peace, that his Majeſty and his allies might conſider them in concert? and, laſtly, Whether France would deſire to communicate any other mode of accompliſhing a peace? The note concluded with a promiſe to tranſmit to the Britiſh court whatever anſwer ſhould be returned; but declared, that Mr Wickham was not authoriſed to enter into any diſcuſſion upon theſe ſubjects.

256 Inſolently rejected by the Directory. On the 26th of the ſame month Barthelemy returned an anſwer in name of the French Directory. This anſwer began by complaining of inſincerity in the propoſal made by the Britiſh court, ſeeing its ambaſſador was not authoriſed to negociate, and that a congreſs was propoſed, which muſt render negociation endleſs. It proceeded to ſtate the ardent deſire of the Directory for peace; but aſſerted, that it could liſten to no propoſal for giving up any territory that had been declared by the conſtitutional act to form a part of the Republic (alluding to the Auſtrian Netherlands); declaring, however, that other countries occupied by the French armies, and political or commercial intereſts, might become the ſubject of negociation. Upon theſe points the Directory declared its readineſs to receive reaſonable propoſals.

To this anſwer no reply was ſent; but the Britiſh court publiſhed a note, of which copies were preſented to the foreign miniſters reſiding at London; and in it the ſpirit of the Directors anſwer was complained of, and alſo the refuſal even to negociate about the retention of foreign territory, under pretence of an internal regulation. It was added, with truth, that while ſuch diſpoſitions were perſiſted in, nothing was left but to proſecute a war equally juſt and neceſſary; but that, when more pacific ſentiments ſhould be manifeſted, his Majeſty would be ready to concur with his allies in taking meaſures for eſtabliſhing a juſt, honourable, and permanent peace.

The French Directory had ſucceeded, during the winter, in reducing the weſtern departments into ſubjection. The emigrant expedition from England had induced the royaliſts once more to try the fortune of war; but after various defeats, their leaders, Charette and Steſſlet, were taken, and put to death on the 29th of March, and the inſurgents were ſuppreſſed in all quarters. 257 French a mies. The French government being thus left without an enemy at home, was enabled to make great efforts on the frontiers. The military force of the Republic was divided into three armies. On the Lower Rhine, the army of the Sambre and Meuſe was chiefly ſtationed about Duſſeldorf and Coblentz, and was commanded by Jourdan. Moreau commanded the army of the Rhine and Moſelle, in the room of General Pichegru, who had been diſmiſſed from his command. This army was ſtationed on the Upper Rhine, and from Landau to Treves. The third and laſt army was ſtationed on the coaſt of Italy, from Nice towards Genoa, and now received Bonaparte as its commander. The name and the actions of this man muſt hereafter fill ſo large a ſpace in the detail of this eventful period, that it is neceſſary to pay ſome attention to his perſonal hiſtory.

258 Bonapart A Corſican gentleman, a lawyer by profeſſion, but who had appeared in arms under the celebrated Paoli in defence of the independence of his native iſland, was the father of Napolone Bonaparte. Napolone was born at Ajaccio in 1767; and by the intereſt of M. de Marboeuf, the French governor of the iſland, he was placed for his education at the celebrated military academy of France (*Ecole Militaire*), which has produced ſo many accompliſhed men. At a very early period of life he preſented himſelf as candidate for a commiſſion in the artillery, and was ſucceſsful, being the 12th on the liſt out of 36 victorious candidates. In conſequence of this event he ſerved two or three years in the French army as a lieutenant in the regiment of La Fere. Bonaparte having riſen to the rank of captain of artillery, returned to Corſica after the revolution, and was there elected lieutenant-colonel of a corps of Corſican national guards. Here he formed a connection, which had nearly proved fatal to him, with General Paoli, the friend of his father. He reſented the treatment which Paoli received from Robeſpierre's government, and entered ſo far into his intereſts as to write the remonſtrance, which was tranſmitted by the municipality to the Convention, againſt the decree which declared the general an enemy to the Republic. In conſequence of this, a warrant was at one time iſſued for his arreſt by the

[*] See INSTITUTE, *Suppl.*

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the commiſſioners of the convention. He made his peace, however, on this occaſion; and reſolved to adhere to the intereſts of France, in oppoſition to Great Britain, which at this period formed the deſign of taking poſſeſſion of Corſica. He embarked with the other members of his family for France, and arrived there at the time when Lord Hood was in poſſeſſion of Toulon. Salicetti, a deputy from Corſica to the Convention, introduced him to Barras, who was now ſuperintending the ſiege of Toulon. Here Bonaparte was advanced to the rank of general of artillery; and, under Dugommier, directed the attack of the various fortified poſts around the city. He was afterwards employed for a ſhort time againſt the royaliſts in the weſt of France; and we have already mentioned, that he was at the capital, and aſſiſted Barras in the conteſt between the Convention and the Pariſians on the 5th October. Hence he was regarded with diſlike by the moderate party, and repreſented as an unprincipled adventurer, brought forward to ſupport the terroriſt faction. He had many enemies, therefore, at the commencement of his career, and his character was treated with much freedom. The ſcandal of the times went ſo far as to aſſert, that he owed his preſent preferment, not ſo much to any talents he had yet had an opportunity to diſplay, as to his marriage with Madame Beaucharnois, a beautiful French woman whom Barras had taken under his protection.

259 kes the nmand he army taly.

The French army of Italy amounted at this time to 56,000 men. Bonaparte at his arrival found it ill equipped, and the troops mutinous for want of pay and neceſſaries. He addreſſed them, however, in the true ſtyle of military enterpriſe, "If we are to be vanquiſhed, we have already too much; and if we conquer, we ſhall want nothing;" and ordered them to prepare for immediate action. His opponents, however, anticipated him in the attack. The Auſtrians employed in the defence of Italy, under General Beaulieu, are ſaid to have more than equalled the French in numbers. To theſe were united the King of Sardinia's army, under Count Colli, of 60,000 regular troops, beſides the militia of the country, which was now embodied, and a ſmall body of Neapolitan cavalry, amounting to about 2500 men. General Beaulieu began the campaign, on the 9th of April, by attacking a poſt called Voltri, which the French poſſeſſed, within ſix leagues of Genoa. They defended themſelves till the evening, and then retreated to Savona. Next morning Beaulieu, at the head of 15,000 men, preſſing upon the centre of the French army, was completely ſucceſsful till one o'clock afternoon, when he reached a redoubt at Montenotte, which was the laſt of their entrenchments. This redoubt contained 1500 French. Their commander, Rampon, prevailed with them, in a moment of enthuſiaſm, to ſwear that they would not ſurrender; and the conſequence was, that they arreſted the progreſs of Beaulieu for the remainder of the day. During the night, Bonaparte ſtationed his right wing under La Harpe, a Swiſs exile, in the rear of the redoubt of Montenotte, which ſtill held out, while he himſelf, with Maſſena, Berthier, and Salicetti, advanced by Altara, to take the Auſtrians on their flank and rear. Beaulieu, in the mean time, had received powerful reinforcements, and on the morning of the 11th renewed the attack on the French under La Harpe; but Maſſena ſoon advancing upon the flank of the Auſtrians and Sardinians, they gave way on all ſides. Two of their generals, Roccavina and Argentau, were wounded. They loſt 2500 priſoners, and were purſued beyond Cairo, of which the French took poſſeſſion on the following day.

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260 His ſucceſſes.

On the 13th at day-break, the defiles of Milleſimo were forced by the French General Angereau; and, by a ſudden movement, General Provera, a knight of the order of Maria Thereſa, at the head of 1500 Auſtrian grenadiers, was ſurrounded; a circumſtance which proved not a little embarraſſing to the French army. For this reſolute officer, inſtead of ſurrendering, inſtantly withdrew to a ruined caſtle on the top of the mountain, and there entrenched himſelf. Angereau brought up his artillery, and ſpent many hours in attempting to diſlodge him. At laſt he divided his troops into four columns, and endeavoured to carry Provera's entrenchments by ſtorm. The French loſt two generals, Banel and Quenin, and Joubert was wounded in this attempt, which proved unſucceſsful. Provera paſſed the night in the midſt of the French army, which had been prevented by his obſtinate reſiſtance from coming to battle. On the 14th the hoſtile armies faced each other, but a diviſion of the French troops was ſtill occupied in blockading General Provera. The Auſtrians attempted to force the centre of the French, but without ſucceſs. Maſſena, in the mean time, turned the left flank of their left wing near the village of Dego; while La Harpe, with his diviſion in three cloſe columns, turned the right flank of the ſame wing. One column kept in awe the centre of the Auſtrians, a ſecond attacked the flank of their left wing, while the third column gained its rear. Thus was the left wing of the combined army completely ſurrounded and thrown into confuſion. Eight thouſand men were, on this occaſion, taken priſoners, and General Provera at laſt alſo ſurrendered.

Theſe victories were not gained over a timid or an inactive adverſary. On the morning after his fatal defeat at Milleſimo, Beaulieu made one of thoſe ſpirited efforts which often retrieve and alter the fortune of war. At the head of 7000 choſen Auſtrian troops he attacked, at day-break, the village of Dego, where the French repoſed in ſecurity after their ſucceſs. He took the village; but the French having rallied under General Maſſena, ſpent the greater part of the day in attempting to retake it. They were thrice repulſed, and one of their generals, Cauſſe, was killed. Towards evening, however, Bonaparte in perſon having brought up reinforcements, the poſt was retaken, and the Auſtrians retired with the loſs of 1400 made priſoners.

Bonaparte had now thrown himſelf between the Auſtrian and Sardinian armies. By the poſſeſſion of the ſtrong poſt of Dego, his right was ſecured againſt the efforts of Beaulieu, while he was enabled to act with the maſs of his force againſt the Piedmonteſe troops. His enterpriſes in this quarter were facilitated by the exertions of Angereau, who had opened a communication with the valley of the Tanaro, where Serrurier's diviſion was approaching the town of Ceva, near which the Piedmonteſe had an entrenched camp defended by 8000 men.

On the 16th Angereau attacked the redoubts which covered this camp, and took moſt of them; which induced the Piedmonteſe to evacuate it during the night,

and

and on the 17th Ceva was entered by Serrurier. Count Colli now retreated to cover Turin; making choice, however, of the ſtrongeſt poſts, and fighting in them all. He was able, on the 20th to repulſe Serrurier; but on the 22d Bonaparte, ſtill preſſing on the Piedmonteſe general, defeated him near Mondovi, and entered that place. The retreating army next endeavoured to make a ſtand, with its head quarters at Foſſano, and its wings at Coni and Cheraſco. On the 25th Maſſena advanced againſt Cheraſco, which was ſpeedily evacuated. Foſſano ſurrendered to Serrurier, and Alba to Angereau.

261
Armiſtice with Sardinia ſucceeded by

262
A formal treaty.

Previous to theſe laſt movements, however, Count Colli, on the 23d of April, had written to Bonaparte, requeſting an armiſtice, to allow the King of Sardinia an opportunity of negociating a peace. The French army was now within 26 miles of Turin; and that prince ſaw himſelf ſuddenly reduced to the neceſſity of ſtanding a ſiege in his capital, or of accepting ſuch terms as the conqueror might think fit to impoſe. Bonaparte granted an armiſtice, on condition that the three fortreſſes of Coni, Ceva, and Tortona, ſhould be delivered up to him, with their artillery and magazines, and that he ſhould be allowed to croſs the Po at Valentia. The armiſtice was ſigned on the 29th, and it was followed by a formal treaty with the French Republic, which was concluded at Paris on the 17th of May. The conditions impoſed by this treaty upon the King of Sardinia were humiliating and ſevere. He gave up to France for ever the duchy of Savoy, and the counties of Nice, Jenda, and Bretueil. He gave an amneſty to all his ſubjects that were proſecuted for political opinions. He agreed that the French troops ſhould have free acceſs to Italy through his territory; and, in addition to the fortreſſes ſurrendered by the armiſtice, he gave up thoſe of Exiles, Suſa, Brunette, Aſſiette, Chateau Dauphin, and Alexandria, to be poſſeſſed by the French during the war; and they were authoriſed to levy military contributions in the territory occupied by them. He agreed to erect no fortreſſes on the ſide of France, to demoliſh the fortreſſes of Brunette and Suſa, and to diſavow his diſreſpectful conduct towards the laſt French ambaſſador.

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Armiſtice with the Duke of Parma.

In the mean time the French army advanced towards the Po. Beaulieu was deceived by the article in the armiſtice; which ſtipulated, that the French ſhould be allowed to croſs that river at Valentia, and made all his preparations for reſiſtance in that quarter. Bonaparte laboured, by ſeveral evolutions, to confirm this error; and while the Auſtrian general waited for him near Valentia, in various well fortified poſitions, he advanced haſtily into Lombardy, and had proceeded ſixty miles down the river to Placentia, where he arrived on the 7th of May, before the direction of his march was diſcovered. He immediately ſeized whatever boats or other craft he could find, and effected his paſſage without difficulty, there being only a ſmall party of Auſtrian cavalry accidentally on the oppoſite bank, and they fled at his approach. Beaulieu in the meanwhile had ſent, when too late, a body of 6000 infantry and 2000 cavalry, to prevent if poſſible the French from paſſing the river; but Bonaparte, now on the ſame ſide of the river with themſelves, met and defeated them on the 8th at the village of Fombio. Another body of 5000 Imperialiſts, advancing to the aſſiſtance of thoſe at Fombio, was met at Codogno, and repulſed by General La Harpe; but this officer was killed on the occaſion. On the 9th Bonaparte granted an armiſtice to the Duke of Parma, on condition of his paying a contribution of 2,000,000 of French money, and delivering 10.000 quintals of wheat, 5,000 quintals of oats, and 2,000 oxen, for the uſe of the army. This prince alſo agreed to deliver up 20 of his beſt paintings to be choſen by the French. This laſt ſtipulation was no ſooner known in France, than many men of letters and artiſts remonſtrated againſt it as both impolitic and uſeleſs. They contended, that it would render the French Republic odious to all Italy, without producing any advantage to compenſate this evil, as the progreſs of the arts could not be promoted by removing their beſt productions from the ſcenes in which they originated. But the Directory was too much occupied by views of national aggrandiſement to liſten to conſiderations of this kind, and ſimilar ſtipulations were ordered to be inſerted in every future treaty; by which means the moſt valuable curioſities of Italy were gradually transferred to the French capital.

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Victory at Lodi.

Beaulieu, now driven from the Po, croſſed the Adda at Lodi, Pizzighitone, and Cremona. He left ſome troops, however, to defend the approaches to Lodi. The advanced guard of the French attacked theſe on the 10th, and drove them into the town; which was entered in ſuch cloſe purſuit, that the imperialiſts, on leaving it, had not leiſure to break down the bridge over the Adda. At the other end of the bridge the Imperial army was drawn up, and thirty pieces of cannon defended the paſſage. The French generals, after a conſultation, agreed that it could not be forced. But Bonaparte having demanded of his grenadiers if they were willing to make the attempt, they applauded the propoſal, and he formed them into a cloſe column. Taking advantage of a cloud of ſmoke which iſſued from the hoſtile artillery, they ruſhed along the bridge, which was about 100 yards in length, and were at the middle of it before they were diſcovered. Here a general diſcharge from the Auſtrians deſtroyed 700 men. The French column heſitated, and the carnage became terrible; but Maſſena, Berthier, Dallemagne, Cervoni, Laſneſs, Dupat, and other officers, flying to the head of the column, urged on the ſoldiers, and preſſing forward, broke into the ranks of the Imperial army, which immediately gave way, and fled in all directions. This exploit has been much celebrated. The intrepidity of the troops by whom it was accompliſhed is unqueſtionable; but how far the leader who urged them to ſuch an enterpriſe is entitled to approbation may well be doubted. He had paſſed the Po with ſcarcely the loſs of a man. The Adda is a very inferior ſtream, which has fords both above and below the town of Lodi. The river was actually croſſed at one of theſe by Angereau with the cavalry, during the attack upon the bridge. With the delay of one day therefore the paſſage might have been effected without difficulty by the whole army, and there was no adequate motive to juſtify the laviſh expenditure of blood which was here made; for the French army no longer preſſed forward in purſuit of Beaulieu, but, after the ſurrender of Pizzighitone and Cremona on the 12th, returned upon Pavia and Milan on its left (A). Theſe places opened their gates without reſiſtance, though the citadel of Milan held out for a ſhort time.

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It would ſeem that, in the original plan of Bonaparte's campaign, the utmoſt expected from his efforts was to gain ſuch an aſcendancy in Italy as might induce the princes and ſtates of that country to deſert the coalition againſt France, which all of them aſſiſted with money and proviſions, if not with troops. To accompliſh this object, though he ſent Maſſena in purſuit of Beaulieu as far as Verona, yet he himſelf now turned aſide into Modena and the territories of the Pope. He took Ferrara, Bologna, and Urbino; and at laſt granted an armiſtice to his holineſs and the Duke of Modena, on the uſual conditions of large contributions of money, paintings, and curioſities. From the Pope he farther exacted the ceſſion of the legations of Bologna and Ferrara, and poſſeſſion of the citadel of Ancona. His march into the Roman territory ſo alarmed the Neapolitan cabinet, that it now ſolicited peace; and Bonaparte granted an armiſtice, without attempting to add to it the humiliating conditions to which the other Italian ſtates were ſubjected. From the territories of the Pope, Bonaparte haſtily advanced with a body of troops to Leghorn, in the neutral ſtate of Tuſcany, under pretence of driving out the Engliſh, whoſe property there he confiſcated. By theſe meaſures the taſk aſſigned to Bonaparte was completed by the time the campaign upon the Rhine was begun. Mantua was ſtill indeed in the hands of the Imperialiſts, but it was blockaded, and all Italy was now ſubmiſſive to France.

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To diminiſh, if poſſible, the efforts of the French on the ſide of Italy, the Imperialiſts thought it neceſſary to renew the conteſt in Germany. An intimation was therefore ſent to General Jourdan, that the armiſtice would terminate and hoſtilities commence on the 31ſt of May. At this time General Wartenſleben oppoſed Jourdan; and the Archduke Charles commanded the army in the Hundſruck, which covered Mentz and Manheim, and was ſtationed againſt Moreau on the Upper Rhine. The French began their operations with a very artful ſtratagem, intended to draw the whole Auſtrian force to the Lower Rhine, that Moreau might have an opportunity of ſuddenly penetrating into Swabia, and conſequently of carrying the war towards the hereditary territories of Auſtria. For this purpoſe Moreau remained quiet, while Jourdan began to act vigorouſly. On the 31ſt of May his left wing, under Kleber, iſſued from the lines of Duſſeldorf, on the right bank of the Rhine, and, advancing towards the Sieg, defeated the Imperialiſts. Thereafter they were driven ſucceſſively from the ſtrong poſitions of Ukareth and Altenkirchen, and retreated acroſs the Lahn. Jourdan, in the mean time, having advanced with his centre and right wing, forced the Auſtrian poſts on the Nahe, croſſed the Rhine, formed the blockade of the fortreſs of Ehrenbreitſtein, and haſtened forward as if about to form the blockade or ſiege of Mentz. By theſe movements the Archduke found himſelf in the hazardous ſituation of having Moreau in his front, while Jourdan, with a victorious army, commanded his rear. He therefore haſtily croſſed the river, leaving the fortreſſes of Mentz and Manheim to keep Moreau in check. Having joined the retreating army, he encountered Jourdan's advanced guard, which he compelled to retire after an obſtinate conflict. Jourdan did not hazard a general engagement, but withdrew to his former poſitions, the Archduke preſſing hard upon him, till he raiſed the blockade of Ehrenbreitſtein, and croſſed the Rhine in its neighbourhood, till Kleber, on the 20th of June, entered the lines of Duſſeldorf, from which he had ſet out.

Theſe movements were foreſeen. For the inſtant that the Archduke withdrew from the Palatinate to drive Jourdan down the Rhine, Moreau aſcended rapidly towards Straſburg; ſo that theſe hoſtile armies ſeemed to be flying from each other with all poſſible ſpeed. On the 24th of June, Moreau effected the paſſage of the river oppoſite to fort Kehl. This was an enterpriſe of conſiderable difficulty; for a ſudden ſwell, by covering a part of the iſlands with which the river abounds, had prevented the Auſtrians from being taken by ſurpriſe, as was originally intended. The entrenchments on ſuch iſlands as were occupied by troops were ſpeedily carried by the bayonet, and 2600 French landed on the oppoſite ſhore, but without cavalry or artillery. Here they were expoſed to the attacks of the Auſtrian horſe from the camp of Wilſtedt, and to the fire of the cannon of the fort. They maintained their ground, however, and even acted on the offenſive, till the boats, which had been ſent back, returned with a reinforcement. The whole redoubts and the fort were then inſtantly taken by ſtorm, or with the aſſiſtance of ſuch cannon as had been found in the firſt redoubts at which the French arrived, and the Imperialiſts fled towards Offenburgh.

The departure of the Archduke to the Lower Rhine in purſuit of Jourdan, and the large detachments which had recently been ſent towards Italy to oppoſe Bonaparte, now enabled Moreau to enter Swabia with a great ſuperiority of force. The ſtrong military poſitions, however, which the country affords, preſented to him conſiderable difficulties. On the 26th of June he drove the Auſtrians from their camp of Wilſtedt; and on the 27th he advanced with his army, in three columns, againſt another camp of 15,000 men in front of Offenburg. General Wurmſer ſent a ſtrong reinforcement from Manheim to the aſſiſtance of theſe troops; but having encountered two of the French columns on its way, the reinforcement was defeated, and the camp at Offenburg was evacuated during the night. The Auſtrians made an obſtinate ſtand at Renchen, near Philipſburg, on the 29th, but were at laſt compelled to retire with the loſs of 1200 men taken priſoners, and ſeveral pieces of cannon. On the 2d of July a diviſion of the French army, under General Laroche, ſucceeded in ſeizing the mountain Knubis, which is the higheſt point of the ridge of mountains called the Black Foreſt. On the 3d, after an obſtinate conflict, the Auſtrians were driven from the paſs of Friedenſtadt; in conſequence of which

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(A) We think this conduct cannot be accounted for, but by the ſuppoſition of a very improper correſpondence between Bonaparte and the Auſtrian officers.

which they loſt all communication with the emigrant troops under the Prince of Condé, and other Imperial troops ſtationed on the Rhine towards Switzerland. On the 6th, the left wing of the French, under Deſaix, encountered the Imperialiſts at Raſtadt, where the Auſtrians, who had received ſome reinforcements from the Lower Rhine, made a very determined reſiſtance; but were at laſt compelled to give way, and to retire to Ettingen.

The Archduke Charles now arrived in perſon with his army from the Lower Rhine, where he had left Wartenſleben, but with inferior force, to oppoſe Jourdan. The French, under this general, had inſtantly reſumed the offenſive upon the departure of the Archduke. Kleber advanced from the lines of Duſſeldorf, as formerly; while the centre and right wing croſſed the Rhine near Coblentz. The poſts of Ukareth and Altenkirchen were forced, and on the 9th of July the whole of Jourdan's army croſſed the Lahn. On the 10th, Wartenſleben was defeated near this river, after great ſlaughter on both ſides, with the loſs of 500 priſoners; and the French on the 12th entered Franckfort. The ſituation of the hoſtile armies was now become extremely important. The two imperial armies were at no great diſtance from each other, and were placed in the centre between the armies of Moreau and Jourdan. Could the Archduke, who was commander in chief, have reſiſted one of theſe armies for a ſhort time, at any ſtrong poſition, by a detachment of his troops, while he precipitated himſelf with the maſs of his force upon the other, it is probable than any farther invaſion of Germany might have been prevented. But the activity of the French generals, whoſe progreſs could nowhere be reſiſted by partial efforts, prevented the poſſibility of executing ſuch a plan. He was therefore under the neceſſity of making his final exertion for the preſent ſafety of Germany againſt Moreau at Ettingen, on the 9th of July, without having formed any junction with Wartenſleben. The battle was moſt obſtinately fought. The French were four times repulſed in their attempts to force the heights of Rollenſolhe; and it was not till they had experienced a dreadful ſlaughter that they at laſt carried the field by the bayonet.

The loſs of the battle of Ettingen compelled the two Imperial armies to retire eaſtward. After placing ſtrong garriſons in Mentz, Manheim, and Philipſburg, the Archduke retreated through Swabia towards Ulm, where his magazines were placed. At every ſtrong poſition, however, he made an obſtinate ſtand; thus endeavouring to render the progreſs of the French under Moreau as tardy as poſſible. Wartenſleben, with the other Imperial army, retired through Franconia, reſiſting Jourdan in the ſame manner. Many bloody battles were fought, of which it is here unneceſſary to give a minute deſcription. It is ſufficient to remark, that the French were long ſucceſsful in them all. They gradually preſſed forward till Moreau's army compelled the Archduke to croſs the Neckar, and afterwards the Danube, leaving the whole circle of Swabia in the rear of the French. Wartenſleben was in like manner driven through Aſchaffenburg, Wurtzburg, Schweinfurt, and found it neceſſary to croſs the Rednitz, on the 6th of Auguſt, at Bamberg, to avoid the preſſure of Jourdan's army in his rear. This army continued to advance till its right wing, under Bernadotte, was poſted at Neumarck, with his advanced poſts at Teining, while the body of the army had driven Wartenſleben beyond the Nab, and had reached Amberg on the 22d of Auguſt.

267 Alarm througho Germany

Excepting a part of the mountains of Tyrol, three French armies, under Jourdan, Moreau, and Bonaparte, now occupied the whole country reaching from the frontiers of Bohemia to the Adriatic Sea. The alarm throughout Germany was extreme. The Duke of Wirtemberg obtained peace from the French on condition of paying 4,000,000 of French money. The circle of Swabia did the ſame, on engaging to pay 12,000,000 of livres and to deliver 8,400 horſes, 5,000 oxen, 100,000 quintals of wheat, 50,000 quintals of rye 100,000 ſacks of oats, 100,000 pairs of ſhoes, and a large quantity of hay. The Margrave of Baden obtained peace on ſimilar terms. The elector of Bavaria and the circle of Franconia negociated, and offered large payments; and even the diet of Ratiſbon ſent a deputation to treat with the French generals for neutrality. The King of Pruſſia now entered into a new treaty with the French; the conditions of which were concealed, but its nature appeared in the advantage which he took of the progreſs of their arms to take poſſeſſion of certain territories in Germany, and particularly of the ſuburbs of Nuremberg, under pretence of ſome antiquated title. Spain alſo entered into a treaty offenſive and defenſive with France, which was afterwards followed up by a declaration of war againſt Britain.

268 Danger the houſ of Auſtr

The danger of the houſe of Auſtria was now very great; and had Bonaparte, inſtead of being detained in Italy, by events of which we ſhall immediately take notice, been able to croſs the Tyrol by Inſpruck, and to reach the banks of the Danube, there is little doubt that the Emperor muſt have ſubmitted to ſuch conditions as the French thought fit to impoſe. Deſerted in all quarters by the members of the coalition, he ſtill, however, retained an ally in Great Britain, whoſe riches, liberally beſtowed in the form of a loan, extricated him from the preſent difficulties. Having the command of abundance of money, he was enabled to ſend one army after another to oppoſe Bonaparte in Italy, while he recruited his armies in Germany by extenſive levies, and by taking into his pay the troops of thoſe ſtates that made peace with France.

269 Maſterly conduct the Archduke.

The Archduke, having received powerful reinforcements, reſolved to make a ſtand, on the 11th of Auguſt, againſt Moreau at Umenheim. A ſevere battle was fought during ſeventeen hours, and one of the wings of the Auſtrian army, under General Rieſe, even ſucceeded in occupying four leagues of territory in the rear of the French army; but the Archduke having received intelligence, in the mean time, that Wartenſleben could not maintain his ground againſt Jourdan, he thought it neceſſary to continue his retreat, and to adopt new meaſures. On the 17th of Auguſt he left General La Tour, with a part of his numerous army, to oppoſe Moreau, and having croſſed the Danube at Neuburg and Ingolſtadt, he marched to Wartenſleben's aſſiſtance to fall upon Jourdan with united forces. On the 23d he attacked Bernadotte at Teining, and forced him to retire towards Nuremberg. The Archduke was thus upon the right of Jourdan, while Wartenſleben was ſtationed on his front. The French general, finding his poſition dangerous, began to retreat on the 24th. From

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the ſtate of the finances, the French armies, at the commencement of this campaign, had been extremely ill equipped and ill paid. Hence the two armies of Moreau and Jourdan plundered, without decency or mercy, every place into which they entered. In Jourdan's army, more eſpecially, the want of diſcipline was extreme (A). Hence, when they began to retreat, loaded as they were with ſpoil, they ſuffered not leſs from the enraged inhabitants of the countries through which they paſſed, than from the military efforts of the hoſtile army. The Archduke having joined Wartenſleben, was enabled to ſend off Nauendorf with reinforcements to La Tour, who oppoſed Moreau, and, in the mean time, he continued in perſon to purſue Jourdan towards Wurtzburg. Here the French made a ſtand, on the 3d of September, and a general engagement took place. Both parties ſuffered great loſs, but more eſpecially the French, who retreated during the night. Jourdan now fled by Fuldaw to Wetzlaer. Having croſſed the Lahn, where he made ſome reſiſtance, he deſcended along the banks of the Rhine, till his army, on the 17th, reached Coblentz and Duſſeldorf, from which it had originally departed.

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The ſituation of Moreau's army was now uncommonly dangerous. He maintained his poſition, however, till the 17th of September; but he was undecided in his movements, and was obviouſly at a loſs how he ought to proceed. He attempted, without ſucceſs, to withdraw the Archduke from the purſuit of Jourdan, by detaching a part of his troops towards Nuremberg. Many attacks were made upon him, but all of them without ſucceſs; and the Imperial generals at laſt gave way to him wherever he turned. Finding at laſt that Jourdan's defeat was irretrievable, and that Bonaparte did not arrive from Italy, he reſolved to retreat. He had recroſſed the Lech, to prepare for this event; but now ſuddenly paſſing it again, as if determined to advance farther into Auſtria, he drove back General La Tour as far as Landſperg. Having thus obtained freedom for his future movements, he ſet out in full retreat, proceeding between the Danube at Ulm and the lake of Conſtance. La Tour, however, ſoon preſſed upon his rear. He found the paſſes of the Black Foreſt occupied by large bodies of Auſtrians and armed peaſants, while Generals Nauendorf and Petrarſch haraſſed his right flank with 24,000 men. Once more therefore he turned upon La Tour, at Biberach, on the 3d of October, with great impetuoſity, and having defeated him, took no leſs than 5000 priſoners; whom he was able to carry to France. He now continued his retreat; his right wing, under General Deſaix, keeping Nauendorf and Petrarſch in check, whilſt the reſt of the army cleared the paſſages in front till he arrived at what is called the Valley of Hell (*Val d'Enfer*), a narrow defile, running for ſome leagues between lofty mountains, and in ſome places only a few fathoms in breadth. The centre of his army, advancing in a maſs, forced this paſſage, while the wings repelled the Imperial troops under La Tour and Nauendorf. After this deſperate effort he reached Fribourg on the 13th of October, and was ſoon compelled by the Archduke Charles, who had now arrived from the purſuit of Jourdan, to evacuate all his poſitions on the Swabian ſide of the Rhine, with the exception of Kehl, and a temporary fortification erected at Huningen, called a bridge-head (*tete de pont*), though there was no bridge at that place.

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The Imperial troops, in the mean time, had taken advantage of the defenceleſs ſtate of the French frontier to croſs the Rhine at Manheim, and to advance in various detachments to Weiſſemburg, Seltz, Hagenau, and almoſt to the gates of Straſburg, levying contributions and taking hoſtages wherever they came. Theſe detachments being now recalled, the Archduke reſolved to terminate the campaign by the capture of Kehl, and of the fortification at Huningen. But this proved no eaſy taſk. As the communication with the French ſide of the river was open at both places, the diviſions of Moreau's army did duty at them by turns. A great part of the winter was ſpent in fruitleſs attempts, on the part of the Auſtrians, ſometimes to take them by ſtorm, and ſometimes to reduce them by the forms of regular ſiege. Different ſallies were made by the French, and immenſe numbers of men were loſt on both ſides by the ſword, and by the ſeverity of the ſeaſon. It was not till the 10th of January that the French agreed to evacuate Kehl, and the fortification at Huningen was not given up till the ſucceeding month.

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Reflections
on the different orders of
battle.

During the invaſion of Germany that has been now mentioned, and the reverſes that were ſuffered by the French armies there, Bonaparte ſtill continued to gain victories in Italy. The ſucceſs and the wonderful fortune of this man, require that we ſhould give ſome account of the arts by which he was enabled, ſo unexpectedly, to triumph over the moſt experienced military commanders of the age in which he lived. In the military art three orders of battle, or forms of drawing up an army, have been chiefly adopted by thoſe nations whoſe force has principally conſiſted of foot ſoldiers. The firſt form or mode conſiſts of arranging the troops in

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(A) It would be improper to interrupt our military detail with the following information reſpecting the morals of Jourdan's army at this time; which however, it is of importance for our readers to know. We have it from a German Count, who ſaw with his own eyes a conſiderable extent of the march and countermarch of the French through Franconia.

Almoſt every officer in Jourdan's army had a miſtreſs; and ſuch of them as by plunder could ſupport the expence, gave balls, acted plays, and exhibited every ſpecies of gaiety when the army was not in actual motion. In all this there was nothing wonderful. The ladies, however, were not unfrequently pregnant; and as nurſing would keep them from theſe aſſemblies, where their company could not be diſpenſed with by the ſoldiers of liberty, they drowned their new-born infants—*they drowned them publicly!* Our correſpondent (the Count) ſaw two of the little victims, and he heard, from unqueſtionable authority, of ſeveral more. At a place within ſix miles of Nuremberg, a Pruſſian pariſh-miniſter, who was alſo a ſort of juſtice, endeavoured to ſave one innocent, and was thrown into the river and fired at by the French, when his pariſhioners endeavoured to ſave him. He had the happineſs, however, to ſave the child, and was allowed to keep it, the mother never enquiring after it!

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in a deep line; that is, with from 16 to 30 men placed cloſe behind each other. This is the moſt ancient and the ſimpleſt order of battle. It was carried to perfection by the Greeks, under the name of the *Phalanx*; and, when the ſoldiers were armed with the long ſpear, it was extremely formidable. It left little to the ſkill of the general, except the choice of the ground where he was to fight, and made all to depend upon the ſteadineſs of the troops. It was attended with theſe diſadvantages, however, that an army thus drawn up commanded very little territory, and that if its ranks happened to be broken by unequal ground, or an uncommon effort of the enemy at a particular quarter, its parts could not eaſily be re-united, and it infallibly went into confuſion. In modern times, this order of battle cannot be adopted with ſucceſs on account of the facility with which it is broken by artillery, and the ſlaughter to which it expoſes the troops from every kind of fire arms. The ſecond, or modern order of battle, conſiſts in forming a front of an immenſe extent, with only two or three men in depth, and uſually ſupporting theſe by another, and perhaps a third equally ſlender line, at a conſiderable diſtance in the rear. Troops thus drawn up derive the greateſt poſſible benefit from their own fire arms, and ſuffer the leaſt loſs from thoſe of the enemy. They provide for their own ſubſiſtence by covering an immenſe track of country. Their battles are not ſanguinary, as they are ſeldom very cloſely engaged; and in caſe of a defeat, little loſs is ſuffered, becauſe they can ſcatter themſelves over a wide ſpace, as the rear protects the advanced body; and as the troops in a long line can ſeldom all be engaged at once, they are ſupported by each other in a retreat. This order of battle, however, is eaſily broken; and the moment the flank of an army is turned, it is under the neceſſity of retreating, as troops cannot ſpeedily be brought from other quarters to face the enemy there. The laſt order of battle conſiſts of dividing an army into columns of a narrow front and very great depth, and of ſtationing the columns at ſome diſtance from each other, with a ſecond ſet of columns oppoſite to the intervals between the firſt. This arrangement is ſuperior to the phalanx, in this reſpect, that it does not expoſe an army to diſorder by inequalities of ground, by the turning of its flank, or even by the defeat of one of its parts. The celebrated Epaminondas won the battles of Leuctra and Mantinea, by forming a part of his troops, on each of theſe occaſions, into a ſtrong column, which, by its great depth, and the mechanical weight of its ſhock, broke through the Spartan phalanx. The Romans are known to have owed their military ſucceſs, in a great meaſure, to the arrangement of their legion. It was drawn up upon the principle now mentioned; and tho' the columns were only 16 men in depth, it was confeſſedly ſuperior to the phalanx. In modern times, however, this order of battle is attended with great difficulties. It muſt reduce an army to embarraſſment with regard to proviſions from the ſmallneſs of territory which is thus occupied, and it expoſes the troops in an engagement to dreadful deſtruction from the powerful miſſile weapons which are now employed. In every enterpriſe they muſt inſtantly carry their point or be undone, as the fire of a few guns from a ſingle battery or redoubt would exterminate them by thouſands. With all its imperfections, however, this laſt order of battle has at times been employed by enterpriſing men. It was the favourite arrangement of Guſtavus Adolphus; and his troops were drawn up according to it at the battle of Lutzen, where he himſelf was killed, while his army was victorious. The celebrated Marquis of Montroſe alſo uſed it on more than one occaſion, and it was now adopted in all important caſes by Bonaparte. Truſting to its ſucceſs, he puſhed his columns into the midſt of the Auſtrian army at Milleſimo, and fairly captured one of its wings. He ventured farther to throw himſelf into the centre, between the Auſtrian and Sardinian armies, and to vanquiſh the one, by acting againſt it with his whole troops while ſeparated from the other. Being careleſs about the ſhedding of blood, he never heſitated to expoſe his whole army to utter ruin in caſe of a failure. The ſucceſs of his battles, by enabling him to lay almoſt all Italy under contribution, gave him the means of maintaining the moſt ſteady and ſevere diſcipline over a well paid army. Filled with high notions of military glory, which he is ſaid to have derived from the writings of Plutarch, he laboured to inflame with the ſame ſpirit, the minds of his ſoldiers by proclamations, expreſſed in a very different ſtyle from the formal and more modeſt language of modern times. "Soldiers (ſaid he, when he firſt entered Lombardy), you have ruſhed like a torrent from the ſummit of the Appenines, you have driven back and diſperſed all who oppoſed your march. Your fathers, your mothers, your wives, your ſiſters, your ſweethearts, rejoice in your ſucceſs, and boaſt with pride of being related to you. But remains there nothing more for you to effect? Shall poſterity reproach us with having found a Capua in Lombardy? But I already ſee you ruſhing to arms; an unmanly repoſe fatigues you, and the days loſt to glory are loſt to your felicity. But let the people be tranquil; we are the friends of all nations, and more particularly of the deſcendants of the Brutuſes, the Scipios, and the illuſtrious perſonages whom we have choſen as models. To reſtore the Capitol, to replace with honour the ſtatues of the heroes who rendered it renowned, and to rouſe the Roman people, become torpid by ſo many ages of ſlavery, ſuch will be the fruit of your victories; they will form an epoch to poſterity, and you will have the immortal glory of renovating the faireſt portion of Europe. The French nation, free and reſpected by all the world, will give to Europe a glorious peace. You will then return to your homes and your fellow-citizens; who, when pointing to you, will ſay, *He was of the army of Italy.*"

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275 Marſha Wurmſ attacke

At the commencement of the French invaſion of Germany, Marſhal Wurmſer was ſent into Italy to replace Beaulieu, who was removed from his command. On his arrival, he collected the wrecks of the Auſtrian army, and prepared, till he ſhould receive re-inforcements, to confine the French within as narrow limits as poſſible, by lines drawn from the lake of Garda to the river Adige. At the end of June, however, theſe lines were attacked and carried by Maſſena's diviſion, which induced Wurmſer to avoid farther exertion till he ſhould receive an increaſe of force. In the mean time Bonaparte was not a little diſturbed by partial inſurrections of the Italians. Soon after his arrival in Lombardy, the inhabitants of Milan and of Pavia had riſen in concert againſt his troops; but they were reduced to ſubjection with little bloodſhed. In the beginning of July, farther

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farther inſurrections broke out in the Romagna. The inſurgents eſtabliſhed their head quarters at Lugo, and repulſed a party of French cavalry that was ſent againſt them. It was not till Angereau had overcome them, on the 6th, in a battle in which he loſt 200 men, that they could be ſubdued. The ſlaughter of theſe unhappy people was very great. Their town was given up to pillage, and all found in arms were deſtroyed.

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The firſt part of the month of July was ſpent by Bonaparte in commencing the ſiege of Mantua in regular form; and towards the cloſe of that month he expected its capture. In this, however, he had ill calculated the immenſe military efforts which Auſtria, aided by the money of Britain, was capable of making. Twenty thouſand troops had been ſent from the Rhine, and other reinforcements were marching towards Italy from all quarters; ſo that Bonaparte, inſtead of being able to take Mantua, had ſpeedily to defend himſelf againſt the force of a ſuperior army to his own, that approached to raiſe the ſiege, and even threatened to drive him out of Italy. Wurmſer's army deſcended from the Tyrol in two diviſions. One half of it proceeded along the eaſt ſide of the lake of Garda, and the other came by the weſt to cut off the retreat of the French, who were thus encloſed by the Auſtrians. On the 29th of July, at three o'clock in the morning, Maſſena was driven from the ſtrong poſt of La Corona, on the eaſt of the lake, while, at the ſame time, 15,000 Auſtrians drove the French from Salo, and afterwards took Breſcia, with all the magazines and hoſpitals of Bonaparte's army. There was a fatal error, however, in the general plan of operations that had been formed by the Imperialiſts. Their army united was an overmatch for the French; but they had voluntarily divided it into two parts, placing Bonaparte between them. The error was inſtantly diſcerned, and taken advantage of by their antagoniſt. On the night of the 30th, he ſuddenly raiſed the ſiege of Mantua, and leaving a ſmall body of troops to keep in check the Imperialiſts on that ſide, he marched rapidly weſtward, and on the firſt of Auguſt retook Breſcia, with the magazines and hoſpitals. Having the maſs of his army united, Bonaparte ſurpaſſed his antagoniſts in numbers wherever he encountered them. He prepared to attack the Imperialiſts on the 3d at Salo, Lonado, and Caſtiglione, but was anticipated by them. Having formed a large body of his troops into cloſe columns, the Auſtrians, who were not yet aware of the nature of his mode of fighting, extended their line to ſurround them; a movement which enabled the columns to penetrate the Imperial army in all directions, and throw it into complete diſorder. The French took 4000 priſoners, and 20 pieces of cannon. The Imperial troops were here ſo completely defeated, that a conſiderable diviſion of them having in vain attempted to retreat by Salo, which they found occupied by the French, wandered about in ſearch of a road by which to eſcape; and having next day come to Lonado, they ſummoned it to ſurrender, upon the ſuppoſition that the greater part of the French army had gone eaſtward to encounter Wurmſer. This was actually the caſe; but it ſo happened, that Bonaparte was in perſon at Lonado with only 1200 men. He was ſufficiently perplexed by this accident; but having ordered the meſſenger to be brought into his preſence, he threatened to deſtroy the whole diviſion for having dared to inſult the French army, by ſummoning its commander in chief to ſurrender. The ſtratagem was ſucceſsful. The Imperial officers imagined that the whole army was in the place, and immediately, with their troops, laid down their arms, to the number of 4000 men.

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Such is the account of this tranſaction, which we have from the partial pen of the panegyriſt of Bonaparte, who writes the hiſtory of his campaigns in Italy; but we believe that the General has himſelf aſſigned the true reaſon of his ſucceſs on this occaſion, and others, where ſucceſs could not be reaſonably expected. In one of his intercepted letters, Bonaparte informs his correſpondent, that the Auſtrian armies in Italy coſt him more money than his own; and indeed it is not within the compaſs of ſuppoſition, that a body of veteran ſoldiers could have been intimidated to lay down their arms by ſo vain glorious a threat as this, had not their officers been corrupted by French gold and French principles. The ſtratagem might have its effect upon the common ſoldiers, but it could not poſſibly impoſe upon their leaders, or upon the meſſenger who ſummoned Lonado to ſurrender.

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Again defeated.

On the 5th and 6th, Bonaparte attacked Marſhal Wurmſer, and drove him from Peſchiera and the river Mincio. On the 7th, the Auſtrians were compelled to quit Verona, and to retire once more to the mountains of Tyrol. This conteſt, which had laſted more than ſix days, coſt the Imperialiſts more than 20,000 men, upwards of 15,000 of whom were made priſoners. A part of the Emperor's troops had been levied in Gallicia, the part of Poland which, in the partition of that country, had been allotted to Auſtria. Theſe men ſeized the moment of defeat to quit a ſervice which they diſliked, and to go over to the French; a circumſtance which greatly ſwelled the liſt of priſoners.

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His maſterly conduct
after a third
defeat.

It was now neceſſary for the French to commence the ſiege of Mantua anew. The garriſon in their abſence had deſtroyed their works, and carried into the place 140 pieces of heavy cannon which they had left behind them, and procured a conſiderable quantity of proviſions. The blockade was renewed; but the French, by the loſs of their artillery, were unable to proceed to a regular ſiege; and by the beginning of the month of September, Marſhal Wurmſer, having received new reinforcements, was again enabled to attempt the relief of the place. Bonaparte having information of his intended approach, left ſufficient troops to keep up the blockade, while he advanced northward with his army; and on the 4th of September drove the Auſtrians from the paſſes of St Marco and the city of Roveredo to the paſs of Calliano, where they made their principal ſtand. Here a battle enſued, in which the French took no leſs than 6000 priſoners, and entered Trent as conquerors. Upon ſuffering this defeat, Marſhal Wurmſer adopted a meaſure which cannot be ſufficiently approved of. Inſtead of retiring before the conqueror, who might have driven him to Inſpruck, and arrived at a critical moment at the Danube, where Moreau, after much heſitation, had only commenced his retreat, he ſuddenly threw himſelf with his vanquiſhed army into Baſſano, upon the flank and rear of Bonaparte, and then advanced by haſty marches towards Mantua. He attempted to make a ſtand at Baſſano on the 8th, but was defeated, and 5000 of his men were taken priſoners. He had ſtill a conſiderable body of troops however. With

280 He enters Mantua.

theſe he puſhed forward; and having fought different ſcattered diviſions of the French at Cerea, Caſtellano, and Due Caſtello, he effected the paſſage of the Adige at Porto Legnano, entered Mantua with the wreck of his army, amounting to about 4000 infantry and 4500 cavalry. In this enterpriſe the Imperialiſts loſt altogether 20,000 men; but the effect of it was, that it fixed Bonaparte in Italy, where he was obliged to remain watching and keeping under blockade the numerous garriſon of Mantua. He hoped that its numbers would ſoon reduce it by famine to the neceſſity of a capitulation; but in this he was deceived, as the fleſh of the horſes, carried into it by Wurmſer, afforded ſubſiſtence to the troops during a very long period.

281 Corſica revolts from Britain, and unites with France.

In the mean time, the fame which their countryman Bonaparte gained by theſe victories, produced in the Corſicans a deſire to change the Britiſh government for that of France. They accordingly diſplayed ſo mutinous a ſpirit, that the Britiſh Viceroy thought fit to evacuate the iſland which was no longer of any value to his government after all Italy had, in a great meaſure, ſubmitted to the French. The Imperial ſubjects in Italy alſo, along with the inhabitants of Bologna, Ferrara, and Modena, who were completely corrupted by the falſe philoſophy of the age, began now to republicaniſe themſelves under the patronage of the French general. They ſent deputies to a convention, levied troops, and aboliſhed all orders of nobility.

282 Partial ſucceſſes of the Auſtrians.

The Emperor ſoon ſent into the field a new army to attempt the relief of Mantua. In the beginning of November this army advanced under the command of Field Marſhal Alvinzi, who advanced towards Vizenza on the eaſt, ſeconded by General Davidovich, who deſcended with another diviſion from Tyrol. Alvinzi had already croſſed the Piava, when he was met by the French, and compelled to repaſs that river. But Davidovich, in the mean time, after ſeveral engagements, having ſucceeded in driving the French down the Adige towards Verona, Bonaparte was under the neceſſity of concentrating his forces. He now adopted his uſual expedient of keeping one diviſion of the hoſtile army in check, while he contended with the maſs of his forces againſt the other. He left Vaubois with ſome troops to detain Davidovich, while he advanced in perſon againſt Alvinzi, who was now haſtening towards Verona. He was met, on his way, by the Auſtrians at the village of Arcole. To ſeize this village, which could not be ſpeedily turned on account of a canal, the French were under the neceſſity of paſſing a narrow bridge in the face of the fire of the Auſtrians. They made the attempt without ſucceſs. Their officers ruſhed to the head of the column, and in vain attempted to rally the troops. Generals Verdier, Bon, Verne, and Laſnes, were carried off the field. Angereau advanced with a ſtandard to the extremity of the bridge, but nobody followed him. At laſt Bonaparte, who in the mean time had ſent Guieux with 2000 men to turn the village at two miles diſtance, haſtened to the bridge of Arcole. Seizing a ſtandard, he advanced at the head of the grenadiers, crying, "Follow your general" They accordingly followed him to within 30 yards of the bridge, when they were intimidated by the terrible fire of the Auſtrians, and their leader found it neceſſary to retire. Attempting to mount his horſe to rally the column, leſt the Auſtrians ſhould advance to the purſuit, he was thrown into a moraſs, while ſtill under the fire of the troops in the village; but here he again eſcaped, as the Auſtrians did not attempt to follow up their advantage.

283 They ar defeated

The village of Arcole was taken towards the evening by Guieux, and afterwards evacuated by the French. On the following day (the 16th of November) an obſtinate conflict enſued in its neighbourhood, in which nothing deciſive was accompliſhed. On the 17th the Auſtrians, having preſſed impetuouſly forward upon the centre of the French army, were taken by ſurpriſe upon their flank by the left wing of the French, which had been ſtationed for that purpoſe in ambuſcade. Their left wing, however, maintained its ground till Bonaparte ſent round a party of horſe with twenty-five trumpeters to their rear, who, by the noiſe they made, induced the Auſtrians to believe themſelves ſurrounded, and to fly on all ſides in confuſion.

Here again appear evidences of treachery among the Auſtrian officers, though the battle of Arcole was the moſt ſevere which the French had yet fought in Italy, and extremely fatal to their officers, as well as to a multitude of their troops. During its continuance, Davidovich had ſucceeded in defeating Vaubois, who was oppoſed to him and Rivoli, and the blockade of Mantua was actually uncovered for a time. But Bonaparte now returned, after having driven Alvinzi acroſs the Brenta, and the poſitions of Rivoli and La Corona were retaken, and Davidovich repulſed into Tyrol. General Wurmſer, however, ſtill held out in Mantua during the remaining part of the year; and the only fruit hitherto derived from ſo many victories was, that the French nation was led to look towards Bonaparte as its only invincible commander, upon whom all its hopes of conqueſt were to depend.

284 Negociation between B tain and France.

During theſe military tranſactions, Great Britain had entered into a negociation with France. In conſequence of paſſports obtained from the Directory, Lord Malmeſbury arrived in Paris, and began the negociation with De la Croix the miniſter for foreign affairs. Tho' the Directory could not decently refuſe to negociate, yet they were unwilling ſeriouſly to conclude a peace with Britain. On the other hand, the Britiſh miniſtry have ſince declared that, as individuals, they actually diſapproved of a peace at this time, but that they thought it neceſſary both to negociate, and even to conclude a treaty, if proper terms could be obtained. In judging thus, they were certainly right; for the country at large, not ſeeing the danger of peace, was very deſirous of it, whilſt a deſperate faction was conſtantly aſcribing the continuance of the war to the criminal obſtinacy of the Britiſh government. The negociation which was now ſet on foot opened the eyes of all but thoſe who wiſhed to ſell their country to French regicides. Lord Malmeſbury propoſed, that the principle of mutual reſtitutions ſhould be agreed upon as the baſis of the treaty. After much uſeleſs altercation, and many notes had paſſed upon this ſubject, and alſo upon the queſtion, how far Lord Malmeſbury could negociate for the allies of Great Britain, from whom he had received no official powers, the Directory at laſt agreed to the general principle of mutual reſtitutions, and required that the objects of theſe ſhould be ſpecified. Accordingly, the Britiſh ambaſſador propoſed, in two memorials, that France ſhould relinquiſh the

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Auſtrian Netherlands, and offered to give up the French foreign ſettlements in return. An offer was alſo made to reſtore a great part of the Dutch foreign poſſeſſions, on condition that the Stadtholder's ancient authority ſhould be acknowledged in that country. The Directory now required Lord Malmeſbury to preſent the ultimatum of his conditions within twenty-four hours. On his complaining of this demand, he was informed, on the 19th of December, that the Directory would agree to no conditions contrary to the French conſtitution; and it was added, that his farther reſidence at Paris was unneceſſary!

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During this year, Great Britain retained her uſual ſuperiority by ſea. A Britiſh ſquadron, under Admiral Elphinſton, had taken poſſeſſion of the Dutch ſettlement at the Cape of Good Hope, on the 16th of September 1795. This ſettlement the Dutch wiſhed eagerly to recover; and for this purpoſe they advanced money to enable the French to fit out a ſquadron to co-operate with them in an attack upon it. The French government took the money, but the ſquadron was never equipped. The Dutch themſelves this year ſent a ſquadron of ſeven ſhips of war, under Admiral Lucas, to attempt to reconquer the Cape; but being no match for the Britiſh ſquadron, and being likewiſe caught between two fires, without the poſſibility of eſcaping, the Dutch fleet, without firing a gun, was delivered up to the Britiſh admiral.

287 ſucceſs- attempt the nch on and.

Notwithſtanding the ſuperiority of Great Britain by ſea, the French, towards the cloſe of this year, attempted an invaſion of Ireland; but the plan was ill concerted, and, of courſe, unſucceſsful. The whole conduct of it was intruſted to one man, General Hoche, and no ſecond was prepared to occupy his place in caſe of any accident. The diſaffected faction with whom the French meant to co-operate was not warned of their approach, and the fleet was ſent towards a quarter of the country where the people were little diſpoſed, or, at leaſt, by no means prepared to receive them. Eighteen ſhips of the line, thirteen frigates, twelve ſloops, and ſome tranſports, having 25,000 land forces on board, were employed in this expedition. When about to ſail, it was detained for ſome time by a mutiny which aroſe in conſequence of the enliſtment of about 1,200 galley ſlaves. The fleet ſailed on the 10th of December; but a ſhip of the line was loſt in going out of Breſt, and ſome of the reſt were damaged. The frigate in which the commander in chief had embarked was ſeparated from the fleet in a gale of wind; and the conſequence was, that when the greater part of the fleet arrived at Bantry Bay, on the weſt coaſt of Ireland, nobody had inſtructions how to proceed. The troops and their officers wiſhed to land, but the admiral, Bouvet, refuſed to comply with their requeſt. Having remained ſeveral days upon the coaſt, he ſailed for France, and arrived at Breſt with a part of the fleet on the 31ſt of December. General Hoche did not reach Bantry Bay till it was too late, and therefore could not land. The fleet ſuffered great loſſes in its return. One ſhip of the line and two frigates foundered at ſea, a frigate was taken by the Britiſh, and a ſhip of the line, after an engagement with two Britiſh ſhips, was run aſhore to prevent her being captured.

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At the commencement of the year 1797, the Archduke Charles was ſtill occupied in the reduction of Kehl, and of the French fortifications oppoſite to Huningen. Moreau ſtill commanded the army that oppoſed the Archduke; but General Hoche, after his return from the expedition to Ireland, was appointed to ſucceed Jourdan on the Lower Rhine. Bonaparte was ſtill engaged in the blockade of Mantua, while the Auſtrian government was making vaſt efforts to recruit the army of Alvinzi after its defeat at Arcole, and to enable that General to make a laſt and deſperate effort for the relief of Mantua. The young men of Vienna were urged to give their aſſiſtance on this important occaſion, and 6000 of them marched into Italy as volunteers. Alvinzi's army amounted now to nearly 50,000 men; and he commenced his operations on the 8th of January, by ſkirmiſhing along the whole of the French line from below Porto Legnago upwards, to La Corona near the lake Garda. He continued for ſome days to alarm the French at all points, and thus to conceal the plan of his future efforts. On the 10th Bonaparte was ſtill at Bologna, on the other ſide of Mantua, taking precautions againſt the eſcape of Wurmſer by that quarter, which, from an intercepted letter, he had learned was in contemplation. Being now informed of the approach of the Auſtrian army, he haſtened to Mantua, and from thence to Verona, which was the centre of the line of his army that oppoſed Alvinzi. He arrived at Verona on the morning of the 12th; but as the Auſtrians continued to make their attacks upon all quarters at once, he was unable to penetrate the deſign of their leader. At laſt, on the 13th, the efforts of the Auſtrians began to aſſume a more formidable aſpect on the lower part of his line near Porto Legnago; but on the evening of the ſame day he received intelligence, that the upper extremity of his line, where Joubert commanded, had been attacked by ſuch an immenſe ſuperiority of numbers, that there could be no doubt that the greateſt number of the Imperial troops was concentrated there. The poſt of La Corona had even been forced, and Joubert compelled to withdraw to Rivoli, which he alſo abandoned.

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288 Succeſſes of the Auſtrians.

289 They divide their army;

The Auſtrians ſtill perſiſted in their unfortunate plan of dividing their army, that they might have two chances of ſucceſs. Ten thouſand choſen troops, among whom were the Vienna volunteers, were deſtined under General Provera to penetrate to Mantua by Porto Legnago, at the lower extremity of the French line; while Alvinzi in perſon advanced with the maſs of the army againſt Joubert at its other extremity. On the 13th all went well; Joubert was compelled to retreat; and he was ſo ſituated, that the eaſy capture of his whole diviſion on the following day appeared a very probable event.

Bonaparte, in the mean time, having learned the ſtate of affairs, left Verona in the evening of the 13th, having firſt ordered the whole centre of his army under Maſſena to follow him to the neighbourhood of Rivoli with all poſſible ſpeed. Here he ſpent the night with his officers in arranging the order of battle for next day, and in occupying proper poſitions. At day-break of the 14th the attack was begun by Joubert's diviſion, to the no ſmall ſurpriſe of the Imperialiſts, who were not aware of the arrival of Bonaparte with reinforcements. The battle, however, was long and obſtinate. The ſuperiority of numbers on the ſide of the Auſtrians enabled them to defeat all the efforts of the French to turn

turn their diviſions. They at laſt ſucceeded in driving back upon the centre the two wings of the French army in conſiderable diſorder. Alvinzi now attacked the centre, which ſcarcely maintained its poſition; and the Auſtrian wings advancing on both ſides, completely ſurrounded the French army. The victory ſeemed already won; and it is ſaid that Alvinzi diſpatched a courier to Vienna to announce the approaching capture of Bonaparte and his army. Bonaparte indeed conſidered his own ſituation as very alarming; and is ſaid to have meditated his eſcape acroſs the Auſtrian right wing. From the nature of his order of battle, his troops had rather been concentrated than ſcattered by the repulſe they had received, and it was therefore ſtill in his power to make a deſperate effort. Having formed three ſtrong columns, he ſent them againſt the Auſtrian right wing. They ſucceeded in penetrating it at different points; and it fled in ſuch confuſion, that having encountered a party of French that had not arrived in time to join the body of the army, 4000 Auſtrians laid down their arms in a panic, and ſurrendered themſelves priſoners of war.

290
And are defeated.

Night put an end to any farther conteſt; but Bonaparte conſidering this quarter of his line as no longer in danger, departed to oppoſe General Provera, leaving Joubert to proſecute the victory now gained. This ſervice he performed with great ſucceſs. A detachment under General Murat having marched all the night of the 14th after the battle, forced Montebaldo in the rear of the poſition at Corona, to which a conſiderable diviſion of the Auſtrians had retreated, while Joubert, next morning, attacked them in front. Finding themſelves ſurrounded, they ſoon fell into confuſion. Six thouſand men were made priſoners, many were drowned in attempting to croſs the Adige, and the remainder fled to Tyrol.

During this ſanguinary conteſt on the upper part of the Adige, General Provera had forced his paſſage acroſs the lower part of that river at Angiara near Porto Legnago, and compelled the French General Guieux to retire to Ronco. Angereau collected all the troops in the neighbourhood, and marched to attack Provera; but as he haſtened towards Mantua, Angereau could only come up with his rear; of which, after an engagement, he took 2000 priſoners. On the 15th, however, General Provera arrived in the vicinity of Mantua. The city, which ſtands in a lake, was blockaded at the two points, by which it has acceſs to the main-land called *St George* and *La Favorite*. Alvinzi was to have formed his junction with Provera at the poſt of St George. Receiving no intelligence of him, General Provera ſummoned the French commander here to ſurrender; and on his refuſal, endeavoured to carry the poſition by aſſault.

291
Mantua ſurrenders.

Having failed in this attempt, he turned his attention towards the poſt of La Favorite, which he attacked on the morning of the 16th; while Wurmſer, who had perceived his arrival, advanced with the troops of the garriſon againſt the ſame point. But by this time Bonaparte had arrived with reinforcements. General Wurmſer was repulſed (B); and Provera being completely ſurrounded by the French, was under the neceſſity of ſurrendering himſelf with his troops priſoners of war. The reſult of all theſe battles at Rivoli and Mantua was the capture of 23,000 priſoners and 60 pieces of cannon; and thus four Imperial armies had periſhed in Italy in the attempt to preſerve Mantua. The capture of this city, however, was now inevitable, in conſequence of famine. It ſurrendered by capitulation on the 2d of February. Bonaparte on this occaſion endeavoured to acquire the reputation of humanity. To allow the French emigrants in the garriſon to eſcape, he conſented to an article in the capitulation that General Wurmſer ſhould be allowed to ſelect and carry out of the garriſon 700 men, who were not to be examined nor conſidered as priſoners; and the General himſelf was allowed to depart unconditionally.

292
The Pop perſever in hoſtilities;

In the meanwhile, the Pope, who of all the European princes had the beſt reaſon for diſliking the French cauſe, uncautiouſly perſevered in hoſtility, in the hope that ſome one of the Imperial armies might ſucceed in driving Bonaparte from Italy. Having recovered from the panic which induced him to ſolicit an armiſtice when the French firſt entered Lombardy, he had avoided concluding a treaty of peace, and attempted to enter into a cloſe alliance with the court of Vienna. He procured officers to be ſent from thence to take the command of his troops, and flattered himſelf with the vain hope of being able to make an important diverſion in favour of the imperial troops.

As the Emperor and the French were both preparing with all poſſible ſpeed to renew their bloody conteſt on the frontiers of Germany, it was of importance to Bonaparte to leave all Italy in peace on his rear. On the 1ſt of February he ſent a diviſion of his troops under General Victor, along with what was called the *Lombard Legion*, conſiſting of Italians, to enter the territory of the Pope; and upon the ſurrender of Mantua Bonaparte followed in perſon. The troops of his Holineſs made feeble reſiſtance. The new raiſed Lombard legion was made to try its valour againſt them on the river Senis on the 2d. After ſtorming their entrenchments, it took their cannon and 1000 of themſelves priſoners.

293
But is co quered.

Urbino, Ancona, and Loretto, ſucceſſively fell an eaſy prey to the French. From the chapel at Loretto the papal General Colli had carried moſt of the treaſure; but the French ſtill found gold and ſilver articles worth 1,000,000 of livres, and the image of the virgin was conveyed as a curioſity to Paris. Bonaparte now proceeded through Macerata to Tolentino. He was

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(B) Marſhal Wurmſer had before this time begun to ſuſpect that his plans were betrayed to the enemy. When he reſolved to make his laſt ſally to co-operate with Alvinzi, he kept his plan to himſelf; and in the morning of that day on which the army was to march out, he gave to each of the generals commanding the diviſions (which we think were ſeven) his orders in a ſealed packet. The troops marched at the hour fixed on, in ſo many diviſions; and they were inſtantly attacked at all points by the enemy. Upon this, the old General ſaid to a Britiſh officer of high rank, who was with him in the fortreſs, We are betrayed, make your eſcape by any means that you can. This anecdote was communicated to us through a channel which leaves no doubt of its truth in our own minds; but not being authoriſed to give the *names* of our informers, we thought it not right to inſert it in the text. Its truth or falſehood may be eaſily aſcertained.

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was here met by a meſſenger from the Pope with offers of peace, and concluded a treaty with his Holineſs on the 19th. By this treaty the conditions of the armiſtice were confirmed; and in addition to the payments then ſtipulated; the Pope promiſed to pay 15,000,000 of livres, and to deliver 800 cavalry horſes, with as many draught horſes and oxen. He alſo engaged to pay 300,000 livres to the family of the French envoy Baſſeville, who had been murdered at Rome, and to apologiſe by his miniſter at Paris for that event.

94
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orced.

The French had been ſo unſucceſsful in their late irruption into Germany, through Swabia and Franconia, that they now reſolved to make their principal effort from Italy under Bonaparte. For this purpoſe, the Directory detached great bodies of the veteran troops that had fought under Moreau as ſecretly as poſſible through Savoy into Italy. The court of Vienna, however, was aware of the approaching danger, and gave the command on the ſide of Italy to the Archduke Charles, who of all their military leaders had alone of late been ſucceſsful againſt the French. He brought along with him his beſt troops from the Rhine, and numerous levies were endeavoured to be made in all the hereditary ſtates for his farther ſupport. The war was now about to be carried into new territories, on which the houſe of Auſtria had ſcarcely hitherto beheld a foe. It was neceſſary that Bonaparte ſhould once more attempt to ſcale the ſummit of the Alps. This immenſe chain of mountains, which takes its riſe in the vicinity of Toulon, at firſt ſtretches northward under the names of *Piedmont* and *Savoy*. It then runs towards the eaſt, forming the countries of Switzerland, Tyrol, Carinthia, and Carniola. The three laſt of theſe, paſſing along the head of the Adriatic, form the frontier in this quarter of the hereditary ſtates of Auſtria. Between the mountains and the ſea lies the level and fertile tract of territory which belonged to Venice. It is croſſed by many large ſtreams, which are fed by the melting ſnows of the Alps, and whoſe nature is this, that they are greateſt in ſummer, and that their waters diminiſh during the froſts of winter.

95
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The council of war at Vienna now committed an important error in the plan of defence which it adopted. Inſtead of making a ſtand in the defiles of the mountains, the Archduke was ſent down into the plain to defend the paſſages of the rivers. War is eſſentially an offenſive art. Whatever the general purpoſe of hoſtility may be, it is always conducted with moſt ſucceſs when the detail of its operations is ſo managed as to aſſume the form of enterpriſe and of vigorous attack. This ariſes not from any thing in the nature of the art of war, but from the immutable conſtitution of the human character. The ſtrength of men who are fixed without motion in a particular ſpot, is ſubdued by the depreſſing paſſion of fear, and by the deſpair of accompliſhing any important object; whereas, when urged to action and to enterpriſe, their energy is increaſed by hope, and by that preſumption of their own ſuperiority which all men readily entertain. Hence we have ſo few inſtances in hiſtory of nations ſucceſsfully defended by rivers or extenſive fortified lines; whereas mountainous countries have uſually ſet bounds to the progreſs of armies. In ſuch ſituations, the defending party can always act upon the offenſive. He finds his adverſaries divided, by their ſituation, into ſmall parties. He hopes to vanquiſh them in detail, and he acquires ſtrength and courage from the proſpect of ſucceſs.

296
Progreſs of
the French
army.

While Bonaparte was advancing into the territory of the Pope, the Auſtrian army was arranging itſelf along the eaſtern bank of the Piava. The French were on the oppoſite bank, and Bonaparte haſtened to join them after he had concluded his treaty with the Pope. The beginning of March was ſpent in preparations; but at laſt the troops advanced, that the point of reſiſtance might be diſcovered. Having croſſed the Piava on the 12th of March, the Auſtrians retired, ſkirmiſhing for ſome days till they had croſſed the Tagliamento, where they made a ſtand with their whole force. Early on the 17th the French army arrived at Valvaſone, on the oppoſite bank; and after ſome heſitation, reſolved to force the paſſage of the river. To have accompliſhed this object very ſpeedily would have been difficult, had not a recent froſt diminiſhed the ſtream, by which means the French were enabled to croſs it in the face of the enemy in columns at various points. The army of Bonaparte was now in three diviſions. Joubert, with the left wing, advanced along the courſe of the Adige into Tyrol, and was ordered to croſs over from thence, and to deſcend along the valley of the river Drave, which is beyond the higheſt chain of what the Romans called the *Noric Alps*. Maſſena, with the centre, after croſſing the Tagliamento, advanced into the defiles of theſe mountains; while the right diviſion, which was attended by Bonaparte in perſon, proceeded along the coaſt of the Adriatic.

297
The Auſtrians defeated.

After forcing the paſſage of the Tagliamento on the 17th, the French had eaſily defeated the Auſtrians on the oppoſite bank, and compelled them everywhere to retreat. The other rivers were eaſily paſſed; and on the 19th, the town of Gradiſca, on the river Liſonzo, ſurrendered to the right wing of the army, and its garriſon amounting to 3000 men, were made priſoners of war. On the 21ſt Goritz was entered by the ſame diviſion, who found there the principal Auſtrian magazines and hoſpitals. Trieſte was entered on the 23d; and the French ſent off in waggons, from the quickſilver mines of Ydria, materials worth 2,000,000 of livres. In the mean time, the Auſtrians, in their haſty retreat, entangled themſelves and their baggage among the mountains. On the 24th, a large body of them was hemmed in between Maſſena, who had reached Tarvis, and a part of the French right wing under Guieux. Reinforcements, however, having found means to reach them from the Archduke's head quarters at Clagenfurt, they hazarded an engagement on the following day, but were defeated, with the loſs of 5000 taken priſoners, and 400 waggons loaded with baggage. The French left wing under Joubert, Baraguay D'Hilliers, and Delmas, was equally ſucceſsful. On the banks of the Lavis, after an obſtinate engagement, 4000 Auſtrians were taken; and thereafter at Clauzen they were again defeated, with the loſs of 1500 taken priſoners. Having entered Brixen, this diviſion turned eaſtward, and deſcended the valley of the Drave towards Clagenfurt, the capital of Carinthia, where it was met by General Maſſena; the Archduke, after a ſlight conteſt, having evacuated the place, and advanced farther towards the capital of the empire, which was now ſeriouſly menaced, and in which great conſternation prevailed. In 15 days Bonaparte had taken 20,000 priſoners,

French Revolution 1797.

298 Wonderful ſucceſs of Bonaparte.

priſoners, and croſſed the Alps; and though the country ſtill preſented ſome difficulties, there was no fortified place capable of reſiſting his progreſs towards Vienna. He did not, however, conſider his own ſituation as deſtitute of hazard, and ſeized the preſent moment of unbounded ſucceſs to make propoſals of peace. On the 31ſt of March he ſent a letter to the Archduke, in which he deprecated the uſeleſs prolongation of the war, and intreated him to interpoſe his good offices to put a ſtop to its farther ravages. But this prince, who ſeems to have doubted his own influence at the court of Vienna, returned a cold anſwer, ſtating, that it belonged not to him to inveſtigate the principles on which the war was carried on, and that he had no powers to negociate.

299 Partial ſucceſſes of the Auſtrians.

The Auſtrian chiefs made a laſt effort, by raiſing the peaſants of the Tyrol in a maſs to embarraſs the rear of the French. They accordingly gained ſome ſucceſſes under General Laudohn, and drove out the French troops that had been left at Botzen and Brixen. The inhabitants of the Venetian ſtates alſo roſe againſt the troops that remained in their country; and being joined by ten regiments of Sclavonians, which had been in the pay of the government of Venice, they put the French to death wherever they were found, without excepting the ſick in the hoſpitals, of whom 500 were maſſacred at Verona. A party of Imperialiſts alſo drove the French garriſon out of Trieſte, and thus attempted to ſurround the invading army. Bonaparte, however, knew that the court of Vienna muſt be at leaſt as much embarraſſed as himſelf. His army amounted to 95,000 men. It had hitherto proved irreſiſtible; and the Auſtrians knew, that to ſurround was not to conquer it. He therefore perſiſted in advancing. On the 2d of April he ſucceeded in forcing the ſtrong defiles between Freiſach and Newmark, after a bloody battle, in which he took 600 priſoners. On the 4th, his advanced guard reached Huntmark, where the Auſtrians were again defeated; and his army occupied Kintenfeld, Murau, and Judenbourg. Theſe advantages compelled the Auſtrian cabinet to treat for peace, as there was no longer any point at which the Archduke's army could hope to make a ſtand till it came to the mountains in the vicinity of Vienna. Meaſures were taken for removing the public treaſure and effects into Hungary, while Generals Bellegarde and Morveld were ſent to requeſt from Bonaparte a ſuſpenſion of hoſtilities. On being ſuffered to take poſſeſſion of Gratz and Leoben, within little more than 50 miles of Vienna, he conſented, on the 7th of April, to an armiſtice, which was only to endure till the night of the 13th, but was afterwards renewed for a longer period. It was followed on the 19th by a preliminary treaty, ſigned at Leoben; by which it was agreed that the Auſtrian Netherlands ſhould belong to France, and that the new republic in Lombardy ſhould continue under the name of the *Ciſalpine Republic*, and ſhould include the Milaneſe, the duchy of Mantua, and the territories of Modena, Ferrara, and Bologna. There is reaſon to ſuſpect that ſomething hoſtile to the independence of Venice was here alſo ſtipulated. Bonaparte agreed to withdraw without delay into Italy, on receiving ſubſiſtence for his army during its march; and it was reſolved, that all farther diſputes ſhould be afterwards ſettled by a definitive treaty of peace. On his return he accuſed the Venetian government of connivance at the inſurrection which had taken place againſt the French in his abſence; and having ſeized their city and whole territory, he diſſolved that ancient and ſingular, but now feeble, ariſtocracy.

300 The Auſtrian cabinet treats for peace.

301 Unjuſt and cruel conduct of Bonaparte.

Fren Revolu 1797

While Bonaparte was advancing towards Vienna, the French armies on the Rhine had begun to preſs upon the Auſtrians, to prevent farther reinforcements from being ſent againſt him from that quarter. The Auſtrians offered an armiſtice; but as the French demanded the fortreſs of Ehrenbreitſtein as the price of it, both parties prepared for action. The left wing of the army of General Hoche advanced rapidly from Duſſeldorf, while the centre and right wing croſſed the Rhine near Coblentz. The Auſtrians under General Wernecht retreated to the Lahn, where they waited the arrival of the French. Here a violent conteſt enſued on the 18th of April, in which 4000 Auſtrians were taken priſoners. The French took poſſeſſion of Wetzlar, and drove their antagoniſts to the gates of Francfort. In the mean time, General Moreau, on the Upper Rhine, forced the paſſage of the river near Straſburg, and attacked the village of Dierſheim, of which he at laſt retained poſſeſſion, after having been more than once driven out, and the village nearly deſtroyed. The following day, however, the Auſtrians renewed the attack, and forced the French for ſome time to give way; but powerful reinforcements having croſſed the river, the French were at laſt enabled to renew the battle with ſuch vigour, that they took Fort Kehl, together with 5000 priſoners. The imperialiſts in this quarter were now purſued towards the Danube; when all military operations were ſuddenly arreſted by meſſengers ſent through Germany by the Archduke Charles and Bonaparte, announcing that peace was concluded. Theſe meſſengers found the army of Hoche violently attacking Francfort on the Maine, which General Wernecht was endeavouring to defend. The news was diffuſed in an inſtant through both armies; and the contending troops, throwing aſide their weapons, congratulated each other upon the event.

30 Succeſſ the Fre on the Rhine.

30 Peace cluded.

30 Power France this pe

France now held a very elevated rank, and a formidable character, among the nations of Europe. Spain, Italy, and Holland, were held in dependence; while her victorious armies had compelled the laſt continental member of the coalition to accept of peace from an army that approached his capital. Had the Auſtrian officers been faithful, and the court of Vienna leſs ſelfiſh, ſubſequent events have indeed ſhewn that the affairs of the Emperor were not yet deſperate, and that Bonaparte was not that invincible hero which his rapid ſucceſſes gave ſome reaſon to ſuppoſe him. After the peruſal of his letters from Egypt, his victories loſe much of their brilliancy; nor does any action, or all the actions of his life, diſplay ſuch military ſkill, as the retreat of Moreau through Swabia, when preſſed on the rear by a victorious army, and ſurrounded on all hands by an incenſed populace. But Bonaparte had been ſucceſsful; the Archduke knew not whom to truſt: there is reaſon to believe that his plans were continually thwarted by a corrupt council at home; and the court of Vienna was bribed to make a peace. Of all the enemies of the French revolution, Britain alone remained in hoſtility. From her command of the ocean ſhe was enabled indeed to retain the feeble ſtate of Portugal,

30 Britain contin the wa

tugal, attached to her cauſe; but on land, ſuch was the terrible energy of France, that, with this exception, which ſeemed only to exiſt by tolerance, the Britiſh trading veſſels were excluded, by her influence, from all approach to the continent, from the Elbe to the Adriatic; and the Britiſh government was once more induced, in theſe circumſtances, to try the effect of a new negociation. All theſe external advantages, however, were ſpeedily loſt by the French nation; and it ſeemed the unhappy deſtiny of this people to be conſtantly deprived of the fruits of all their ſufferings, and their courage, by the turbulence of their domeſtic factions, and the profligacy and unprincipled conduct of their rulers.

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A ſerious conteſt between the executive power and the legiſlature was now approaching. We already remarked, that the Directory was originally ſelected by thoſe men who had been the aſſociates of Robeſpierre; and though deſerted of late by ſome of the more violent ſpirits, who were termed *Anarchiſts*, it was ſtill conſidered as the head of the Mountain party. By the victory obtained over the ſections of Paris on the 5th of October, all oppoſition had been ſet at defiance for a time; but the nation at large had never been reconciled to theſe men. The period now arrived when a third of the legiſlative body was to be changed. On the 19th of May, Letourneur went out of the Directory by lot. On the 20th, the new third took their ſeats in the Councils, a third of their predeceſſors having evacuated their ſeats by lot; and on the following day, Barthelemi, the ambaſſador to Switzerland, was choſen to ſucceed Letourneur in the Directory. The election of the members of the new third had almoſt entirely fallen upon men who were underſtood to be hoſtile to the directory. Many Generals out of employment were choſen; ſuch as Pichegru, Jourdan, and Willot, and many repreſentatives of the families of the ancient nobility who had not emigrated (among whom was the prince of Conti) were now elected into the legiſlature. The moderate or oppoſition party in the two Councils now poſſeſſed a complete majority. Carnot and Barthelemi were underſtood to be favourable to them in the Directory; the former having made his peace with them, and the latter being eſtabliſhed by themſelves. The effect of this change in the ſtate of the Councils ſpeedily appeared in their adopting every meaſure that could embarraſs the Directory, or caſt odium upon the Mountain party, and alter the ſtate of things which it had eſtabliſhed.

On the 14th of June, Gilbert Deſmolieres brought forward a report from a committee upon the ſtate of the finances; in which he exhibited and reprobated in the ſtrongeſt terms the prodigality of the Directory, and the profuſion and rapacity of its agents. On the 18th the ſame committee propoſed a new plan of finance, the object of which was to deprive the Directory of any ſhare in the adminiſtration of the public money. In the mean time, on the 17th of the ſame month, Camille Jourdan had preſented a long report on the ſubject of religion; in which he endeavoured to demonſtrate the impropriety of prohibiting the public diſplay of its ceremonies, and the injuſtice of the perſecution which its miniſters had undergone for refuſing to take oaths preſcribed by the legiſlature. This report was afterwards, on the 15th of July, followed up in the Council of Five Hundred, by a decree repealing all the laws againſt refractory prieſts, or which aſſimilated them to emigrants. On the following day, another decree, requiring from them a declaration of fidelity to the conſtitution, could only be carried by a majority of 210 againſt 204.

307 Mild meaſure of the Councils.

A propoſal was now brought forward in the Council of Five Hundred by Emery, a new member, to repeal the laws which confiſcated the property of emigrants, and to allow their relations to ſucceed to them as if they had died at the period of their emigration. Thoſe who had fled into foreign countries from Toulon and other places, during the reign of terror, were alſo encouraged to return, and allowed to expect that their names would be erazed from the liſt of emigrants. The conduct of the Directory towards foreign powers was attacked on different occaſions; and Dumoullard propoſed the appointment of a committee to enquire into the external relations of the republic. This was a delicate ſubject; as it involved the character of the armies and their leaders, and as it might ſubvert the intereſts of the Directory with ſome of their friends of the Mountain party. The Venetian republic, though a neutral ſtate, had been overturned by Bonaparte on account of a popular inſurrection, for which the government apologiſed. Little account had been given of the immenſe ſums of money that had been levied in Italy. The armies in the preceding year had entered Germany in the character of plunderers; which had diſguſted all thoſe in that country who had once been friendly to their cauſe, and longed for their arrival. The Directory, at the ſame time, inſtead of encouraging the progreſs of revolution, which the Jacobins eagerly deſired, had ſuddenly made peace with the German princes, upon receiving pecuniary contributions, which were left to be exacted according to the ancient laws of the different ſtates (which exempt the nobles and the clergy), and thus fell heavieſt upon thoſe very perſons who had cheriſhed the new republican principles.

The diſcuſſion of theſe ſubjects brought the majority of the Directory and of the Councils into a ſtate of complete hoſtility. Both parties reſolved to violate the conſtitution, under the pretence of preſerving it. The one wiſhed to change the Directory before the time preſcribed by law, and the other to deprive of their ſeats a great number of the new legiſlators elected by the people. Barras was the moſt obnoxious of the directors; and an attempt was made to deprive him of his office, upon the footing that he was leſs than 40 years of age. But his colleagues aſſerted that he was born in the year 1755; and as no proof to the contrary could be brought, this abortive attempt ſerved only ſtill farther to irritate the contending parties, and they began to prepare for more effectual meaſures. Had not force been ſpeedily uſed on the ſide of the Directory, the Councils muſt naturally have prevailed.

308 Their popularity.

The majority of the people confided in them. The national purſe was in their hands; and they hoped to ſubdue the Directory, as the conſtituent aſſembly had done the king, by avoiding to vote the neceſſary ſupplies. They could enact what laws they pleaſed. They had not indeed the command of the armies; but to remedy their weakneſs in this reſpect, General Pichegru, on the 20th of July, preſented a plan for reorganiſing the national guard, and placing it more at the diſpoſal

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of the Councils, by depriving the Directory of the nomination of the officers.

In the mean time the Directory was by no means deſtitute of adherents. The reſolutions of the Councils in favour of the prieſts, and the relations of emigrants, looked ſo like a deſertion of former maxims, that many perſons expected an immediate counter-revolution. The royaliſts gained courage, and a multitude of journals or newſpapers, favourable to their cauſe, began to be publiſhed. Emigrants obtained paſſports, and haſtened to Paris in the hope of being ſtruck off the liſt, upon alleging that they fled to avoid proſcription during the power of the Jacobins. The effect of all this was, that the purchaſers of national property, and thoſe who had become rich by the revolution, were alarmed. The whole Mountain party, and all thoſe who had been active in oppoſition to royalty, rallied round the Directory. The armies, whoſe chiefs found themſelves involved in ſome of the accuſations brought againſt that body, ſent addreſſes, in which they declared their reſolution to ſupport its power. The Councils declared theſe addreſſes, which the Directory had received from armed bodies, unconſtitutional, and procured counter addreſſes from different departments. At laſt the partizans of the two contending powers began to diſtinguiſh themſelves in Paris by their dreſs, and every thing preſaged an approaching appeal to force. On the 20th of July the Councils received intelligence that a diviſion of the army of General Hoche had advanced within a few leagues of Paris; whereas, by the conſtitution, the Directory incurred the penalty of ten years impriſonment if it authoriſed troops to approach nearer to the reſidence of the legiſlative body than twelve leagues, without its own conſent. An explanation of this event was immediately demanded. The Directory denied that they had ordered the march, and aſcribed it to a miſtake of the officer by whom it was conducted. Their explanation was treated with contempt, and much angry debate took place in the Councils concerning it; the Directory all the while conducting themſelves with much ſeeming moderation, and even ſubmiſſiveneſs. In the mean time their antagoniſts acted a very undecided part.

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The Directory victorious.

They long hoped to gain Lareveillere Lepaux to their ſide; in which caſe they would have had a majority in the Directory. This vain expectation rendered their conduct indeciſive. At length the majority of the Directory procured an addreſs of adherence from the ſuburb St Antoine, which in all the tempeſtuous days of the revolution had been the rallying point of the Mountain party. Encouraged by this addreſs they proceeded to immediate action. General Angereau had been ſent from Italy under pretence of preſenting ſome Auſtrian ſtandards to the Directory, and he was employed as their tool upon this occaſion. They commanded the garriſon of Paris, and they had managed to bring over to their party the ſoldiers compoſing the guard of the two councils. Before day-break on the morning of the 4th, Angerean ſurrounded the Thuilleries with a diviſion of the troops. The guard of the Councils refuſed to reſiſt, and their commander, Ramel, was taken priſoner. Having entered the hall, he found Pichegru and other twelve of the chiefs of the oppoſite party ſitting in conſultation, and immediately ſent them priſoners to the Temple. Some other obnoxious members of the Councils were alſo put under arreſt. The director Carnot had made his eſcape on the preceding evening, but Barthelemi remained, and was impriſoned.

All this was accompliſhed without noiſe, and in an inſtant. Many members of the Councils, when they came to the hall at the uſual hour, were ſurpriſed to find that ſeals were put upon the doors, and that they could not obtain admittance. They were invited, however, to go to the Surgeons Hall and the theatre of the Odeon, where they were told the Directory had appointed the Councils to aſſemble. At theſe places, about forty of the Council of Ancients, and double that number of the other Council, aſſembled about noon, and ſent to demand from the Directory an account of the proceedings of the morning. They received an anſwer, declaring, that what had been done was neceſſary to the ſalvation of the Republic, and congratulating the Councils *on their eſcape* from the machinations of royaliſts.

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Being ſtill at a loſs how to act, the Council of Five Hundred appointed a committee of four members (of whom Sieyes was one) to report upon the meaſures to be adopted. On the following day Boullay de la Meurth preſented a report from this committee, in which he announced, that a vaſt royaliſt conſpiracy, whoſe centre was in the boſom of the Councils, had been formed to overturn the conſtitution, but that it had been baffled by the wiſdom and activity of the Directory. The report concluded, by propoſing the immediate tranſportation of the conſpirators without a trial. Accordingly, theſe degraded repreſentative bodies proceeded, after ſome debate, on hearing the names of the accuſed perſons read over, to vote the tranſportation to Guiana in South America, of fifty-three of their own members, and twelve other perſons, among whom were the directors Carnot and Barthelemi. They annulled the elections in forty-nine departments, repealed the laws lately enacted in favour of the diſaffected clergy and the relations of emigrants; and even ſo far aboliſhed the liberty of the preſs, as to put all periodical publications under the inſpection of the police for one year. New taxes were voted without heſitation, Francis de Neufchateau and Merlin were elected to fill the vacancies in the Directory, and affairs were endeavoured to be conducted in their ordinary train.

All this while the city of Paris remained tranquil. That turbulent capital, which had made ſo many ſanguinary efforts in favour of what it accounted the cauſe of freedom, had been ſo completely ſubdued ſince its unfortunate ſtruggle on the 5th of October, that it now permitted the national repreſentation to be violated, and the moſt obvious rules of practical liberty to be infringed, without an effort in their defence.

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The Directory, in the mean time, attempted to juſtify their conduct to the nation at large, by publiſhing various documents intended to prove the exiſtence of a royaliſt conſpiracy. The moſt remarkable of theſe was a paper, ſaid to be written by M. d'Antraigues, and found by Bonaparte at Venice; in which a detail was given of a correſpondence between General Pichegru and the Prince of Condé in the year 1795. The correſpondence itſelf was alſo, at the ſame time, ſaid to be found by General Moreau among papers taken by him at the late paſſage of the Rhine. It ſtated, that Pichegru had offered to the Prince of Condé to croſs the Rhine with his army, and having joined the Auſtrians under General Wurmſer, and the emigrants under

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der the Prince of Condé, to return with the united armies and march to Paris, where they were to re-eſtabliſh royalty. The Prince is ſaid to have refuſed to accept of the offer, from jealouſy of the participation of the Auſtrians in the honour of the tranſaction. He therefore inſiſted that it ſhould be conducted without their aid; but Pichegru thought the attempt too hazardous in this form, and, being ſoon after removed from his command, the project failed. At the time of its publication, the genuineneſs of this correſpondence, and alſo of the paper found by Bonaparte, was denied; and nothing has appeared ſince to induce an unprejudiced man to think otherwiſe at preſent. Moreau, who was certainly involved in this conſpiracy, if real, has been intruſted ſince that period with the command of the armies of the republic; and though defeated by Marſhal Suwarrow, he is ſo far from being now conſidered as a royaliſt, that the revolutionary government ſeems inclined to intruſt to his military ſkill and fidelity its laſt efforts for the continuance of its exiſtence.

From the violation of the repreſentative government that has been now ſtated, it became obvious to ſurrounding nations, that France had paſſed under the dominion of a ſmall faction at variance with the majority of the people. The directory was all powerful. Its members, however, ſeem very ſoon to have become giddy by the elevated nature of their ſituation, and to have adopted a notion that there was no project of ambition or rapacity in which they might not venture to engage. During their conteſt with the Councils, they had protracted the negociations with Lord Malmeſbury at Liſle, and had ſuffered thoſe to relax which had been entered into between Bonaparte and the Imperial ambaſſadors at Campo Formio near Udine. Great Britain had offered to conſent to peace, on condition of being allowed to retain the Dutch ſettlement of the Cape of Good Hope, and the Spaniſh iſland of Trinidad, which had been taken in the month of February this year. The Directory now recalled their former negociators Letourneur and Maret, and ſent two others, Treilhard and Bonnier, in their ſtead; who immediately demanded whether Lord Malmeſbury had full power to reſtore all the ſettlements taken from France and her allies during the war? Upon his Lordſhip's declining to anſwer ſuch a queſtion, becauſe it implied an enquiry, not into his powers, which were in the uſual form, but into his inſtructions, which would preclude all negociation, he was required to return home to procure more ample powers. The negociations with the Emperor, however, were now ſpeedily brought to a concluſion. On the 17th of October, a definitive treaty was ſigned at Campo Formio. By it the Emperor gave up the Netherlands to France, the Milaneſe to the Ciſalpine republic, and his territories in the Briſgaw to the Duke of Modena, as an indemnification for the loſs of his duchy in Italy. The Emperor alſo conſented that the French ſhould poſſeſs the Venetian iſlands in the Levant of Corſu, Zante, Cephalonia, Santa Maura, Cerigo, and others. On the other hand, the French Republic conſented that the Emperor ſhould poſſeſs in full ſovereignty the city of Venice, and its whole other territory, from the extremity of Dalmatia round the Adriatic as far as the Adige and the lake Garda. The Ciſalpine Republic was to poſſeſs the remaining territory of Venice in this quarter, along with the city and duchy of Mantua, and the eccleſiaſtical ſtates of Ferrara and Bologna.

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Upon whatever principles the war might have hitherto been conducted, the terms of this treaty ſufficiently demonſtrated to all Europe, that its leſſer ſtates had no better reaſon to expect ſecurity from the houſe of Auſtria than from that of the new republic. This truth would have been ſtill more evident, had the articles of a convention, which was ſigned by theſe parties at the ſame period at Campo Formio, been publiſhed to the world. Fearing, however, to alarm too much the Germanic body, theſe articles were kept ſecret, and the parties agreed to prevail with the German princes, at a congreſs to be opened at Raſtadt, to conſent, in conſequence of an apparently fair negociation, to what France and Auſtria had determined ſhould take place. By the ſecret convention or treaty now alluded to, it was ſtipulated, that the Rhine, including the fortreſs of Mentz, ſhould be the boundary of the French Republic; that the princes, whoſe territories were alienated by this agreement, ſhould be indemnified by the ſecularization of church lands in Germany; that the Stadtholder of Holland ſhould be indemnified for the loſs of his eſtates in that country, by receiving German territory; that the Emperor ſhould receive the Archbiſhopric of Saltzburg, and the part of the circle of Bavaria ſituated between that archbiſhopric, the rivers Inn and Salzt, and the Tyrol; that the Imperial troops ſhould immediately withdraw to the confines of the hereditary ſtates beyond Ulm; and if the Germanic body ſhould refuſe peace on the above terms, it was ſtipulated, that the Emperor ſhould ſupply to it no more troops than his contingent as a co-eſtate amounted to, and that even theſe ſhould not be employed in any fortified place.

Theſe treaties were immediately begun to be put in execution. The Auſtrians left the Rhine, which enabled the French to ſurround the fortreſſes of Mentz and Ehrenbreitſtein. Of the former, they ſpeedily obtained poſſeſſion; but the latter coſt them a very tedious blockade, before the garriſon, conſiſting of troops of the Palatinate, would agree to ſurrender. The Imperial troops, at the ſame time, entered Venice; the French having evacuated that city after carrying off or deſtroying its whole navy. The Ciſalpine Republic was eſtabliſhed, and Bonaparte left Italy; leaving, however, an army of 25,000 men to garriſon Mantua, Breſcia, Milan, and other places, and to retain this new republic in dependence upon France. Genoa was, at the ſame time, brought under a ſimilar dependence by means of popular commotions, inſtigated by the French, and a revolution in its government which took place at this period. And thus the French Directory, without the excuſe of hoſtility, as in the caſes of Holland and Spain, began a ſyſtem of interference in the affairs of weaker neighbouring ſtates, which was ſpeedily carried to an height that once more alarmed all Europe. Theſe men even attempted, at this time, to compel the ſtates of North America to purchaſe with money their forbearance from war. This was done through a circuitous channel, and in the form of an intrigue, by private perſons, who were inſtructed to inform the American miniſters at Paris, that a large loan on the part of America would be the beſt means of ſecuring peace; and it was hinted, that it would be rendered more acceptable

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of the Directory.

if accompanied with a private preſent of L. 50,000 ſterling to the members of the Directory. This laſt propoſal was indeed denied by the French miniſter Tallyrand, who had given his countenance to this crooked negociation: but the general impreſſion produced by the tranſaction could not be removed; and its effect was to injure very deeply the character of the French government in the opinion of thoſe diſtant nations that were otherwiſe diſpoſed to regard it in the moſt favourable light. Nor was its reſpectability increaſed by a law which the two Councils, at the deſire of the Directory, thought fit to enact, declaring the ſhips of all neutral ſtates bound for Britain, or returning from thence, liable to capture. This law was not leſs impolitic than unjuſt. It placed the whole carrying trade of the weſtern world in the hands of the Britiſh, and thus enriched the very people whom it was intended to injure.

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Invaſion of Wales.

For at this period Britain had acquired over the ocean a degree of uncontrouled dominion that was altogether unexampled in former times. During the whole year the French fleet lay blockaded in its own ports, and no enterpriſe was attempted by ſea, excepting in one ſolitary but ſingular inſtance. We have already mentioned that a number of galley ſlaves were ſent as ſoldiers with Hoche in his attempt upon Ireland. On the failure of that expedition, the Directory were at a loſs how to diſpoſe of theſe men. They could not now with propriety be ſent back to puniſhment, the troops would not ſerve along with them in the army; and as the new laws of France allow no remiſſion of crimes, they could not receive a pardon, nor was it ſafe to let looſe upon the country 1400 criminals. In this dilemma, the Directory reſolved to throw them into England. Accordingly, they were ſent in two frigates and ſome ſmall veſſels to the coaſt of Wales, and there landed with muſkets and ammunition, but without artillery. In the evening of the very day on which they landed, the 23d of February, they ſurrendered themſelves priſoners of war to a party of militia, yeomanry, cavalry, colliers and others, under the command of Lord Cawdor. The Directory boaſted that, by this enterpriſe, they had demonſtrated the poſſibility of landing troops on the Britiſh coaſt in ſpite of the vigilance of the navy; but this aſſertion was ill ſupported by the fate of the two frigates accompanying the expedition; both were captured in attempting to return to Breſt.

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Brilliant victory of Sir John Jervis over the Spaniſh fleet,

Though the French navy remained in port, and conſequently ſafe during the reſt of the year, their allies, the Spaniards and Dutch, ſuffered ſeverely. On the 14th of February, a Britiſh fleet of 15 ſail of the line, under the command of Sir John Jervis, engaged the Spaniſh fleet, amounting to 27 ſail of the line, off Cape St Vincent. In this action, the Spaniſh force, if it be eſtimated by the number of men, the number of guns, and the weight of metal, was more than double that of the Britiſh; but by the ſkilful manœuvres of its heroic commander, the Britiſh fleet twice croſſed through the line of the Spaniards, and ſucceeded in cutting off a part of their fleet from the reſt. Four ſhips of the line were taken, and the Spaniſh admiral's own ſhip eſcaped with difficulty. The fleet had been on its way to Breſt to join the French fleet there; but in conſequence of this action, it returned to Cadiz, where it was blockaded by the Britiſh.

For his gallant conduct in this engagement which, when every circumſtance is taken into conſideration, is perhaps unparalleled in the annals of naval war, Sir John Jervis was immediately created Earl St Vincent, and received the thanks of both houſes of the Britiſh Parliament

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The Dutch were ſtill more unfortunate. The Texel, within which their fleet lay, was blockaded during the whole ſummer by Admiral Duncan. The French intended, by means of the Dutch fleet, to make another attempt upon Ireland. Troops were accordingly embarked, under the command of General Daendels; but a reſolution having at laſt been adopted of hazarding an engagement with the Britiſh, the Dutch admiral De Winter, in oppoſition to his own remonſtrances, was ordered to put to ſea. The Britiſh admiral had by this time left his ſtation near the Texel, and gone to Yarmouth to refit. On receiving intelligence, however, that the Dutch had ſailed, he inſtantly proceeded in queſt of them. On the 11th of October the Britiſh fleet, amounting to 16 ſail of the line, and 3 frigates, came in ſight of the Dutch fleet, which in force was nearly equal, within about nine miles of Camperdown in Holland. Admiral Duncan immediately run his fleet through the Dutch line, and, though on a lee ſhore, began the engagement between them and their own coaſt. A moſt bloody and obſtinate conflict enſued, which laſted nearly three hours. By that time, it is ſaid that almoſt the whole Dutch fleet had ſtruck. The ſhips could not all be approached and ſeized, however, on account of the ſhallowneſs of the water upon the coaſt, to which the fleets were now very near. Eight ſhips of the line, with two of 56 guns, and one of 44, were taken, beſides a frigate, which was afterwards loſt near the Britiſh coaſt, and one of the ſhips of 56 guns foundered at ſea. Admiral de Winter was taken with his ſhip, and alſo the Vice-admiral Rentjies.

Similar honours were conferred upon Admiral Duncan as upon Sir John Jervis, and both admirals had each a penſion of L. 2000 *per annum* conferred upon him for life, with the full approbation, we may venture to ſay, of every well affected man in the kingdom.

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Decline public ſ rit in France.

The internal hiſtory of France now ceaſed to be very intereſting. Political freedom could not be ſaid to exiſt after ſo many of the repreſentatives choſen by the people had been driven from the legiſlature, and the departments reduced to the neceſſity of electing men more acceptable to their preſent rulers. Public ſpirit therefore rapidly declined. The high notions of the freedom and felicity it was about enjoy, which had once been ſo eagerly cheriſhed by a great part of the nation, now gave way to a growing indifference about political queſtions, and the future deſtiny of the republic; for the people at large found themſelves little intereſted in a government which exiſted independent of their will, which conſiſted of a narrow circle of perſons, and whoſe conduct was ſurely not leſs crooked, intriguing, and unprincipled, than that of the ancient royalty, and its attending court, from which they had eſcaped: whilſt its ferocious cruelty, and total diſregard even of the forms of juſtice, were infinitely greater. But though the Directory was all-powerful, yet its power was limited by the preſent ſtate of things, which denied it the poſſeſſion of an abundant revenue. It had not yet been found poſſible to re-eſtabliſh a ſyſtem of productive

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tive taxation The legiſlative councils, indeed, who now complied with every wiſh of the Directory, voted abundance of taxes: but theſe were ſcantily paid; partly on account of the total loſs of the national commerce, and partly becauſe the people were not diſpoſed to make great exertions in this way for the ſupport of government. By the conſtitution, they ſtill poſſeſſed the election of the judges and other magiſtrates; the country was filled with veteran ſoldiers, who at different times had returned from the armies after the lapſe of the uſual period of ſervice. The Directory, kept in awe by theſe circumſtances, turned its attention abroad, and found means to eſtabliſh an extenſive patronage, by dividing among its adherents the plunder of neighbouring ſtates, in whoſe welfare the people of France were little intereſted. The Girondiſt party had formerly propoſed to propagate their principles by eſtabliſhing a number of petty republics in the vicinity of France. The Directory now adopted the ſame project; that, under the pretence of diffuſing liberty, they might obtain new ſources of revenue and of power, by the dominion which they meant to exerciſe over theſe new governments. Holland and the Ciſalpine republic were already placed in dependence upon them; and Rome and Switzerland readily afforded them opportunities for extending their plan.

After the treaty with the Emperor had been concluded at Campo Formio, Joſeph Bonaparte, brother of the General had entered Rome as ambaſſador from the French Republic. The Pope, now deprived of all hope of foreign aid, and accuſtomed to humiliations, had ſubmitted to every demand made by him for reducing the number of his troops, and ſetting at liberty perſons impriſoned on account of political opinions. But an event ſoon occurred to afford the Directory a pretence for accompliſhing the ruin of this decayed government. On the 26th of December 1797, three perſons had waited upon the French ambaſſador, and ſolicited the protection of his government to a revolution which a party at Rome meant to accompliſh. He rejected their propoſals, and diſſuaded them from the attempt; but did not, as was certainly his duty, communicate theſe propoſals to the papal government, to which he was ſent on a friendly embaſſy. On the following day, however, a tumult took place, in which the French cockade was worn by about 100 inſurgents. They were ſpeedily diſperſed, but two of the Pope's dragoons were killed. The ambaſſador, who probably knew the diſpoſition of the Directory towards the Pope, ſeems to have reſolved that his own perſonal conduct ſhould be blameleſs on the occaſion. He therefore went on the 28th of December to the ſecretary of ſtate, and preſented a liſt of the perſons under his protection who were entitled to wear the French cockade, conſenting that all others adopting it ſhould be puniſhed. He alſo agreed to ſurrender ſix of the inſurgents who had taken refuge in his palace. Towards the evening of this day, however, the popular tumult became more ſerious, particularly in the courts and neighbourhood of the French miniſter's palace. The Pope appears to have been perſonally unacquainted with the ſtate of affairs; but the governor of the city ſent parties of cavalry and infantry to diſperſe the inſurgents. About twenty perſons, having a Frenchman at their head, had, in the mean time, ruſhed into the palace, and demanded aid towards accompliſhing a revolution. A number of French officers, and others who were with the ambaſſador, propoſed to drive the whole inſurgents by force from the juriſdiction of the palace. This was certainly a ſalutary advice, and ſuch as could not have been rejected by the ambaſſador, had not his deſigns been hoſtile to the eſtabliſhed government. Rejected, however, it was; for, pretending to believe that his authority would be ſufficient to accompliſh the object in a peaceable manner, he went out into the court to addreſs the multitude. He was prevented from doing ſo by a diſcharge of muſquetry from the military, who were firing within the juriſdiction of the palace. He interpoſed with his friends between the military and the inſurgents; and while a part of the French officers in his train drove back the inſurgents with their ſabres, the ambaſſador advanced towards the ſoldiers, and demanded why they preſumed to violate his juriſdiction? as if the juriſdiction of a foreign ambaſſador were a legal aſylum for men in open rebellion againſt the government of the ſtate. It is not, therefore, ſurpriſing, that no attention was paid to this arrogant and abſurd demand; and the nature of the ground being ſuch, that the troops could fire over his head upon the multitude in the rear, they made a ſecond diſcharge, which killed ſeveral of the inſurgents. Upon this the ambaſſador advanced cloſe upon the ſoldiers, to prevail with them to depart; but they remained in a menacing attitude, and prepared for another diſcharge. Eager to prevent this, the French General Duphot, who was with the ambaſſador, and was next day to have married his ſiſter, ruſhed into the ranks of the military, intreating them to deſiſt. Here a petty officer of the Pope's troops diſcharged his muſket into the body of Duphot. Upon this, the ambaſſador and his other friends found it neceſſary to make their eſcape through a bye-way into the palace. The Spaniſh miniſter hearing of this event, ſent to the ſecretary of ſtate to proteſt againſt this violation of the privileges of ambaſſadors. But the government equally alarmed and perplexed by the fear of a revolution, and of French vengeance, remained during many hours totally inactive. All this while the palace of the French ambaſſador remained cloſely beſet by the military, who occupied the whole of its juriſdiction, and all its courts and paſſages. He at laſt ſent to demand paſſports, to enable him to leave the territories of the Pope. They were granted; but with many proteſtations of the innocence of the government, and its regret on account of this unfortunate occurrence.

321
A French general killed.

Joſeph Bonaparte retired to Florence, and from thence to Paris. The Pope ſolicited the protection of the courts of Vienna, Naples, Tuſcany, and Spain; but they all ſtood aloof from his misfortunes: and this government, which had once poſſeſſed the moſt uncontrouled dominion over the minds of men, now fell without a ſtruggle. General Berthier, at the head of a body of French and Ciſalpine troops, encountered no oppoſition in his march to Rome, where he overturned the government of the Pope, and proclaimed the ſovereignty of the Roman people, with circumſtances of wanton inſult; which convey a ſtriking example of French humanity and French delicacy.

322
The papal government overturned.

"That the head of the church might be made to feel with more poignancy his humiliating ſituation, the day choſen for planting the tree of liberty on the Capitol was the anniverſary of his election to the ſovereignty. Whilſt he was, according to cuſtom, in the Siſtine chapel celebrating his acceſſion to the papal chair, and receiving the congratulations of the cardinals, Citizen Haller, the commiſſary general, and Cervoni, who then commanded the French troops within the city, gratified themſelves in a peculiar triumph over this unfortunate potentate. During that ceremony they both entered the chapel, and Haller announced to the ſovereign Pontiff on his throne, that his reign was at an end.

323 Cruel treatment of the Pope.

"The poor old man ſeemed ſhocked at the abruptneſs of this unexpected notice, but ſoon recovered himſelf with becoming fortitude; and when General Cervoni, adding ridicule to oppreſſion, preſented him the national cockade, he rejected it with a dignity that ſhewed he was ſtill ſuperior to his misfortunes. At the ſame time that his Holineſs received this notice of the diſſolution of his power, his Swiſs guards were diſmiſſed, and republican ſoldiers put in their place."

He was himſelf removed to the territory of Tuſcany, where he reſided in much obſcurity, till his enemies, driven from Rome in their turn, thought fit to carry him ſtill farther from his capital, to end his days beyond the Alps.

324 Roman r public.

In the mean time, the Roman ſtates were converted into a republic after the French model; excepting that the ancient appellations of *conſuls*, *ſenators*, and *tribunes* were adopted, inſtead of the new names of a *Directory* and *two Councils* (D). But this oſtentatious grant of freedom was rendered completely illuſory, by a condition annexed to it, that for ten years the French General

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(D) The character of a nation, like that of an individual, will not perhaps admit of a ſudden and total change. This remark is exemplified in the French; who, even when they affect to aſſume the ſtern manners of Republicans, cannot diveſt themſelves of their frivolous and fantaſtical turn, and of that fondneſs for pomp and ſhow by which they were always diſtinguiſhed. The following account of the re-eſtabliſhment of the Roman Republic, by an author of reſpectability, who witneſſed the ſolemn farce, will amply confirm the truth of our aſſertion.

"That the regenerated Roman people might be conſtitutionally confirmed in their newly-acquired rights, a day was ſet apart ſolemnly to renounce their old government, and ſwear fidelity to the new. For the celebration of this ſolemnity, which took place on the 20th of March, an altar was erected, in the middle of the piazza of St Peter's, with three ſtatues upon it, repreſenting the French, Ciſalpine, and Roman Republics. Behind the altar was a large tent, covered and decorated with ſilk of the Roman colours, ſurmounted with a red cap, to receive the deputies from the departments who had been ſummoned to aſſiſt. Before the altar was placed an open orcheſtra, filled with the ſame band that had before been employed to celebrate the funeral honours of Duphot. At the foot of the bridge of St Angelo, in the piazza di Ponte, was erected a triumphal arch, upon the general deſign of that of Conſtantine, in the Campo Vacino, on the top of which was alſo placed three coloſſal figures, repreſenting the three republics. As a ſubſtitute for baſs-reliefs, it was painted in compartments in *chiaro ſcuro*, repreſenting the moſt diſtinguiſhed actions of Bonaparte in Italy. Before this arch was another orcheſtra.

"The ceremony in the piazza began by the marching in of the Roman legion, which was drawn up cloſe to the colonnade, forming a ſemicircular line; then came French infantry, and then cavalry, one regiment after another alternately, drawn up in ſeparate detachments round the piazza. When all was thus in order, the conſuls made their entrance, on foot, from the Vatican palace, where they had robed themſelves, preceded by a company of national troops and a band of muſic; and if the weather had permitted, a proceſſion of citizens, ſelected and dreſſed in *gala* for the occaſion, from the age of five years to fifty, were to have walked two and two carrying olive branches; but an exceſſively heavy rain prevented this part of the ceremony.

"Before the high altar, on which were placed the ſtatues, there was another ſmaller one with fire upon it. Over this fire the conſuls, ſtretching out their hands, ſwore eternal hatred to monarchies, and fidelity to the republic; and at the concluſion, one of them committed to the flames a ſcroll of paper he held in his hand, containing a repreſentation of all the inſignia of royalty, as a crown, a ſceptre, a tiara, &c.; after which the French troops fired a round of muſketry; and, at a ſignal given, the Roman legion raiſed their hats in the air upon the points of their bayonets, as a demonſtration of attachment to the new government; but there was no ſhouting—no voluntary ſigns of approbation; nor do I believe that there ever was a ſhow, in which the people were intended to act ſo principal a part, where ſo decided a tacit diſapprobation was given as on this occaſion.

"After the ceremony was concluded, the French officers, with the conſuls and deputies from the departments, dined together in the papal palace on Monte Cavallo, and in the evening gave a magnificent ball to the exnobles and others, their partizans, which was numerouſly attended, yet with an exception to the houſes Borgheſe, Santacroce, Altemps, and Ceſarini: I believe not one diſtinguiſhed family was preſent from deſire or inclination: but it was now no longer time to accumulate additional cauſes for oppreſſion; and he who hoped to ſave a remnant of his property, avoided giving occaſion for perſonal reſentment. At night the dome of St Peter's was illuminated, with the ſame ſplendour as was cuſtomary on the anniverſary of St Peter's day. This was the ſecond time of its illumination ſince the arrival of the French, having been before diſplayed on the evening of the ſolemn fete to honour the manes of Duphot, which, though not quite ſo opportune, was done to gratify the officers that were to leave Rome on the morrow.

"The day after this federation, the French publiſhed the Roman conſtitution in form, which was only a repetition of the one given to the unfortunate Venetians, conſiſting of 372 articles, and which I think unneceſſary to tranſcribe, as it would only be giving what we have already had from time to time in tranſlations made from their own."—*Duppa's Journal of the moſt remarkable Occurrences that took place in Rome*, upon the Subverſion of the Eccleſiaſtical Government in 1798.

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volution
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ral ſhould poſſeſs a negative upon all laws and public acts. At firſt, however, the conquerors took care to place the government in the hands of the moſt reſpectable perſons in the ſtate favourable to democracy. But theſe men finding that they were merely to be employed as tools to plunder their fellow-citizens, for the emolument of their northern maſters, ſoon renounced their odious dignities, and were ſucceeded by men of more compliant characters, and leſs ſcrupulous integrity. The whole public property was ſeized by the invaders, and contributions were levied without end. The property of the cardinals and others who fled was confiſcated, and thoſe members of the ſacred college who remained were thrown into priſons, from which they could only eſcape by purchaſing their freedom at a high price.

325
perſeded
military
ſpotiſm.

When this was done, and Generals and Commiſſaries had glutted themſelves with wealth, quarrelled about a *juſt* diviſion of the ſpoil, mutinied, and diſperſed, other unpaid, unclothed, unproviſioned armies from the north, with new appointments, ſucceeded; and when at length, even by theſe *conſtitutional* means, nothing more was to be obtained, and artifice had exhauſted every reſource, the maſk was put under the feet that had been long held in the hand; liberty was declared dangerous to the ſafety of the republic, the conſtituted authorities incapable of managing the affairs of the ſtate, and military law the only rational expedient to ſupply their place. Thus at once the mockery of conſular dignity was put an end to, the ſenators ſent home to take care of their families, and the tribunes to blend with the people whom they before repreſented. This new and preferable ſyſtem began its operations with nothing leſs important for the general welfare than ſeizing the whole annual revenue of every eſtate productive of more than ten thouſand crowns; two-thirds of every eſtate that produced more than five, but leſs than ten; and one-half of every inferior annual income.

326
ethods
ployed
corrupt
Roman
uth.

Even the degenerated Romans could not have ſubmitted to all this, or at leaſt would not have aſſiſted in forging their own chains, had not the ſame means been employed to eradicate from their minds every moral and religious principle, which had been formerly employed for the ſame purpoſe in Paris. In order that the ſpirit of equality might be more extenſively diffuſed, a conſtitutional democratic club was inſtituted, and held in the hall of the Duke d'Altemp's palace. Here the new-born ſons of freedom harangued each other on the bleſſings of emancipation; talked loudly and boldly againſt all conſtituted authority; and even their own conſuls, when hardly inveſted with their robes, became the ſubjects of cenſure and abuſe. The Engliſh were held as particularly odious, and a conſtant theme of imprecation; and this farce was ſo ridiculouſly carried on, that a twopenny ſubſcription was ſet on foot to reduce what they were pleaſed to call the proud Carthage of the North.

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If this fooliſh ſociety had had no other object in view than ſpouting for each other's amuſement, bowing to and kiſſing a buſt of Brutus which was placed before the roſtrum (a ceremony conſtantly practiſed before the evening's debate), it would have been of little conſequence to any but the idle, who preferred that mode of ſpending their time; but it had other objects of a very different tendency, more baneful, and more deſtructive to the peace and morals of ſociety—that of intoxicating young minds with heterogeneous principles they could not underſtand, in order to ſuperſede the firſt laws of nature in all the ſocial duties; for there were not wanting men who knew how to direct the folly and enthuſiaſm of thoſe who did not know how to direct themſelves. Here they were taught, that their duty to the Republic ought ever to be paramount to every other obligation; that the illuſtrious Brutus, whoſe buſt they had before them, and whoſe patriotic virtue and juſtice ought never to be loſt ſight of, furniſhed them with the ſtrongeſt and moſt heroic example of the ſubordination of the deareſt ties of humanity to the public good; and that, however dear parental affection might be, yet, when put in competition with the general welfare of ſociety, there ought not to be a moment's heſitation which was to be preferred.

This ſort of reaſoning might perhaps have done no harm to the ſpeculative cloſet metaphyſician, who might have had neither father, nor mother, nor brother, nor ſiſter, nor a chance of ever being thrown in the way to reduce his theory to practice; but with a people who knew of no other ties but ſuch as depended on their religion and their natural feelings, without having been previouſly educated to diſcriminate, how far their reaſon might be deluded by ſophiſtry, or upon what cauſes the permanent good of ſociety depended, it had the moſt direct tendency to generate the worſt paſſions, and to annihilate the beſt.

Young men were thus initiated to loſe all reſpect for their parents and relations, and even encouraged to lodge information againſt them, with the hopeful proſpect of being conſidered as deſerving well, of what they were pleaſed to denominate, the republic; and by thus weakening or deſtroying the bonds of affection, the way was made ſmooth and eaſy to the deſtruction of every thing like what, in a ſtate of civilization, is called character; doubtleſs, in order to prepare them the better to become the faithful agents of thoſe whom they were thus educated to ſerve.

327
Monuments of
ancient art
expoſed to
ſale.

The moſt remarkable curioſities of this celebrated city had already been conveyed to Paris; and as national vanity had now given place to avarice in the minds of the Directory, the remaining monuments of ancient or of modern art, with which Rome abounded were ſold by public auction. Advertiſements (E) were ſent through Europe, offering paſſports to the natives of countries at war with France, if they ſhould wiſh to become purchaſers; and thus the wealthier inhabitants of the Roman territory not only ſaw themſelves ſubjected to ſevere exactions, but they beheld with cruel mortification

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(E) A copy of an advertiſement, iſſued on this occaſion by what was called *The Adminiſtration of Finances and Contributions of the French Republic in Italy*, is to be found in *Nicholſon's Journal of Philoſophy, Chemiſtry, and the Arts, for May* 1798. The advertiſement is dated at Rome, 28th Feb. 1798. A copy of it was ſent by Hubert, the agent of the French adminiſtrators, to Mr Trevor the Britiſh miniſter at Turin, and by him was tranſmitted to England.

tification thoſe objects now given up as a prey to vulgar ſpeculation, and diſperſed over the world, which had ſo long rendered their city the reſort of all nations.

Such was the progreſſive conduct of the *Great Nation* towards an injured and oppreſſed people, whoſe happineſs and deareſt intereſts were its firſt care, and to whom *freedom* and *liberty* had been reſtored, that they might know how to appreciate the virtue of their benefactors, and the ineſtimable bleſſings of independence.

328 French ingratitude to Switzerland.

More ſanguinary ſcenes were, in the meanwhile, taking place in Switzerland. That country had remained neutral during the conteſt in which France had lately been engaged; and had thus protected the weakeſt portion of her frontier, while the reſt of it was aſſailed by the combined forces of Europe. The merit of this ſervice was now forgotten, and the Directory reſolved to render Switzerland one of their tributary ſtates. Ambitious nations have in all ages found it an eaſy matter to deviſe apologies for invading the territory of their neighbours. The wealthier branches of the Swiſs confederacy were in general governed by hereditary ariſtocracies. Some of the cantons had no government within themſelves, but were the ſubjects of neighbouring cantons. In conſequence of this circumſtance, and of the contending privileges of different orders of men, popular inſurrections were more frequent in Switzerland than in any country in Europe, though none was more equitably governed. When an inſurrection took place in one canton, its government was frequently under the neceſſity of ſoliciting the aid of the government of an adjoining canton, or even of the neighbouring monarchs of France or Sardinia, to enable it to ſubdue its own rebellious ſubjects. A dangerous precedent was thus eſtabliſhed; and as the French kings had formerly interfered in favour of the rulers, the republican Directory now interfered in favour of the ſubjects. The canton of Berne was ſovereign of the territory called the *Pays de Vaud*. In this diſtrict diſcontents had always exiſted; and an inſurrection, under the countenance of the French Directory, broke out towards the end of the year 1797. The government of Berne ſaw the dangerous nature of its own ſituation; and on the 5th of January iſſued a proclamation, commanding the inhabitants of the Pays de Vaud to aſſemble in arms, to renew their oath of allegiance, and to reform every abuſe that might appear to exiſt in their government. A commiſſion was at the ſame time appointed by the Senate or Sovereign Council at Berne to examine all complaints, and to redreſs all grievances. The proceedings of this commiſſion, however, did not keep pace with the popular impatience; and the inſurgents began to ſeize the ſtrong places in their country. The government of Berne now reſolved to reduce them by force, and ſent troops againſt them; but their commander Weiſs appears to have acted with much heſitation, if not with treachery. In the mean time, a body of French approached under General Menard. He ſent an aide de camp with two huſſars, with a meſſage to General Weiſs. On the return of the meſſengers, an accidental affray took place, in which one of the huſſars was killed. This was magnified into an atrocious breach of the law of nations. The French advanced; and by the end of January obtained poſſeſſion of the whole Pays de Vaud. Still, however the government of Berne attempted to preſerve peace, while it endeavoured to prepare for war. The ſoldiers who had killed the French huſſar were delivered up, negociations were begun, and a truce entered into with General Brune, who ſucceeded Menard in the command of the French troops in the Pays de Vaud. As internal commotions were breaking out in all quarters, an attempt was made to quiet the minds of the people, that they might be induced to unite againſt the threatened invaſion.

329 Undecid conduct the mag trates of Berne.

Fifty-two deputies from the different diſtricts were allowed to ſit in the Supreme Council of Berne, and a ſimilar meaſure was adopted by the cantons of Zurich, Lucerne, Fribourg, Soleure, and Schaffhauſen. An army of 20,000 men was at the ſame time aſſembled, and intruſted to the command of M. d'Erlach, formerly field marſhal in the French ſervice. But diſaffection greatly prevailed in this army, and the people could not be brought to any tolerable degree of union. The French knew all this, and demanded a total change of government. M. d'Erlach, dreading the increaſing tendency to deſertion among his troops, requeſted leave to diſſolve the armiſtice. It was granted by the government, and immediately recalled. But the French now refuſed to negociate; and on the 2d of March, General Schawenberg, at the head of 13,000 men, entered Soleure. Fribourg was afterwards reduced by Brune, and the Swiſs army retreated.

330 Conſter tion of t govern- ment, a capitula tion of Berne.

The government of Berne was in conſternation, and decreed what was called the *landſturm*, or riſing of the people; which, in caſes of emergency, was authoriſed by their ancient cuſtoms. The people accordingly aſſembled; and their firſt act was to diſſolve the government, and to offer to diſmiſs the army, on condition that the French troops ſhould proceed no farther. This offer was refuſed, unleſs a French garriſon ſhould be received into Berne, and the invaders continued to advance. The regular troops under M. d'Erlach were reduced by deſertion to 14,000. The riſing of the people had indeed ſupplied him with numbers, but there was no time for arranging them. On the 5th of March he was attacked, and driven from the poſts of Newenbeg and Favenbrun. He rallied his troops, however, at Uteren, where they made a ſtand for ſome time. They renewed the conteſt at Grauholtz without ſucceſs, and were driven from thence about four miles farther to the gates of their capital. Here the Swiſs army made a laſt and bloody effort. Being completely routed, they murdered many of their officers in deſpair, and among others their commander M. d'Erlach. The ſlaughter on both ſides is ſaid to have been nearly equal; but the French ſucceeded in obtaining poſſeſſion of Berne by capitulation on the evening of the day on which theſe battles were fought. Upon the capture of this city, the other more wealthy and populous ſtates ſubmitted to the French; but the poorer cantons, who had leaſt to loſe, made a terrible effort in defence of their ſmall poſſeſſions, and the independence of their country. They even at firſt compelled Schawenberg to retire with the loſs of 3000 men; but were at laſt overpowered by the ſuperior numbers and military ſkill of the French army.

331 Switzer land tre ed as a c quered country

Switzerland was treated as a conquered country. Its public magazines were ſeized by the French, heavy contributions were levied, and a new conſtitution, in imitation of that of France, was impoſed.

rench
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While the Directory continued to encroach upon the independence of other nations, they were not likely to reſpect the freedom of their countrymen at home. In the month of April, a third of the legiſlature was changed. Francis de Neufchateau went out of the Directory by ballot, and Treilhard was choſen in his ſtead. The Directory had made great efforts to influence the elections in favour of their friends, but with little ſucceſs. They prepared therefore to preſerve the legiſlature in ſubjection to them by a new violation of the conſtitution. On the 2d of May they complained to the Council of Five Hundred of the plots of anarchiſts and royaliſts; by which they alleged that the elections had in many places been made to fall on men hoſtile to the Republic. On the 7th a committee made a report upon this meſſage, and propoſed that the proceedings of many electoral aſſemblies ſhould be totally or partially annulled, according to the characters of the perſons they had choſen. General Jourdan, and ſome others, ventured to oppoſe this plan as utterly inconſiſtent with the freedom of election, and as proceeding upon alleged intrigues of conſpirators againſt the Republic, while no conſpiracy had been proved to exiſt. But the majority agreed to the propoſal of the committee, and arbitrarily annulled the whole elections in ſix or ſeven departments, beſides the particular elections of a great number of individuals.

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The Directory now carried into effect the moſt fatal of all their projects, that of ſending a powerful army to the eaſt to ſeize upon Egypt, and from thence to attack the empire which Britain has acquired in India. The treaty with Auſtria had no ſooner been ſigned at Campo Formio, than the Directory excited the expectation of France and of all Europe, by loudly proclaiming their determination to invade Great Britain. They ſent troops into their own weſtern departments, called them the *Army of England*, and appointed Bonaparte their commander in chief. This officer in the mean time, had reſided during the winter at Paris. Here he ſeems to have endeavoured to guard againſt the jealouſy of government, and the envy of individuals, by paſſing his time in retirement, and aſſuming the character of a man of letters. He procured himſelf to be elected a member of the National Inſtitute; but ſo ſeldom did he appear abroad, that when he attended ſome of its public ſittings his perſon was altogether unknown to the ſpectators. Greedy of renown, but aware that it ultimately depends upon the labors and the approbation of the learned, he never failed, when called into military ſervice, to remind this order of men of his alliance with them, by adding to his name at all proclamations and diſpatches the deſignation of *Member of the National Inſtitute*.

Whether the expedition to Egypt was now ſuggeſted by Bonaparte himſelf, or whether it was not a ſnare by which the preſent rulers of France impoſed upon the vanity of an enterpriſing young man, to enable them to get quit of him and his veteran army, is not known. It is very poſſible, however, that Bonaparte might neither be the deviſer nor the unconſcious victim of this plan; but that he might account himſelf more ſafe abroad, upon the moſt hazardous expedition, than expoſed at home to the malice of a government that had become jealous of his reputation, and was by no means ſcrupulous in its conduct.

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The projected invaſion of Egypt was conducted with much ſecrecy. The world was amuſed with tales of monſtrous rafts to be conſtructed to convey the army of England over into Britain. To favour the deception, Bonaparte made a journey to the weſtern coaſt. In the mean time, the fleet was preparing at Toulon, and troops aſſembling in its neighbourhood. When all was in readineſs, Bonaparte embarked with 40,000 of the troops that had fought in Italy. On the 9th of June he arrived at the iſland of Malta, and contrived to quarrel with the Grandmaſter, becauſe he refuſed to admit ſo large a fleet all at once into his ports to water. The French General immediately landed his troops in different quarters, and endeavoured to reduce the iſland. The knights were divided into factions. Many of them, as is now well known, were of the order of ILLUMINATI, and of courſe prepared to act the part of traitors. After making a very feeble reſiſtance, the Grandmaſter propoſed a capitulation; and thus was treacherouſly ſurrendered, in a few days, a fortreſs which, if defended by faithful troops, might have held out for as many weeks againſt all the forces of the French Republic. Bonaparte, after leaving a garriſon of 4000 men in the iſland, ſailed on the 21ſt of June for Alexandria.

334
Preparations for it conducted with ſecrecy.

335
Conqueſt of Malta.

336
Admiral Nelſon fails in queſt of Bonaparte.

In the mean time, Rear-admiral Nelſon, who, in the ſtation of Commodore, had ſignalized himſelf in a very high degree under Lord St Vincent, had been diſpatched in queſt of him from the Britiſh fleet, which ſtill blockaded Cadiz. Not knowing the object of the French expedition, the Britiſh Admiral ſailed firſt to Naples; and having there been informed of the attack upon Malta, he directed his courſe to that iſland. By the time he arrived there, however, Bonaparte had departed. Conjecturing now that Alexandria might be the deſtination of the French troops, he ſailed thither; but they had not been ſeen in that quarter, and he therefore went eagerly in ſearch of them to other parts of the Mediterranean. Bonaparte, in the mean while, inſtead of ſteering in a direct line for Alexandria, had proceeded ſlowly, with his immenſe train of nearly 400 tranſports, along the coaſt of Greece, till he arrived at the eaſtern extremity of the iſland of Candia. Here he ſuddenly turned ſouthward; and in conſequence of his circuitous courſe, did not arrive at the coaſt of Egypt till Admiral Nelſon's fleet had left it. He landed his troops; and on the 5th of July took by ſtorm the city of Alexandria. The inhabitants defended themſelves very deſperately, but without ſkill; and for ſome time a ſcene of barbarous pillage and maſſacre enſued. The tranſports that had conveyed the army were now placed within the inner harbour of Alexandria, and the ſhips of war under Admiral Brueys caſt anchor in a line cloſe along the ſhore of what proved to them the fatal Bay of Aboukir. The army proceeded to the Nile, and aſcended along the banks of that river, ſuffering great hardſhips from the heat of the climate. They were met and encountered by the Mamalukes, or military force that governed Egypt; but theſe barbarians could not reſiſt the art and order of European war. Cairo was taken on the 23d of July. On the 25th another battle was fought; and on the 26th the Mamalukes made a laſt effort in the neighbourhood of the celebrated pyramids for the preſervation of their empire. Two thouſand of them were killed on this occaſion, 400 camels laden with their baggage were taken, along with 50 pieces of cannon.

337
Conqueſts of Bonaparte in Egypt.

A proviſional government was now eſtabliſhed in Egypt.

gypt. Proclamations were iſſued in the Arabian tongue, declaring that the French were friendly to the religion of Mahomet, that they acknowledged the authority of the Grand Signior, and had only come to puniſh the crimes committed by the Mamalukes againſt their countrymen trading to Egypt. Thus far all had gone well; but on the 1ſt of Auguſt the Britiſh fleet appeared at the mouth of the Nile; and the ſituation of the French fleet having been diſcovered, Admiral Nelſon prepared for an attack. In number of ſhips the fleets were equal; but in the number of guns and weight of metal the French ſquadron had the ſuperiority. It was drawn up, too, in a form which ſuggeſted to its ill-fated commander the idea of its being invincible; but remaining at anchor, the Britiſh Admiral was enabled, by running ſome of his ſhips between thoſe of the enemy and the ſhore, to ſurround and engage one part of their fleet, while the reſt remained unemployed and of no ſervice. In executing this plan of attack, a Britiſh ſhip, the Culloden, run aground; but this accident only ſerved as a beacon to warn the others of the ſpot that ought to be avoided. The battle commenced at ſunſet, and was continued at intervals till daybreak. At laſt, nine ſail of the French line were taken; one ſhip of the line was burned by her own commander; a frigate was burned in the ſame manner, to prevent her being taken. The French Admiral's ſhip L'Orient took fire, and blew up during the action, and only a ſmall number of her crew of 1000 men eſcaped deſtruction. Two French ſhips of the line and two frigates were ſaved by a timely flight (f).

338 Admiral Nelſon attacks and deſtroys the French fleet.

339 Conſequences of his victory.

No naval engagement has in modern times produced ſuch important conſequences as this. The unexampled military efforts made by France had gradually diſſolved the combination which the princes of Europe formed againſt her. By the train of victories which Bonaparte had gained, the houſe of Auſtria, her moſt powerful rival, had been humbled and intimidated. The whole continent looked towards the new Republic with conſternation; and when the Directory ſeized upon Rome and Switzerland, none were found hardy enough to interpoſe in their favour. The current of affairs was now almoſt inſtantaneouſly altered. Europe beheld Bonaparte, with his *invincible* army, exiled from its ſhores, and ſhut up in a barbarous country, from which the triumphant navy of Britain might for ever prevent his return. The enemies of France could not beforehand have conceived the poſſibility of the event which was now realiſed; and the hope was naturally excited of being able to form a new and more efficient coalition againſt a government which had ſo groſsly abuſed the temporary proſperity it had enjoyed. The northern powers began to liſten to the propoſals made to them by Great Britain for commencing hoſtilities anew, and the Italian ſtates prepared to make another effort for independence. The court of Naples in particular openly avowed its joy on account of the recent deſtruction of the French fleet. The king himſelf put to ſea to meet Admiral Nelſon on his return from the Nile. Illuminations took place in the capital, and vigornus preparations were made for war. The Grand Signior who had poſſeſſed of late little authority in Egypt, and might perhaps have been induced to relinquiſh his claims on that province rather than engage his decaying empire in war, now entered into cloſe alliance with Britain, and engaged in hoſtilities againſt the French. Tippoo Sultan had ſtipulated for the aid of a French army againſt the Britiſh in India; but Bonaparte, on taking poſſeſſion of Suez and the other Egyptian ports on the Red Sea, found no ſhipping there fit to tranſport his army to the Indian peninſula. Inſtead of proceeding therefore upon any ſplendid ſcheme of farther conqueſt, he was compelled to remain in his preſent ſituation, and to contend for exiſtence againſt the whole force of the Ottoman empire.

340 Rebellion in Irelan

The French at this time did not venture to ſend forth any large fleet upon the ocean; but wherever their ſmaller ſquadrons appeared, the fortune of Britain overpowered them there no leſs than it had done in the Mediterranean. They had long promiſed aid to the diſaffected party in Ireland; but weary of fruitleſs expectation, the Iriſh had during this ſummer broken out into rebellion, without waiting the arrival of the troops whom the Directory had engaged to ſend to their aſſiſtance. While the rebellion was at its height, and although the inſurgents for ſome time occupied the ſea port of Wexford, the French did not arrive. Afterwards, however, when the rebellion had been totally ſubdued, they attempted to elude the vigilance of the Britiſh fleet, and to land men in ſmall parties. On the 22d of Auguſt, General Humbert came aſhore at Killala, at the head of about 1100 men. Even this ſmall party might have been dangerous had it arrived a month earlier; and it actually produced very ſerious alarm. It conſiſted of men ſelected with great care, and capable of enduring much fatigue. They were joined by a few of the moſt reſolute of the diſcontented Iriſh in the neighbourhood, and ſpeedily defeated General Lake, who advanced againſt them with a ſuperior force, taking from him ſix pieces of cannon. The next marched in different directions, for the purpoſe of raiſing the people, and maintained their ground in the country during three weeks. Finding however, that he was not ſeconded by additional troops from France, that the rebellion in Ireland had been fully ſubdued, and that 25,000 men under Lord Cornwallis were cloſing round him, Humbert diſmiſſed his Iriſh aſſociates; and four days thereafter, having encountered one of the Britiſh columns in his march, he laid down his arms. Now, when it was too late, the Directory was very active in ſending troops towards Ireland; but all their efforts were defeated by the ſuperiority of the Britiſh navy. On the 12th of October, Sir John Borlaſe Warren took La Hoche, a ſhip of 84 guns, and four frigates, attempting to reach Ireland with nearly 3000 men on board. The other ſhips belonging to the French ſquadron, which conveyed 5000 men in all, contrived to make their eſcape by ſailing round by the north of the iſland. On the 20th of the ſame month another frigate bound for Ireland was taken; and the French finding that the ſea was completely occupied by the Britiſh fleet, were at laſt compelled to deſiſt from their enterpriſe.

341 Feebly ſu ported by the Direc tory.

342 Whoſe ef forts are d feated by the Britiſ navy.

Ever ſince the treaty of Campo Formio had been concluded,

(f) The two ſhips of the line and one of the frigates have been ſince taken.

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concluded, a congreſs of miniſters from the French Directory, and from the German princes, had been negociating at Raſtadt a treaty between France and the empire. As theſe negociations terminated in nothing, and were tedious and unintereſting during their progreſs, it is unneceſſary to enter into a detail of the ſteps by which they were conducted. The intended reſult of them had been previouſly arranged between the Emperor and the Directory in the ſecret convention of Campo Formio, which has been already mentioned.

43 ocia- at idt.

That the articles of this convention might be concealed, the French miniſters at Raſtadt formally brought forward their propoſals in ſucceſſion for the diſcuſſion of the German deputies. The French demanded that the Rhine ſhould be the boundary of their Republic. The Germans reſiſted this. References were made to the diet of Ratiſbone, and long diſcuſſions and negociations took place among the different princes. When it was found that little was to be expected from the protection of Auſtria, the German deputies at Raſtadt were inſtructed to offer one half of the territory demanded. This offer was refuſed, and new negociations took place. The other half was at laſt yielded up, and a long diſcuſſion commenced about the debts due by the ceded territory, which the French refuſed to pay. The tolls upon the river, and upon the rivers flowing into the Rhine, alſo gave riſe to much altercation. It was even a matter of no ſmall difficulty, after all, to determine the preciſe boundary of France; whether her territory ſhould extend to the left bank, the right bank, or the thalweg, that is, the middle of the navigable channel of the river. It became alſo a queſtion how thoſe princes ought to be indemnified who loſt their revenues or territories by the new acquiſitions of France; and it was at length agreed that they ſhould receive portions of the eccleſiaſtical eſtates in Germany.

Theſe diſcuſſions, conducted with endleſs formality and procraſtination, ſtill occupied the congreſs at Raſtadt; but it now became gradually more probable that no treaty would be concluded at that place.

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Auſtria began to ſtrengthen her armies in all quarters. Ruſſia, that had hitherto avoided any active interference in the conteſt, placed a large body of troops in Britiſh pay, and ſent them towards the German frontiers. The king of Naples avowedly and eagerly prepared for war. This impatient monarch, reſolving to attack without delay the French troops who occupied the Roman territory, procured General Mack and other officers from the court of Vienna to aſſume the command of his army. Without waiting, however, till Auſtria ſhould commence the attack, he raſhly began the war alone and unaided, excepting by the Britiſh fleet, and thus drew upon himſelf the whole force of the French Republic. The directory did not ſuſpect ſuch imprudent conduct on the part of this prince; and accordingly, when General Mack entered the Roman territory, at the head of 45,000 men, the French troops in that quarter were altogether unequal to the conteſt. A French ambaſſador ſtill reſided at Naples when this event took place, and war was not declared. When the French General Championnet complained of the attack made upon his poſts under theſe circumſtances, he was informed in a letter by General Mack, that the king of Naples had reſolved to take poſſeſſion of the Roman territory, having never acknowledged its exiſtence as a Republic; he therefore required the French quietly to depart into the Ciſalpine ſtates; declaring, that any act of hoſtility on their part, or their entrance into the territory of Tuſcany, would be regarded as a declaration of war.

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Championnet finding himſelf unable to reſiſt the force now brought againſt him, actually evacuated Rome.

345 The Neapolitans take poſſeſſion of Rome.

He left, however, a garriſon in the caſtle of St Angelo, and endeavoured to concentrate whatever troops he could haſtily collect in the northern extremity of the Roman ſtate. Towards the end of November, General Mack entered Rome without oppoſition.

When theſe events came to be known at Paris, war was immediately declared againſt the king of Naples, and alſo againſt the king of Sardinia. This laſt prince had made no attack upon France; but he was accuſed by the Directory, in their meſſage to the Councils, of *diſaffection* to the Republic, and of *wiſhing* to join the king of Naples in his hoſtile efforts. This accuſation could not well be falſe. From the period of Bonaparte's ſucceſsful irruption into Italy, the king of Sardinia had felt himſelf placed in the moſt humiliating circumſtances; his moſt important fortreſſes were occupied by the French; they levied in his country what contributions they thought fit; and when they recently required him to receive a garriſon into his capital, he found himſelf unable to reſiſt the demand.

346 Hard fate of the king of Sardinia.

Even now, when they performed the uſeleſs ceremony of declaring war, he could make no effort in his own defence, and quietly gave them a formal reſignation in writing of his whole continental dominions, conſenting to retire to the iſland of Sardinia.

In the mean time, the conteſt with Naples was ſoon decided. The French on their retreat were much haraſſed by the people of the country. The Neapolitan troops regarded them with ſuch animoſity, that they ſcarcely obſerved the modern rules of war towards the priſoners who fell into their hands. Even their leaders ſeemed in this reſpect to have forgotten the practice of nations; for when General Bouchard, by order of General Mack, ſummoned the caſtle of St Angelo to ſurrender, he declared, that he would conſider the priſoners of war and the ſick in the hoſpitals as hoſtages for the conduct of the garriſon; and that for every gun that ſhould be fired from the caſtle, a man ſhould be put to death. It cannot well be imagined that the Neapolital officers would have acted in this vehement manner, had they not expected countenance and ſupport from the immediate co-operation of Auſtrian troops. In their hopes from this quarter, however, they were completely diſappointed.

347 Naples conquered by the French.

Mindful of her recent calamities, and attentive only to her own aggrandiſement, Auſtria ſeems ſtill to have expected more from negociation than from war, and the territory of Naples ſoon fell into the hands of the French. Such indeed was the terror of the French name in Italy, or ſuch was the diſaffection or cowardice of the Neapolitan troops themſelves, that they were beaten by one-fourth of their number in different engagements, at Terni, Porto Fermo, Civita Caſtellana, Otricoli, and Calvi. At the commencement of the conteſt, a body of Neapolitans, with the aſſiſtance of the Britiſh fleet, had been landed at Leghorn, for the purpoſe of taking the French in the rear: but they, diſregarding this attempt on the part of ſuch an enemy, preſſed on towards Naples. By degrees, General Mack's army being reduc-

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ed by the reſult of the battles which it fought, and by deſertion, to 12,000 men, he found it neceſſary to adviſe the king and royal family of Naples to take refuge on board the Britiſh fleet. They did ſo; and arrived at Palermo, in Sicily, on the 27th of December, in the Britiſh Admiral Lord Nelſon's ſhip. General Mack, in the mean time, requeſted an armiſtice, to afford an opportunity for making peace; but this was refuſed. Being driven from Capua, which is the laſt military poſt of any ſtrength in the Neapolitan territory, and his life being in no ſmall danger from the diſaffection of his own troops, he at laſt found it neceſſary to ſeek for ſafety, by ſurrendering himſelf, along with the officers of his ſtaff, to the French General. The governor of Naples, in the mean time, offered to the French a contribution in money, if the commander in chief would conſent to avoid entering that city. The offer was accepted, and the invading army remained at Capua. General Serrurier, on the 28th of December, at the head of a column of French troops, expelled the Neapolitans from Leghorn, and took poſſeſſion of that place. So far as the efforts of regular armies are to be conſidered, the war might now therefore be regarded as brought to a termination; but the French had ſpeedily a new and unuſual enemy to contend againſt.

1799.

348 The Lazzaroni riſe againſt the French.

From the mildneſs of the climate, and the fertility of the ſoil, human life can be ſuſtained in the ſouthern parts of Italy with fewer efforts of induſtry than in almoſt any other country in Europe. Hence ariſes a general propenſity to idleneſs, which is increaſed by the numerous charitable inſtitutions to which the Roman Catholic religion gives riſe. In the city of Naples there had long exiſted a body of perſons under the denomination of *Lazzaroni* or Beggars, amounting to the incredible number of from thirty to forty thouſand men, who did nothing, and ſubſiſted merely by charity, or by ſuch ſhifts as occaſionally occurred to them. One of theſe frequently was the menacing the ſtate with an inſurrection, in caſe their wants were not inſtantly ſupplied; which uſually drew from a feeble adminiſtration very liberal diſtributions of money and proviſions. On the preſent occaſion they demonſtrated abundance of loyalty; but the king had thought fit to avoid entruſting his ſafety to ſuch defenders. During the confuſion which followed the flight of the court and the approach of the French army, the Lazzaroni became mutinous. They heard that the French aboliſhed, wherever they came, all thoſe monaſteries and other religious eſtabliſhments which are the great ſources of public charity. The Lazzaroni, therefore, conceived the moſt violent hatred againſt them, and againſt all who were ſuſpected of favouring opinions hoſtile to royal government. In the beginning of January they began to ſhew ſymptoms of diſcontent, and in a few days broke out into open inſurrection. The members of the government left by the king, overcome by habitual terror of the Lazzaroni, conſulted merely their own perſonal ſafety, and made no effort to preſerve the public tranquillity. Prince Militorni had gained conſiderable applauſe on account of his vigorous defence of Capua againſt the French. The Lazzaroni therefore elected him their commander in chief; but he attempted in vain to reſtrain their violence and love of plunder. They declared hoſtility againſt the French and all the adviſers of the armiſtice. They broke open the priſons, and put to death all thoſe who were confined on account of political offences againſt the royal government. They next ſpread themſelves over the city in ſearch of thoſe perſons whom they conſidered as favourable to the invaders, and committed murder and robbery in all quarters, concluding by burning the houſes of thoſe accounted diſaffected. An attempt was made by a conſiderable body of the inhabitants, who thought themſelves in the greateſt danger, to reſiſt their fury, by fortifying the convent of the Celeſtins, and retiring thither; but the Lazzaroni, after encountering the fire of cannon and of muſketry, ſucceeded in ſtorming the place, and deſtroyed all who had taken refuge there. Their power and their fury were now equally boundleſs, and the city became in many quarters a ſcene of maſſacre and pillage. Prince Militorni, therefore, went to Capua, and requeſted Championnet to reſcue Naples from utter ruin by occupying it with his army. For this purpoſe it was arranged, that a column of French troops ſhould ſecretly advance by a circuitous march, and ſuddenly enter the city from the oppoſite quarter. Before this plan could be fully executed, the Lazzaroni had adopted the daring reſolution of attacking the French within the fortifications of Capua. Accordingly two thirds of them marched out upon this enterpriſe, and ſpent the 19th and 20th of January in attempting to take Capua by aſſault. Multitudes of theſe men here periſhed by the artillery of the place; for the French, to favour the capture of Naples by the party that had been ſent eaſtward for that purpoſe, avoided making any ſally, and remained upon the defenſive. The Lazzaroni at Capua, however, having learned on the 21ſt that a French column had marched to Naples, and approached the gates, ſuddenly returned to the aſſiſtance of their brethren in the capital. They were cloſely purſued by the French; but they had leiſure, nevertheleſs, to barricade the ſtreets, and to form themſelves into parties for the defence of different quarters. A dreadful and ſanguinary conteſt now enſued, which laſted from the morning of the 22d to the evening of the 23d of January. The Lazzaroni, with ſome peaſants who had joined them, diſputed obſtinately every ſpot of ground; and by the energy which they diſplayed, caſt a ſevere reproach upon the feeble and unſkilful government, which had not been able to direct in a better manner the courage of ſuch men. At length, after having been gradually driven from ſtreet to ſtreet, the Lazzaroni rallied for the laſt time at one of the gates of the city, where they were nearly exterminated. The inhabitants rejoiced on account of their own eſcape from immediate ruin; and while the French armies found themſelves become odious in all the other countries which they had entered, they here found themſelves, from the peculiar circumſtances of the caſe, received with unfeigned welcome, in a city which holds the third place in population and ſplendour among the capitals of Europe.

French Revolutio 1799.

349 Their ou rages.

350 They ar nearly e terminat

This may be regarded as the laſt triumph enjoyed by the Directory. The conſequences of their conduct were now gathering faſt around them. They were deſervedly unpopular at home; not only from the violations they had offered to the conſtitution of their country, but alſo from the manner in which they conducted public affairs in detail. They ſet no bounds to their profuſion, or to the exactions with which their agents vexed

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vexed the conquered countries. Championnet, aſhamed of the extortions of which the commiſſaries of the Directory were guilty, attempted in Italy to reſtrain them; and the conſequence was, that, upon the complaint of the commiſſary Taypoult, he was deprived of his command, and thrown into priſon. Scherer, the miniſter of war, was appointed his ſucceſſor. Under him the rapacity of the agents of government, and the embezzlement of the public ſtores, was carried to its height. The numbers of the armies were ſuffered to decline, that the Directory, the commiſſaries, and the generals, might become rich. Thus the ſtate was left totally unprepared againſt the ſtorm which was now rapidly gathering from abroad. Still, however, France was feared by the neighbouring nations, to whom the preſent ſtate of her internal affairs was obſcurely known. Though an army of 45,000 Ruſſians had advanced to the aid of Auſtria, yet that Cabinet heſitated to declare war. Pruſſia was eagerly ſolicited by Britain to take up arms againſt France, and large pecuniary aid was offered; but Sieyes, the Directory's ambaſſador at Berlin, artfully contrived to defeat this negociation, and to counteract the unpopularity of his country in Germany, by publiſhing the ſecret convention at Campo Formio, which we have already mentioned. This treaty demonſtrated ſo clearly to the German princes the utter unconcern with which their independence and their intereſts were regarded by the head of the empire, that no ſteady co-operation with Auſtria could henceforth be expected from them. The greater number of them, therefore, reſolved to maintain their neutrality under the protection of Pruſſia.

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On the 2d of January, the French miniſters at Raſtadt preſented a note to the congreſs, in which they intimated, that the entrance of Ruſſian troops into Germany, if not reſiſted, would be regarded by them as a declaration of war. Some negociation took place in conſequence of this note, but no ſatisfactory anſwer was returned. On the 26th of that month, the ſtrong fortreſs of Ehrenbreitſtein ſurrendered, after having remained under blockade ſince the concluſion of the treaty of Campo Formio. By the poſſeſſion of this place, and of Mentz and Duſſeldorf, France was now rendered very formidable on the Rhine. As ſhe poſſeſſed alſo the ſtrong country of Switzerland, and all the fortified places of Italy, ſhe was well prepared, not only for defence, but for active operation; for it is now known, that the conferences of Raſtadt were purpoſely protracted, by orders from the Directory, till the French armies ſhould be ready to take the field with advantage againſt an enemy whoſe conduct betrayed the moſt culpable tardineſs. At this time Jourdan commanded on the Upper Rhine from Mentz to Huningen; Maſſena occupied with an army the eaſtern frontier of Switzerland towards the Griſon country; Scherer was commander in chief in Italy; Moreau acted as general of a diviſion under him; and Macdonald commanded the troops that occupied the territory of Rome and Naples. But theſe armies that kept in ſubjection, and were now to defend ſo many countries, ſcarcely amounted to 170,000 men in all, and were far outnumbered by the armies which Auſtria alone, without the aid of Ruſſia, could bring into the field. The Directory, however, confiding in the unity of its own plans, in the undecided politics of the court of Vienna, and in the conſequent ſlow movements of the Imperial armies, was eager to renew the war; and the two Councils, on the 13th of March, declared France to be at war with the Emperor of Germany and the Grand Duke of Tuſcany. The war, however, had already been begun. On the 1ſt of March Jourdan croſſed the Rhine at Straſburg, and occupied ſeveral ſtrong poſitions in Swabia. Manheim was taken, and Philipſburg ſummoned to ſurrender by Bernadotte (c), while St Cyr entered Stutgard. On the 4th of March the Auſtrians croſſed the Lech, under the command of the Archduke Charles, to oppoſe this army. Maſſena advanced into the territory of the Griſons; and ſurpriſing a ſtrong body of Auſtrians, took them all priſoners, together with their General Auffenburgh, and the whole of his ſtaff, after a deſperate reſiſtance under the walls of *Coire*. The reduction of the Griſons was the conſequence of this victory.

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But in order to complete the plan of the French, which was to effect a junction with their two armies, that of Maſſena in Switzerland with that of Jourdan in Germany, it was neceſſary to carry the important poſt of Feldkirch, which was occupied by the Auſtrian General Hotze, whoſe line extended from the frontiers of the Griſons, to the north-eaſt by the Vorelberg, to the eaſtern extremity of the Lake Conſtance. Vigorouſly repulſed in his firſt attack, Maſſena renewed it, five different times, with freſh forces, and increaſed impetuoſity. But all could not avail againſt the ſteady bravery of the Auſtrians, who drove back the aſſailants with immenſe ſlaughter. The French, however, being in poſſeſſion of the Griſons, the invaſion of the Engadine, and the county of Bormio, by a diviſion of the army of Italy cantoned in the Valteline, under the orders of General Caſabianca, was facilitated. The Auſtrians, too weak in that quarter to reſiſt them, retreated into the Tyrol, whither they were purſued by the French, who forced ſome of the defiles by which the entrance of that country was defended, and extended their deſtructive incurſions as far as Glurenz and Nauders.

Meanwhile the van-guard of the main army of the Imperialiſts puſhed forward to meet the enemy. On the 20th of March it was attacked by Jourdan, who drove in the outpoſts; but on the following day that general was himſelf attacked in the centre of his army, driven from his poſition, and compelled to retire during the night to Stockach. Both parties now prepared for a deciſive engagement. On the 24th, the Archduke encamped before Stockach, with his right wing towards

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(c) This ſummons was conceived in very extraordinary terms, and cannot be accounted for but upon the ſuppoſition that Bernadotte believed the Auſtrian officers infected with French principles. He calls upon the commander of the fortreſs to ſurrender without reſiſtance, and thus violate the truſt repoſed in him by his ſovereign. He tells him, that a diſcharge of his duty would produce the *defection of his officers and men* He warns him of the folly and danger of leading troops to action *againſt their will*; and, laſtly he threatens him with *vengeance* if he ſhould *dare to reſiſt!*

354 The French are defeated in Swabia,

Nellenburg, and his left near Wallenweis. On the 25th, at day-break, the French army began the attack. They directed their chief efforts againſt the right wing of the Auſtrians commanded by General Meerfeldt. The battle was long and obſtinate. From five o'clock in the morning till paſt one of the afternoon, its termination remained extremely doubtful. The French ſucceeded in their attempt againſt General Meerfeldt. His poſition was forced, and he retreated into a wood between Liptingen and Stockach. Here he renewed the combat without ſucceſs. He was gradually driven to the extremity of the wood, though it is a German mile in breadth. The left wing of the Auſtrians, however, had in the mean time maintained its ground, and reinforcements were ſent from it to General Meerfeldt. With the aſſiſtance of theſe he at laſt ſucceeded in making a ſtand, and even obliged the French to retire in their turn. At length, about two o'clock, the French found it neceſſary to withdraw from this quarter. The battle, however, was continued in different points till night came on. The French remained upon the ground where they had begun the attack, and they even retained 4000 priſoners whom they had taken during the various movements of the day. The reſult of the battle, upon the whole, however, was fatal to their affairs. Their loſs was ſo great, and the ſuperiority of the Auſtrians ſo manifeſt, that Jourdan dared not to hazard another engagement. On the following day he retired to Weiller near Dutlingen; and finding his army altogether unequal to offenſive operations, he ſent back one part of it to cover Kehl and Straſburg, while he withdrew with the other towards Switzerland. This event compelled Maſſena, who was preſſing upon Tyrol and the Engadine, to return to the defence of Switzerland. He was immediately intruſted with the chief command of the troops in this quarter, in the room of Jourdan, who was removed. The Auſtrians continued to advance in every direction, and immediately occupied the whole of the right, or German ſide, of the Rhine, from the lake of Conſtance to Mentz.

355 And in Italy.

In Italy the ſucceſs of the Auſtrians was equally conſpicuous, notwithſtanding the treachery of the French in attacking them before the expiration of the truce. The attempt of the latter to force the advanced poſts of the former, on the 26th of March, at Santa Lucia and Buſſelango, was rendered abortive; and at Legnago, the Auſtrian general, Kray, obtained a complete victory, and compelled them to ſeek protection under the walls of Mantua. On the 5th of April, the Auſtrians again attacked them in their poſition at Memiruolo, which lies on the road from Mantua to Peſchiera, and compelled them, after an obſtinate conflict, once more to retreat. The loſs of the French in theſe different actions was undoubtedly great; but it is probably overrated at 30,000 men killed, wounded, and taken.

The ſucceſs of the Auſtrians, however, was not cheaply purchaſed. Scherer, who commanded the French army, gained over them, at firſt, ſome advantages, which, had he known how to improve them, might have given a different turn to the tide of affairs. One diviſion of his army had actually forced the Auſtrian poſts on the 26th of March, and taken 4000 priſoners; but the other diviſion being repulſed, he withdrew his troops from their advanced poſition, and thus relinquiſhed the advantage which he had gained. Even on the 5th of April, Moreau's diviſion performed prodigies of valour, and took, it has been ſaid, 3000 priſoners; but from the injudicious diſpoſitions which had been made by Scherer, that general was not ſupported, and the victory of the Auſtrians was complete. Kray now quickly drove the French from the Mantuan, and compelled them, after having ſuſtained new loſſes, to relinquiſh their ſtrong holds on the Mincio and the Adige, and to retreat to the Adda.

356 Moreau fortifies h camp.

On the banks of this river, rendered remarkable for the dear bought victories which Bonaparte had obtained at the bridge of Lodi, the French general Moreau, to whom the Directory had given the chief command of their army, prepared to make a vigorous defence. The military talents of this man had been rendered unqueſtionable by his celebrated retreat through a hoſtile country, and before a victorious army ably commanded. On the preſent occaſion he did not belie his former character. Nothing that could give courage or confidence to his troops was neglected. Entrenchments were thrown up wherever the river was conſidered as paſſable; and a ſituation, remarkably ſtrong by Nature, was ſtrengthened by every means which art could ſupply.

357 Marſhal Suwarro

Before this period, a conſiderable body of Ruſſians had joined the Imperialiſts; and the chief command of the allied army was now aſſumed by Field Marſhal Suwarrow Rimniſki. This celebrated leader, whoſe character every democrate labours to miſrepreſent, had entered into the army at the age of twelve, and riſen from the ranks to the ſtation which he now held, of Generaliſſimo of the Ruſſian armies. Poſſeſſed of ſtrong natural talents, he had likewiſe the benefit of an excellent education, and is ſaid, by thoſe who are perſonally known to him, as well as acquainted with the ſtate of literature in Ruſſia, to be one of the beſt claſſical ſcholars of all the natives of that great empire. He had ſtudied, in early life, mathematics and natural philoſophy, as branches of ſcience abſolutely neceſſary to the man whoſe higheſt ambition is to become a great commander; and his knowledge of the learned, as well as of the faſhionable languages, had enabled him to avail himſelf of all that has been written either by the ancients or the moderns on the art of war. This art had indeed been his chief ſtudy from his youth; it had been at once his buſineſs and his amuſement.

Poſſeſſed with his countrymen, in general, of the moſt undaunted courage, and formed by Nature to endure the greateſt fatigue, it is not ſurpriſing, that with all theſe advantages Suwarrow ſhould have long ago acquired the character of one of the ableſt generals of his time. It is indeed true, that, till the opening of the campaign of 1799, he had diſtinguiſhed himſelf only againſt the Turks, whom we are too apt to deſpiſe, and againſt the Poles when divided among themſelves; but let it be remembered, that the enthuſiaſtic courage of thoſe ſame Turks had found employment for the talents of ſome of the ableſt generals in Europe, a Laudohn and a Cobourg; and that the Poliſh armies which Suwarrow ſubdued were united by the ſtrongeſt of all ties—the knowledge that they muſt conquer or periſh. All this was ſo well known to Frederic the Great, that he held the military talents of the Ruſſian hero in the higheſt eſteem; and the attention of all Europe was now turned towards the quarter where thoſe talents were

were to be exerted in the ſupport of ſocial order, and of every thing which ennobles man. His operations in Italy did not diſappoint the higheſt expectations which had been formed of them. At an age conſiderably above ſixty, he began a campaign not leſs remarkable for its activity than any which had gone before it ſince the commencement of the French revolution. We are by no means prepared, however, to do juſtice to the various military efforts which were now made, or to explain clearly the means employed to inſure ſucceſs. If the work entitled the *Hiſtory of Suwarrow's Campaigns* be deſerving of credit, the ſuperiority of that commander over his rivals and opponents ſeems to have at all times conſiſted principally in the promptitude with which he formed his plans, and the rapidity with which he carried them into execution. It is likewiſe ſaid to be a maxim of his, always to *commence* the attack when he ſees a battle inevitable, from the perſuaſion that the ardour of the attacking army more than counterbalances the advantage of ground, if that advantage be not very great. Such was certainly the principle upon which he acted at preſent.

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On the 24th of April the combined army advanced to the Adda; and having driven in Moreau's outpoſts, Suwarrow reſolved, on the 26th, to attack him in his entrenchments. For this purpoſe, while the ſhew of an attack was maintained along the whole line, a bridge was ſecretly thrown over among the rocks at the upper part of the river, where the French had thought ſuch an enterpriſe unlikely or impoſſible. A party of the combined army was thus enabled, on the following morning, after croſſing the river, to turn the French fortifications, and to attack their flank and rear, while the reſt of the army forced the paſſage of the river at different points. The French fought obſtinately, but were ſpeedily driven from all their poſitions, and compelled to retire to Pavia, leaving 6000 men on the field; while upwards of 5000 priſoners, including 4 generals, fell into the hands of the allies, together with 80 pieces of cannon.

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The advantage thus obtained over the French, in conſequence of the addreſs with which the Adda was croſſed, is ſaid to have gained for Suwarrow more eſtimation from his antagoniſts than they had originally been diſpoſed to grant to any military officer coming from Ruſſia, and who had never before had perſonal experience of the mode in which war is conducted in the ſouth of Europe. But this is probably affectation. The French had ſurely no cauſe to deſpiſe Ruſſian generals, ſince they could not but know that Laudohn was born in Ruſſia, that he had his military education there, and that he had riſen to a high rank in the army before he entered into the ſervice of the Empreſs Queen Maria Thereſa. Indeed it is evident, that while their orators were declaiming againſt Suwarrow and his Ruſſians as merciless barbarians, they were ſecretly trembling at his prowefs and reſources, which they could not but remember had more than once ſaved the armies of the Prince of Cobourg in the Turkiſh war.

Moreau now eſtabliſhed the wreck of the French army, amounting to about 12,000 men, upon the Po, between Aleſſandria and Valentia. On the 11th of May he compelled a body of Auſtrians to retire, though they had already paſſed the river, and took a great number of them priſoners. On the following day, 7000 Ruſſians croſſed the Po at Baſignano, and advanced on Pecetto. Moreau immediately fell upon them with his army. They maintained a long and deſperate conflict; but being at laſt thrown into confuſion, and refuſing to lay down their arms, about 2000 of them were drowned in recroſſing the river, and the French, with difficulty, took a ſmall number of them priſoners. But Suwarrow ſoon advanced, and terminated this active, but petty warfare, which was all that the French could now maintain. Moreau was under the neceſſity of retiring with his troops to occupy the Bochetta, and other paſſes which lead to the Genoeſe territory; and the combined army commenced vigorouſly, and at once, the ſiege of all the fortreſſes in the part of Italy which it now occupied. Peſchiera, Mantua, Ferrara, Tortona, Aleſſandria, and the citadels of Turin and Milan, were all attacked. The French were driven from the Engadine by Bellegarde; Maſſena, cloſely preſſed in Switzerland by the Archduke Charles, was compelled to retreat to the neighbourhood of Zurich, and almoſt all Piedmont had riſen in inſurrection againſt the French; ſo that in every quarter their affairs ſeemed deſperate. Few or no reinforcements arrived from the interior, and their generals were left to act upon the defenſive, and to detain the enemy at a diſtance from the frontiers of France as long as poſſible. One effort of offenſive war only remained, and, after ſome delay, it was made with much vigour.

360
Macdonald and Moreau concert meaſures for attacking the allies.

Macdonald was ſtill with a conſiderable French army in the ſouthern parts of Italy, and occupied the territories of Rome and Naples. No attempt was made on the part of the combined powers to cut off his retreat; probably from the conviction that ſuch an enterpriſe could not be accompliſhed with ſucceſs in the mountainous countries of Tuſcany and Genoa, through which it would be in his power to paſs. Aware of this circumſtance, he was in no haſte to remove, though the combined army now occupied almoſt the whole territory between him and France. He gradually concentrated his forces, however, and drew near to the ſcene of action. His army amounted to 30,000 men; and he was ordered by the Directory to evacuate the new-born republics of Rome and Naples, and to form a junction, if poſſible, with the army of Moreau. The preſent ſituation of the allies, however, tempted Macdonald to hazard an action by himſelf. Marſhal Suwarrow had extended his forces over Lombardy and part of Piedmont, in order to afford protection to the well-diſpoſed inhabitants of theſe countries; and Macdonald and Moreau had concerted between them a plan for dividing their antagoniſts, and vanquiſhing them, as the French generals had often vanquiſhed their enemies in detail. It was only by Macdonald, however, that any important blow could be ſtruck; but it was neceſſary that Moreau ſhould draw upon himſelf a great part of the Auſtro-Ruſſian forces, that the remainder might be more completely expoſed to his colleague's attack. For this purpoſe he had recourſe to a ſtratagem.

Towards the end of April, the French fleet, amounting to 16 ſhips of the line, had ventured out of Breſt harbour. Ireland was ſuppoſed to be the place of its deſtination; and the Britiſh fleet was ſtationed in the ſituations moſt likely to prevent its arrival there. The French, however, intending to form a junction with the

361 Junction of the French and Spaniſh fleets.

the Spaniſh fleet, which was ſtill blockaded in the port of Cadiz, ſailed ſouthward. When they approached Cadiz, a ſtorm aroſe, which prevented any attempt on their part to enter the harbour, and any effort on the part of the Britiſh admiral, Lord Keith, to bring them to an engagement. On the 4th and 5th of May, therefore, they paſſed the Strait of Gibraltar, and ſteered for Toulon. Lord Keith kept his ſtation near Cadiz till the 9th of May, and then entered the Mediterranean in queſt of the French fleet. The Spaniards immediately put to ſea, and went into the Mediterranean alſo. The French fleet entered Toulon, and afterwards went out in queſt of the Spaniſh fleet. They ſailed towards Genoa, and afterwards to Carthagena, where they met their allies. The two fleets being now united once more, paſſed Gibraltar, and ſailed round to Breſt, where they arrived in ſafety, without being overtaken by the Britiſh.

362 Partial ſucceſſes of Macdonald.

Moreau, in the mean time, took advantage of the arrival of the French and Spaniſh ſquadrons in the vicinity of Genoa, to ſpread a report that they had brought him a powerful reinforcement of troops, in the hope of withdrawing from Macdonald the attention of Suwarrow. This laſt officer was himſelf at Turin. His advanced troops poſſeſſed the paſſes of Suſa, Pignerol, and the Col d'Aſſiette; while, at the lower extremity of the vaſt track of country over which his army was ſcattered, General Hohenzollern was poſted at Modena with a conſiderable force, and General Ott was at Reggio with 10,000 men. On the 12th of June, Macdonald began his operations. His advanced diviſions attacked Hohenzollern at Modena on that day, defeated him, and took 2000 of his men priſoners. The French, at the ſame time, attacked General Ott; and, after obliging him to retreat, they entered Parma on the 15th of June. On the 17th, General Ott was again attacked, and compelled to retire upon Caſtel St Giovanni. But here the progreſs of Macdonald was arreſted.

363 He is completely defeated by Suwarrow.

Suwarrow had been informed of his approach and alarming ſucceſſes; and with that preſence of mind, and that promptitude of energy, which ſo ſtrongly mark the whole of his conduct, he ſuddenly left Turin on the 15th of June, at the head of 20,000 men; and having marched ſeventeen leagues in eight-and-forty hours, came up with Macdonald's army on the banks of the Tidone. The Ruſſian Generals Roſenberg and Foerſter commanded the right and the centre; the left wing was commanded by the Auſtrian General Melas; the Ruſſian General Prince Procration commanded the advanced guard, and Prince Lichtenſtein the reſerve. A deſperate action now commenced, which, conteſted with equal obſtinacy on both ſides, was fought during three ſucceſſive days. At length victory, ſtill faithful to the ſtandard of Suwarrow, declared for the allies. The French, driven on the 1ſt day from the Tidone to the Trebbia, were there ultimately defeated on the 19th, after a carnage on both ſides, ſuch as ſome of the oldeſt officers in the army declared that they had never before ſeen. The Ruſſians and French repeatedly turned each others line, and were mutually repulſed. Suwarrow, who appeared in perſon wherever the fire was heavieſt, and his troops moſt cloſely preſſed, is ſaid to have had 7 horſes killed under him, and to have ſtript himſelf to the ſhirt on the 19th, running on foot from rank to rank, to urge the troops forward by his preſence and example (u). With all theſe exertions of heroiſm, however, and greater have ſeldom been made, the iſſue of the conteſt continued doubtful, till the gallant Kray, in direct diſobedience to the pernicious orders of the Aulic Council at Vienna, arrived at the head of a large detachment from the army beſieging Mantua, and, on the 19th, decided the fate of the day.

The French fled during the night; and, on the morning of the 20th, Suwarrow purſued them with his army in two columns. It ſeldom happens that German troops can overtake the French in a march. The Ruſſians now did ſo, however; and at Zena the rear guard of the French, being ſurrounded, laid down their arms. The reſt of the French army found ſafety in the paſſes of the Appennines and the Genoeſe territory, after having loſt on this occaſion, in killed, wounded, and priſoners, not leſs than 17,000 men.

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Moreau, in the mean time, had attacked the Auſtrians under General Bellegarde in the vicinity of Alexandria. Though ſuperior to him in numbers, they were completely beaten; but Suwarrow having returned with infinite rapidity after his victory over Macdonald, the temporary advantage gained by Moreau became of no importance. Suwarrow complained loudly of the conduct of the Aulic Council on this occaſion; while they, in return, imputed their diſaſter under Bellegarde to his unſkilful diſtribution of the whole troops, which had expoſed an immenſe army to great danger from the enterpriſes of an handful of men. It is not our buſineſs to decide between them. The inſtructions of the Council to Kray not to co-operate with the commander in chief of the combined army, ſeem to us in the higheſt degree abſurd, if not treacherous; and we have heard a general officer, whoſe name, were we at liberty to give it, would do honour to theſe pages, ſay, that the diſtribution of the troops, of which that council complained, was the moſt maſterly thing that has been done during the war. Be this as it may, a diſtruſt and mutual miſunderſtanding thus commenced, or, at leaſt, made its firſt open appearance, which gave good reaſon to ſuſpect that little cordiality of co-operation would long exiſt between theſe allies. They continued, however, for ſome time to enjoy uninterrupted proſperity under the command of Suwarrow. The ſieges of the different Italian fortreſſes were very cloſely preſſed. They all ſurrendered in ſucceſſion; and the period appeared faſt approaching when it would be in the power of the allied armies to enter the ancient territory of France.

If we turn our eyes to a different quarter, we ſhall find

(u) We had this information from an officer of high rank, now reſiding in Weimar, who was preſent in the action; and who added, that the Coſſacs, as ſoon as they ſaw their old commander in his *ſhirt*, ruſhed upon the enemy with an impetuoſity which nothing could withſtand. The ſtory is by no means incredible; for Suwarrow, who deſpiſes coſtume, is known to have fought repeatedly in his ſhirt againſt the Turks; and he would be as hot on the Trebbia as ever he was on the Danube.

find the French as much humbled at this time in Paleſtine by Britiſh valour, as they were in Italy by the united armies of Ruſſia and Auſtria. The hero of France, the conqueror of Italy, the boaſted legiſlator of Europe, after having defeated the Mamalukes, taken poſſeſſion of Alexandria and Cairo, and profeſſed himſelf a Mahometan in Egypt, led an army into Paleſtine with the avowed purpoſe, it has been ſaid, to take poſſeſſion of Jeruſalem, and by rebuilding the temple, and reſtoring the Jews, to give the lie to the prophecies of the Divine founder of the Chriſtian religion. At the head of a choſen band, exceeding 12,000 in number, and poſſeſſed of a ſtaff eminent for military ſkill and experience, he arrived at the ſmall town of Acre, ſituated on the ſea-coaſt, 28 miles ſouth of Tyre, and 37 north of Jeruſalem. To this town, which was wretchedly fortified, and defended only by a ſmall garriſon of Muſſelmans, he laid ſiege in form; and the governor would have ſurrendered unconditionally, had he not been, we ſay not *perſuaded*, but *decoyed*, by an Engliſh *naval* officer, to make a vigorous reſiſtance. We need not add, that the naval officer was SIR SIDNEY SMITH, or that the beſieging general was BONAPARTE.

The command of the garriſon being entruſted to Sir Sidney Smith, who was not to be bribed by French gold, or corrupted by French philoſophy, the hero who, by the aid of theſe allies, had ſo quickly routed armies, and conquered ſtates in Italy, was detained before the town of Acre *ſixty nine* days; though the number of the allies who defended that town exceeded not 2000 men! Foiled in *eleven* different attempts to carry it by aſſault, one of which was made during the truce which he himſelf had ſolicited to bury the dead, he was ultimately obliged to retreat, leaving eight of his generals, eighty-five of his officers, and *one half* of his army behind him. The ſuperiority of the Britiſh over the Corſican hero was, during this ſiege, more fully diſplayed in conduct than even in courage. The true magnanimity evinced by the former; his temperate replies to the audacious calumnies and atrocious falſehoods of his adverſary: and the moderation and humanity which characteriſed his diſpatches, and invariably marked his behaviour to thoſe whom the fortune of war ſubjected to his power—give additional luſtre to the brilliant victory which his valour, his energy, and his perſeverance, ſo eſſentially contributed to ſecure.

But while we pay a tribute of juſtice to the merits of our gallant countryman, we muſt not omit to notice the high deſerts of the brave, the loyal, the virtuous PHILIPEAUX, his gallant comrade, the partner of his toils, and the partaker of his glory. The ſkill of this French officer as an engineer was moſt ſucceſsfully diſplayed in the defence of Acre; and, indeed, his exertions on that memorable occaſion ſo far ſurpaſſed his ſtrength, that he actually periſhed through fatigue.

The defeat of Bonaparte at Acre, which effectually ſtopped his deſtructive career, will be conſidered as important indeed, when it is known that his arts of intrigue had ſo far ſucceeded as to prevail on the numerous tribe of the Druſes to join his ſtandard with *ſixty thouſand* men immediately after the reduction of that town. Had this junction been effected, it was intended to proceed to Conſtantinople, and, after plundering the city, to lay it in aſhes! It is ſcarcely poſſible to calculate the dreadful conſequences of ſuch an event on the political ſtate of Europe. If ſervices are to be eſtimated in proportion to their effects, we know of none, during the preſent war, fertile as it has been in brilliant atchievements, that deſerves a higher reward than the defeat of Bonaparte at Acre.

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During theſe reverſes abroad, France had begun to ſuffer much internal agitation, and the Directory found itſelf in a very difficult ſituation. The elections, as uſual, were unfavourable to them; and amidſt the contempt with which they now began to be regarded, it was no longer poſſible to ſecure a majority in the Councils, by unconſtitutionally annulling the elections of their political opponents. They demanded money, and were anſwered by reproaches, on account of their profuſion, and the rapacity of their agents. The royaliſts in the ſouth and the weſt began to form inſurrections. They were ſubdued with much difficulty, on account of the abſence of the troops. The people had totally loſt that enthuſiaſm which, in the earlier periods of the revolution, induced them to ſubmit to ſo many evils, and to make the moſt violent efforts without murmuring. They beheld the renewal of the war with regret, and were unwilling to aſſiſt by their exertions to reſtore power and ſplendour to the faction which had trampled upon their freedom.

Amidſt all theſe difficulties, an event occurred which, for a time, gave the Directory the hope of being once more able to rouſe the dormant energies of their countrymen. After the defeat of Jourdan, a detachment from the army of the Archduke Charles had occupied Raſtadt, where the Congreſs ſtill ſat. On the 28th of April an order was ſent by an Imperial officer to the French miniſters, requiring them to quit Raſtadt in 24 hours. They demanded a paſſport from Colonel Barbaſcy, who had ſent the order; but this he could not grant, none having that power but the commander in chief. They declared themſelves determined to depart without delay, although the evening approached. They were detained about an hour at the gate of the town, in conſequence of general orders which had been received by the military to ſuffer none to paſs. In conſequence of an explanation, however, and of the interpoſition of ſuperior officers, they were allowed to depart. The three miniſters, Bonnier, Roberjot, and Jean Debry, were in carriages. The wife of Roberjot, and the wife and daughters of Jean Debry, were along with them; and they were attended by the miniſters of the Ciſalpine republic. When they had advanced to a very ſhort diſtance from Raſtadt, they were met by about 50 huſſars of the regiment of Szeckler, who made the carriages to halt, and advancing to the firſt of them, containing Jean Debry, demanded his name. He told them his name, and added that he was a French miniſter returning to France. On receiving this anſwer, they immediately tore him from his carriage, wounded him in ſeveral places with their ſabres, and caſt him into a ditch, on the ſuppoſition that he was killed. They treated in the ſame manner the two other ambaſſadors, Bonnier and Roberjot, whom they murdered upon the ſpot. They offered no perſonal violence, however, to the reſt of the company, who were allowed to return to Raſtadt; but they robbed the carriages of whatever effects they contained; and the papers of the ambaſſadors were conveyed to the Auſtrian commander. After the departure of the ſoldiers, and the return of the

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Aſſaſſination of the French envoys.

carriages,

French Revolution 1799.

carriages to Raſtadt, Jean Debry wandered about the woods all night, and returned alſo Raſtadt on the following day. He claimed the papers belonging to the legation from the Auſtrian commander, but they were refuſed to be reſtored.

368 Turned by the Directory to its own advantage.

During the whole of the long period that the Congreſs had ſat, Raſtadt and its vicinity had been occupied by French troops, and it was only a few days ſince the Auſtrians had obtained poſſeſſion of it. This event therefore caſt, at leaſt, a ſevere reproach upon the diſcipline of the Auſtrian army. It did more; it made every honeſt man regret, that troops, engaged in the ſupport of a good cauſe, ſhould think to promote that cauſe by the murder even of the greateſt villains. The Archduke Charles made haſte to diſclaim all knowledge of it in a letter to Maſſena; but the French Directory, regarding it as a fortunate occurrence, from its tendency to rouſe the reſentment of the nation, addreſſed to the two Councils, on the 5th of May, a meſſage, in which they aſcribed it to a deliberate purpoſe on the part of the Auſtrian government to inſult France by the aſſaſſination of her ambaſſadors. They thus converted the private act of a few deſperate individuals into a meaſure of public policy; as if the death of thoſe wretched miſcreants could have been of conſequence to the enemies of the *great* nation. The unpopularity of the Directory, however, and the obvious inutility of ſo groſs a crime, prevented this accuſation from obtaining much credit, or producing great effects upon the people. In a private letter which a friend of our's received at that period from the Continent, he was aſſured that the murder of the envoys "*fait plus de bruit que de ſenſation;*" and that the general opinion was, that the Directory itſelf knew more of the authors of that crime than the Archduke or the Auſtrian government.

369 Diſſenſions in France.

Upon the introduction of the new third of this year into the Councils, a violent oppoſition to the Directory commenced. Sieyes, who was ambaſſador at Berlin, and who had enjoyed, during the whole progreſs of the revolution, a very conſiderable influence over all the parties that had ſucceſſively enjoyed the ſupreme authority, was elected into the Directory. At the firſt eſtabliſhment of the conſtitution he had refuſed to occupy this ſtation, and it excited much ſurpriſe when he readily accepted the office in the preſent calamitous ſtate of the Republic. His admiſſion into the Directory, however, did not reconcile the public or the two Councils to that body. A violent conteſt for power betwixt the Moderate and the Jacobin parties ſeemed to approach; but they ſoon came to a compromiſe. Treilhard was removed from the Directory, under the pretence that he had held an office in the ſtate within leſs than a year previous to his nomination. Merlin and Reveillere were compelled to reſign, to avoid an impeachment with which they were threatened; but Barras ſtill contrived to retain his ſtation. Moulins, Gohier, and Ducos, men little known, and by no means leaders of the contending parties, were appointed Directors. The power was underſtood to be divided, and that neither party greatly predominated. An attempt was made to revive public ſpirit, by encouraging anew the inſtitution of clubs, which had been ſuppreſſed by the Directory. The violent Jacobins were the firſt to take advantage of this licence. They reſumed their ancient ſtyle, their propoſals for violent meaſures, and their practice of denouncing the members and the meaſures of government. But the Directory becoming alarmed by their intemperance, obtained leave from the Councils to ſuppreſs their meetings before they were able to intereſt the public in their favour.

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Conſiderable efforts were now made by the French government to recruit their armies; but the deranged ſtate of the finances, which the votes of the Councils could not immediately remedy, prevented the poſſibility of their gaining a ſuperiority during the preſent campaign. The difficulty was alſo increaſed by the neceſſity of reſiſting immenſe armies in different quarters at the ſame time, France being aſſailed at once on the ſide of Holland, Switzerland, and Italy. Such, however, were the exertions of the Directory, that they ſeemed not deſtitute of the hope of being able ſpeedily to aſſume, on the frontier, a formidable, and even menacing poſture. In the beginning of Auguſt, their Italian army amounted to 45,000 men. The different bodies of troops of which it conſiſted had been drawn together, and concentrated nearly in the ſame poſitions which Bonaparte had occupied before his battles of Montenotte and Milleſimo. The command of the whole was given to Joubert, a young man, who had been much diſtinguiſhed under Bonaparte; and who, in the ſtyle of gaſconade employed by that general, aſſured his government of victory, declaring, that he and Suwarrow ſhould not both ſurvive the firſt battle. In this boaſting declaration he ſeems to have been in earneſt; for, on taking the command, he prevailed with Moreau to remain in the army as a volunteer till the firſt battle ſhould be fought. The allies had now taken Turin, Aleſſandria, Milan, Peſchiera, and Ferrara, with a rapidity which would lead one to ſuppoſe that ſome new mode had been invented of materially abridging the duration of ſieges. The ſtrong citadel of Turin opened its gates, to the aſtoniſhment of Europe, after a bombardment of only *three days;* the citadel of Aleſſandria ſurrendered to the Auſtrian General Bellegarde, on the 22d of July, after a ſiege of *ſeven days;* and the ſtill more important fortreſs of Mantua ſurrendered to the brave General Kray, on the 29th of the ſame month, after a ſiege of only *fourteen days.* The garriſon of Aleſſandria amounted to 2400 men; that of Mantua to 13,000. The former were detained priſoners of war, and the latter were allowed to return to France on their *parole;* a parole which the commanders of the allied armies could not reaſonably expect to be kept. This has given riſe to a ſuſpicion, that the fortreſs was voluntarily ſurrendered to the Auſtrians, in order that the Directory might recruit its armies with the garriſon.

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The allies next began to beſiege Tortona, and Joubert reſolved to attempt its relief. He hoped to accompliſh this object, and to gain ſome advantage over their army, before General Kray could arrive to the aſſiſtance of Suwarrow with the troops that had been occupied in the ſiege of Mantua. On the 13th of Auguſt, the French drove in the whole of the Auſtrian poſts, and took poſſeſſion of Novi. Here they encamped on a long and ſteep, but not high, ridge of hills, with their centre at Novi, their right towards Seravalle, and their left towards Baſaluzzo. On the 14th they remained quiet; and on the 15th they were attacked by Suwarrow, whoſe army was now reinforced

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by the arrival of General Kray from Mantua. The right wing of the allied army was commanded by Kray, its left by Melas, and its centre was occupied by the Ruſſians, under Prince Pongrazion (Procration) and Suwarrow in perſon. The attack began at 5 o'clock in the morning, and was continued during many hours. Soon after the commencement of the battle, while the French commander in chief, Joubert, was urging his troops forward to a charge with the bayonet, he received a muſquet ſhot in his body; and, falling from his horſe, immediately expired. Moreau inſtantly reſumed the command. After an obſtinate conteſt, the allied army gave way, and was compelled to fall back in all quarters. The attack, however, was repeatedly renewed, and much blood was ſhed. From the obſtinate manner in which they fought, the Ruſſians, in particular, ſuffered very ſeverely. They made three unſucceſsful efforts againſt the centre of the French army, and on each occaſion thoſe immediately engaged were rather deſtroyed than repulſed. The laſt attack along the whole line was made at three in the afternoon. The French remained unbroken; and the day muſt have terminated in the defeat of the allies, had not General Melas ſucceeded in turning the right flank of the French line. Their right wing was thus thrown into confuſion. Melas purſued his advantage till he obtained poſſeſſion of Novi, and the whole French army made a rapid retreat under the direction of Moreau.

According to the accounts given by the Auſtrians, the French loſt in this battle 4000 killed and an equal number taken priſoners. They acknowledged their own loſs in killed to be equal to that of the French, but the loſs ſuſtained by the Ruſſians was never publiſhed. The general reſult of the battle was the total ruin of the French affairs in this quarter. The allies retained their decided ſuperiority; and there was no enterpriſe which, on the preſent theatre of the war, they might not have ventured to undertake. The French renounced all hope of defending Genoa, and prepared to evacuate that city and its territory. The Directory expected an immediate invaſion of the ſouth of France, and addreſſed a proclamation to the people, urging them to act with firmneſs and energy amidſt the calamities with which the country was now menaced. But theſe apprehenſions were unneceſſary. The court of Vienna had other objects in view that were leſs dangerous to their enemy. They neither invaded Genoa nor France, but quietly proceeded in the ſiege of Tortona. The vanquiſhed army was ſurpriſed to find itſelf unmoleſted after ſuch a defeat; and in a few days ventured to ſend back parties to inveſtigate the movements of the allies. The new commander Championnet, who had ſucceeded Joubert, found to his no ſmall aſtoniſhment that they had rather retreated than advanced; and he immediately occupied the ſame poſitions which his army had held before the battle of Novi.

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Inſtead of purſuing the advantages they had gained in Italy, the Aulic council, or council of war at Vienna, now perſuaded Suwarrow to leave that country with his Ruſſians, and to ſet out for Switzerland to drive the French from thence. In the early part of the campaign, the Archduke Charles had ſucceeded, after various attacks, in driving the French from the eaſtern part of Switzerland beyond Zurich, of which laſt city he retained poſſeſſion. The Directory, however, had ſent their new levies chiefly towards this quarter; ſo that in the middle of the month of Auguſt Maſſena's army amounted to 70,000 men. The Archduke was now ſo far from being able to purſue the advantages he had gained, that of late the French had reſumed the offenſive, and threatened to endanger his poſition. Their right wing under Lecourbe had even ſucceeded in taking poſſeſſion of Mount St Gothard, which is the great paſs that leads from the centre and eaſtern part of Switzerland into Italy. The cabinet of Vienna probably wiſhed to throw the ſevereſt duties of the war upon their northern aſſociates. The veteran Suwarrow had never, during his long military career, ſuffered a ſingle defeat. His preſumption of ſucceſs was therefore high; and he perhaps felt himſelf not a little flattered by the requeſt to undertake an enterpriſe in which the Auſtrians had failed though led by their moſt fortunate commander. It is indeed certain that he conſidered himſelf as called out of Italy too ſoon. Though confident of being properly ſupported, he agreed to proceed with his troops from Piedmont to Switzerland, where another Ruſſian army had lately arrived. Delays, however, were thrown in his way. Tortona did not fall quite ſo ſoon as was expected; and when he was ready to march, the Auſtrian commander in Italy refuſed to ſupply him with mules for the tranſport of his baggage. Unable to reply to the indignant expoſtulations of the Ruſſian hero, this man deſcended to a pitiful falſehood, by aſſuring him that he would find a ſufficient number of mules at Bellinzone, where, when he arrived, not one was to be had. He had now no other reſource but to diſmount the cavalry, and employ their horſes to drag along the baggage. Under all theſe difficulties, he arrived, by forced marches, on the confines of Switzerland, on the day appointed by him and the Archduke; but the Auſtrian cabinet had, in the mean time, taken a ſtep which made all his exertions uſeleſs.

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Suwarrow
leaves Italy, and
marches to
Switzerland.

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Is deſerted,
if not betrayed, by
the Auſtrians.

Thinking it degrading to a Prince of the Imperial houſe, who had ſo long held the higheſt military rank, to ſerve under the Ruſſian General, and not having the confidence to require the moſt experienced leader in Europe to receive the orders of a man ſo young as the Archduke, they ſent that prince with his army to attack the French, who, in a ſmall body, had entered into Swabia. He began accordingly to draw off his troops in the beginning of September, before Suwarrow was in readineſs to leave Italy. The number which he took with him has been differently eſtimated, the loweſt computation ſtating it at 48,000, and the higheſt at 60,000. The former is the moſt probable; ſince it is well known that 20,000 would have been fully adequate to the purpoſe for which he marched. The army which he left behind him is more perfectly aſcertained: it conſiſted of 21,000 Ruſſians, 18,900 Auſtrians, Bavarians, and other auxiliaries, forming a total of 39,900 men.

Upon what principle of military tactics the Aulic council could ſuppoſe that a ſkilful and intrepid commander like Maſſena, with a force nearly double that of the allies, would remain in a ſtate of inactivity, it is not eaſy to conceive. He perceived at once the advantage which might be derived from this unaccountable movement of the Archduke. The French troops in Swabia were therefore ordered to advance rapidly, and to threaten the rear of the Archduke's army. As the repulſe of theſe troops, and the invaſion of France towards Alſace, formed a part of the Auſtrian commander's plan of operations, he marched againſt them with his army. The French made as much reſiſtance as the ſmallneſs of their force would permit. The Archduke, however, gradually drove them towards the Rhine. The better to carry on their plan of deception, they made a ſerious ſtand in the neighbourhood of Manheim, and were defeated with the loſs of 1800 men. The Auſtrians entered Manheim, and ſeemed ready to croſs the Rhine in this quarter.

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The allies defeated in Switzerland.

All this while Switzerland was left completely expoſed to the enterpriſes of Maſſena. General Hotze, with the Auſtrians, occupied the right wing of the allied army there. The newly arrived Ruſſian army was ſtationed in the centre at Zurich, under the command of General Korſakof; and the left, conſiſting chiefly of Bavarians and other troops of the empire, was commanded by Nauendorf. Maſſena remained quiet till he learned that the Archduke had entered Manheim, and that Suwarrow, having taken Tortona, was on his march towards Switzerland by Mount St Gothard. This laſt poſition was defended by Lecourbe; and Maſſena reſolved, in the mean time, to anticipate the arrival of Suwarrow. On the 24th of September, having drawn the attention of the Ruſſians to another quarter by a falſe attack, he ſuddenly croſſed the Limmat, a river which divided the two armies near the convent of Farr, which is three leagues diſtant from Zurich. A part of the French troops engaged the Auſtrians, while the greater part of the army marched againſt the Ruſſians at Zurich. The Auſtrian General Hotze was killed in the commencement of the action. General Petrarch, who ſucceeded him in the command, contrived to avoid a total rout, and retired during the night with the loſs of about 4000 men. The conteſt with the Ruſſians was ſingularly obſtinate. In a mountainous country, to which they were ſtrangers, and contending againſt the moſt ſkilful military leaders that the ſouth of Europe had been able to produce, they laboured under every diſadvantage. They could not be put to flight, however; and even when different diviſions of them were ſurrounded, they refuſed to lay down their arms, and were ſlaughtered upon the ſpot. By the retreat of the Auſtrians on the evening of the 25th, they found themſelves on the 26th nearly ſurrounded in Zurich. They now began to retreat alſo; and we are only ſurpriſed at the ability of the Ruſſian General in effecting his retreat in ſuch good order, and with ſuch little loſs; for if the official accounts deſerve credit, his loſs in killed, wounded, and taken, did not exceed 3000 men. He was obliged, however, to abandon his baggage and cannon to the enemy.

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Suwarrow's march.

During theſe operations, Suwarrow was advancing on the ſide of Italy with an army rated, in ſome accounts, at 18,000, in others at only 15,000; and forcing the French from their ſtrong poſitions on Mount St Gothard, deſcended, on the very day on which Maſſena made his general attack, into the valley of Urſeren; and driving Lecourbe before him, with conſiderable ſlaughter, advanced as far as Altorf. He even penetrated on the next day into the canton of Glaris, and took 1000 of the French priſoners; while the Ruſſian General Roſemberg was equally ſucceſsful in the canton of Schwitz, where General Auffenberg had effected a junction with him; and General Linken defeated and took another corps of French, conſiſting of 1300 men.

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His adm
rable co
duct.

Maſſena, however, now turned upon the Field-marſhal with the greater part of his army; and, by hemming him in on all ſides, expected to have made him, and the Grand Duke Conſtantine, priſoners. Suwarrow, however, defended himſelf againſt every attack with unexampled vigour and addreſs. A ſingle paſs among the mountains was all that remained unoccupied by the French. He diſcovered this circumſtance, and eſcaped though cloſely purſued. He left his cannon, baggage, and proviſions, among the dreadful mountains and precipices with which that country abounds. He made his way, however, eaſtward through the Griſon country, and at length arrived at Coire with about 6000 men in great diſtreſs.

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His indig
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Vienna.

Nothing could exceed the indignation of this old warrior when he diſcovered the manner in which affairs had been conducted, the hazardous ſtate in which the Ruſſians had been abandoned by the Archduke, and the conſequent ruin which they had encountered. He conſidered himſelf and his countrymen as treacherouſly expoſed to deſtruction; he loudly complained of the Commander of the allied forces in Switzerland; publicly taxed the council of Vienna with ſelfiſhneſs and injuſtice; and refuſed all farther co-operation with the Auſtrian army. He ſent an account of the whole tranſaction to St Peterſburgh in a letter, of which the compoſition would do honour to the fineſt writer of the age, and withdrew with his troops to the neighbourhood of Augſburg to wait for farther orders.

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Invaſion
Holland

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Capture
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fleet.

In the mean time, Great Britain prepared to invade Holland with an army of 40,000 men, conſiſting of Britiſh troops and Ruſſian auxiliaries. The firſt diviſion, under General Sir Ralph Abercromby, ſailed in the month of Auguſt, under the protection of a fleet commanded by Admiral Lord Duncan. Bad weather prevented a landing from being attempted till the 27th. On the morning of that day the troops landed without oppoſition upon the ſhore of Helder Point in north Holland, at the entrance to the Zuyder Sea. They had not been expected in this quarter, and the troops in the neighbourhood were conſequently few. The Britiſh, however, had no ſooner begun to move forward, than they were attacked by a conſiderable body of infantry, cavalry, and artillery, who had been haſtily aſſembled from the neareſt towns. The Dutch troops maintained the conteſt with much obſtinacy; but they were gradually fatigued by the ſteady oppoſition they encountered, and retired to the diſtance of two leagues. In the night they evacuated the fort of Helder, of which the Britiſh took poſſeſſion on the morning of the 28th. A detachment from the Britiſh fleet commanded by Vice Admiral Mitchell, now entered the Zuyder Sea by the ſtrait of the Texel, to attack the Dutch fleet under Admiral Story. This laſt officer, inſtead of retiring for ſafety to any of the ports, or to the ſhallow water with which that ſea abounds, ſurrendered the whole fleet on the 30th of Auguſt without firing a gun, under pretence that his ſeamen were mutinous, and would not fight.

Had the expedition terminated here, it might have been regarded as extremely fortunate, and as eſtabliſh-

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ing the power of the Britiſh navy without a rival. But it was reſolved to follow up this firſt ſucceſs by an effort on land to reſtore the authority of the Stadtholder, and the ancient government of the United Provinces. Many circumſtances were hoſtile to this enterpriſe. The whole army had not been ſent at once from Britain. As no more than the firſt diviſion had arrived, the troops could only reſt upon the ground they had gained till reinforcements ſhould be ſent. The terror ariſing from the firſt appearance of an invading army was thus allowed to paſs away, the enemies of the preſent Dutch government were diſcouraged, and leiſure was afforded to adopt effectual meaſures of defence. The place where the landing was effected was well choſen for an attack upon the Dutch fleet; but for an invaſion, with a view to the reſtoration of the Stadtholder, it was the worſt that could have been ſelected. North Holland, at the extremity of which it was made, is a narrow peninſula, everywhere interſected by canals and ditches, of about 40 miles in length. Here the invaders might be detained, and even ſucceſsfully reſiſted, by a force greatly inferior to their own. This alſo is the quarter of the country the moſt unfavourable to the cauſe of the Stadtholder. In Zealand, where his eſtates are ſituated, and in Rotterdam, which is full of Scotchmen and of families of Scottiſh extraction, his friends are numerous and powerful; but in Amſterdam, and in North Holland, which is under its influence, his enemies abound, and the reſiſtance to his power has been very great during every period of the Dutch hiſtory. When to all this it is added, that the rainy ſeaſon was approaching, and that a winter campaign in Holland is almoſt impoſſible, it will not appear ſurpriſing that this expedition was attended with little ultimate ſucceſs. It is ſaid that, amidſt the preſſure of the many difficulties which ſurrounded them, the French Directory heſitated much about undertaking the defence of Holland; but the place, and the time of landing the invading army, at once brought them to a determination. General Brune was ſent thither, with whatever troops could be haſtily collected, to ſupport the Dutch General Daendels.

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General Abercromby, in the mean time, remained upon the defenſive at Schager Brug, waiting for reinforcements. His inactivity encouraged the enemy on the 10th of September to venture an attack upon his poſition. They advanced in three columns, two of which conſiſted of Dutch and one of French troops. They were repulſed, however, in all quarters, and retired to Alkmaer. On the 13th the Duke of York arrived with additional troops, and aſſumed the chief command. The Ruſſian auxiliaries having alſo arrived, offenſive operations were immediately reſolved upon. On the 19th the army advanced. General Abercromby commanded the left, which proceeded along the ſhore of the Zuyder Sea againſt Hoorne. The centre columns were commanded by Generals Dundas and Pultney; and the right wing, conſiſting of Ruſſians, was commanded by their own General D'Herman. In conſequence of ſome ſtrange miſunderſtanding, the Ruſſians advanced to the attack ſoon after three o'clock in the morning, which was ſome hours previous to the movement of the reſt of the army. They were ſucceſsful in their firſt efforts, and obtained poſſeſſion of the village of Bergen; but preſſing eagerly forward, and being unſupported by the other columns, they were nearly ſurrounded. Their commander was taken priſoner; and though the Britiſh came in time to protect their retreat, they loſt at leaſt 3000 men. This failure on the right obliged the Britiſh Commander in chief to recal his troops from the whole advanced poſitions they had gained, though General Abercromby had actually taken Hoorne with its garriſon, and although General Pultney's column had carried by aſſault the principal poſition of the Dutch army called *Ourds Carſp.l.*

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Stopped by the enemy and the inclemency of the weather.

The ſeverity of the weather prevented another attack till the 2d of October, when after an engagement that laſted from ſix in the morning till the ſame hour in the evening, the Britiſh army ſucceeded in driving the united Dutch and French troops from Alkmaer and the villages in its neighbourhood. The conteſt was chiefly conducted among the ſand hills in the vicinity of the ocean; and the battle was maintained with ſuch obſtinacy, that the fatigue of the troops, together with the difficult nature of the country, prevented the Britiſh from gaining any great advantage in the purſuit. The retreating army immediately occupied a new poſition between Baverwyck and Wyck-op-zee. The Duke of York once more attacked them on the 6th; and after an obſtinate and bloody engagement, which was maintained till night, he remained in poſſeſſion of the field of battle. But this was the laſt ſucceſs of the invaders. Finding himſelf unable to make farther progreſs, in conſequence of the increaſing numbers of the enemy, the impracticable nature of the country, and the badneſs of the weather, which, during the whole of this year, was unuſually ſevere, the Duke of York retired to Schager Brug, and there waited for orders from England to return home. He was, in the mean time, cloſely preſſed by the United Dutch and French forces, ſo that his embarkation muſt have been attended with much hazard. He therefore entered into a convention with the French and Dutch generals; by which it was agreed, that they ſhould no farther moleſt him in his retreat, and that, in return, he ſhould not injure the country by breaking down any of the dykes which protect it againſt the ſea, and that Great Britain ſhould reſtore to France and Holland 8000 priſoners of war, taken previous to the preſent campaign.

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Coalition againſt France ready to be diſſolved.

In conſequence of theſe events, the affairs of France now began to aſſume a leſs unfavourable aſpect. They were indeed driven to the extremities of Italy, Championnet was defeated in every effort which he there made againſt the Auſtrians during the reſt of the year, and Ancona, which was the laſt place of any ſtrength poſſeſſed by the French, alſo ſurrendered on the 13th of November to General Frolich; but they retained the Genoeſe territory, and Switzerland and Holland continued under their power. The new coalition againſt them ſeemed once more ready to diſſolve. From the commencement of the French Revolution, a ſpirit of ſelfiſhneſs had mingled with all the efforts made by the continental powers of Europe againſt it, and had rendered them fruitleſs. To prevent the aggrandiſement of Auſtria, Pruſſia had early withdrawn, and ſtill ſtood aloof. Spain and Holland were retained under the influence of France by the efforts of her arms, and by the univerſal diffuſion of her wild principles among the people. Even the Britiſh cabinet, which of all the European powers has remained moſt true to the original purpoſe of the war, ſometimes forgot that object.

Thus, when invading Holland, the Dutch were informed, by a proclamation, that their ancient government was to be reſtored; but no offer was made to reſtore their diſtant poſſeſſions. Of all the coaleſced powers, however, Auſtria purſued her ſeparate intereſts with the leaſt diſguiſe. With much facility ſhe relinquiſhed the Netherlands, and ſuffered the principal bulwarks of Germany, Mentz, and Ehrenbreitſtein, to fall into the hands of the French, upon obtaining in exchange the Venetian territories, which Bonaparte had conquered, and thought himſelf authoriſed to ſell. During the preſent campaign, the whole conqueſts made by the united efforts of the Auſtrian and Ruſſian forces were ſeized by Auſtria in her own name, and none of the Princes of Italy obtained leave to reſume the government of their own territories. This conduct on the part of the allies gave every advantage to the French. They broke off the negociations at Liſle, under the pretence of defending the Dutch and Spaniſh ſettlements which the Britiſh government refuſed to relinquiſh. They found it eaſy to alarm the King of Pruſſia, by diſplaying the unbounded ambition of the houſe of Auſtria; and the Emperor of Ruſſia, having publicly declared to the members of the German empire, that the purpoſe for which he had taken up arms was not to diſmember France, but to reſtore peace to Europe, became jealous of the Court of Vienna, when he ſaw it purſue a conduct ſo very different. This jealouſy was encreaſed by the misfortunes of the Ruſſian troops; and all circumſtances ſeemed now to promiſe that the new coalition would ſpeedily be deſerted by its northern auxiliary.

385 Bonaparte vanquiſhes the Turks in Egypt.

While affairs were in this ſtate, an event occurred which exhibited the French Revolution under a new aſpect. When Bonaparte found himſelf compelled to retreat, baffled and diſgraced, from the ruins of Acre, he learned that a Turkiſh army was ready to invade Egypt by ſea. He returned, therefore, with his uſual celerity, by way of Suez, acroſs the deſart of Arabia Petrea, which divides Syria from that country, and was in the neighbourhood of the Pyramids on the 11th of July, when an army of 18,000 Turks landed from 100 ſhips at Aboukir. They took this fort by aſſault, and gave no quarter to the French garriſon of 500 men that it contained. On the 15th, Bonaparte began to march down the country againſt them. On the 25th he came in ſight of them, at ſix o'clock in the morning.

It is not wonderful that thoſe barbarians afforded him an advantage which had ſo often been preſented by the armies of Auſtria. They had divided their force into two parts, which were encamped on the oppoſite ſides of a beautiful plain. He had now formed a conſiderable body of cavalry, by obtaining for his men fleet horſes from Arabia. Theſe advanced rapidly into the centre of the Turkiſh army, and cut off the communication between its different parts. His infantry then attacked the right, which was the weakeſt diviſion of the Turks. They being ſpeedily panic ſtruck, attempted to fly to their ſhips, and every man was drowned in the ſea. The left diviſion of the Turks was next attacked. It made a more obſtinate reſiſtance, but was ſoon alſo put to flight. Some caſt themſelves into the ſea, and periſhed in attempting to reach the boats of their fleet; the reſt took refuge in the fort of Aboukir. The news of this battle reached France towards the end of September, and revived the memory of Bonaparte's victories, contraſted with the reverſes which the Republican armies had lately experienced. On the 10th of October a diſpatch was received from him by the Directory, and read to the Councils, giving an account of the capture of the fort of Aboukir, with the whole remains of the Turkiſh army. On the 14th of the ſame month a meſſage from the Directory announced, to the aſtoniſhment of all men, that Bonaparte, along with his principal officers, had juſt arrived in France, and that they left the army in Egypt in a proſperous ſtate. This laſt part of the meſſage was ſoon afterwards proved, by the intercepted letters of Kleber, and the other generals left behind, to be a ſcandalous falſehood. In one of theſe letters, Pouſſielgue ſays, "Every victory carries off ſome of our beſt troops, and their loſs cannot be repaired. A defeat would annihilate us all; and however brave the army may be, it cannot long avert that fatal event."

386 Arrives with hi principa officers France,

Bonaparte, however, was received at Paris with diſtinction, though nobody could tell why he had deſerted his army and come thither. The parties in the government were equally balanced; and both the Jacobins, and what were called the *Moderates*, ſolicited his aſſiſtance. The Jacobins ſtill poſſeſſed a majority in the Council of Five Hundred; but in the other Council their antagoniſts were ſuperior. The Director Sieyes was underſtood to be of the party of the Moderates; and the Jacobins had of late unſucceſsfully attempted to remove him from his office, under the pretence that the interval appointed by the conſtitution had not elapſed between his going out of the Council of Five Hundred and his election to the office of director. Neither party was ſatisfied with the exiſting authorities; but none of the uſual indications of approaching hoſtilities appeared. The Jacobins were far from ſuſpecting that Sieyes had a plot ripe for execution, which was to overwhelm them in an inſtant. They were even in ſome meaſure laid aſleep by an artful ſcene of feſtivity, in which the whole members of the Councils were induced to engage, on the 6th of November, under pretence of doing honour to the arrival of Bonaparte. On the morning of the 9th, one of the committees of the Council of Ancients, called the committee of Inſpectors of the Hall, preſented a report; in which they aſſerted, that the country was in danger, and propoſed to adjourn the ſitting of the legiſlature to St Cloud, a village about ſix miles from Paris. We have already mentioned, that the conſtitution entruſted to the Council of Ancients the power of fixing the reſidence of the legiſlative bodies, and that this Council could in no other caſe aſſume the initiative, or propoſe any law; their powers of legiſlation being otherwiſe limited to the unconditional approbation or diſapprobation of the decrees paſſed by the Council of Five Hundred. The Council of Ancients now ſuddenly decreed, that both Councils ſhould meet next day at St Cloud. As the Council of Five Hundred had no conſtitutional right to diſpute the authority of this decree, and as the ruling party in it was completely taken by ſurpriſe, its members ſilently ſubmitted, and both Councils aſſembled on the 10th of November at the place appointed.

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The Council of Five Hundred exhibited a ſcene of much agitation. They received a letter from Legarde, ſecretary to the Directory, ſtating, that four of its

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members had ſent reſignations of their offices, and that the fifth (Barras) was in cuſtody by order of General Bonaparte, who had been appointed commander of their guard by the Council of Ancients. While the Council were deliberating, Bonaparte entered the hall, attended by about twenty officers and grenadiers. He advanced towards the chair, where his brother Lucien Bonaparte ſat as preſident. Great confuſion enſued; he was called a Cromwell, a Cæſar, an uſurper. The members began to preſs upon him, and his countryman Arena attempted to ſtab him with a dagger. He was reſcued by his military eſcort. Lucien Bonaparte then left the chair, and caſt aſide the badge of office which he wore as a member of the Council. The confuſion did not diminiſh; but in a ſhort time a party of armed men ruſhed into the hall, and carried off Lucien Bonaparte. A tumultuous debate now began; in which it was propoſed that Bonaparte ſhould be declared an outlaw. The debate was ſoon terminated, however. The doors of the hall were once more burſt open. Military muſic was heard; and a body of troops proceeding into the hall in full array, the members were compelled to diſperſe. The Council of Ancients, in the mean time, ſetting aſide the conſtitution, paſſed a variety of decrees. They aboliſhed the Directory, and appointed in its ſtead an Executive Commiſſion; to conſiſt of Bonaparte, Sieyes, and Roger Ducos, under the appellation of Conſuls. They adjourned the ſittings of the legiſlative bodies till the 20th of February, and appointed two committees, conſiſting of twenty-one members, ſelected from each of the two councils, to act as legiſlators in the mean time. They alſo expelled a great number of members from their ſeats in the councils.

Moſt of the members of the Council of Five Hundred returned to Paris, after having been driven from their hall by the military; but a part of them remained at St Cloud, and, on the evening of the ſame day, confirmed all the decrees of the Council of Ancients. The new government entered upon its functions at Paris on the following day. That city remained tranquil, and the public funds even roſe upon the occaſion. On the 17th of November the conſuls decreed the tranſportation of a great number of the leading Jacobins and zealous republicans to Guiana, and ordered many others to be impriſoned; but theſe decrees were ſpeedily recalled, and affairs went on as quietly as if nothing unuſual had occurred.

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While Bonaparte was thus obtaining boundleſs perſonal aggrandiſement in Europe, the African expedition in which he had been engaged was utterly unſucceſsful in all its objects. The circumſtances which led to it, ſo far as concerned foreign nations, now came to light, and were ſhortly theſe: Tippoo Sultan, the ſon and ſucceſſor of the celebrated Hyder Ally, and ſovereign of the Myſore country, which forms a part of the peninſula of India, had been compelled to conclude a treaty of peace in the year 1792 with the Britiſh governor general, Lord Cornwallis, under the walls of Seringapatam his capital. By this treaty he reſigned to the invaders a part of his territory, and agreed to pay a large ſum of money. He was, moreover, under the humiliating neceſſity of conſenting that two of his ſons ſhould be delivered as hoſtages, to remain with the Britiſh till the pecuniary payments could be completed.

A war thus concluded could not become the foundation of much cordial amity between the parties. Tippoo had inherited from his father a deep ſentiment of hoſtility againſt the growing power of Britain in India. Though he ſubmitted on the occaſion now mentioned to the neceſſity of his circumſtances, yet he only waited a more fortunate opportunity to endeavour to recover what he had loſt; and even, if poſſible, to accompliſh the favourite object of all his enterpriſes, the complete expulſion of the Britiſh from India. At a former period, almoſt the whole of the native princes of this vaſt continent had entered into a combination againſt the power of Britain; but their deſigns had been defeated by the talents and exertions of Warren Haſtings, Eſq; The aſcendency of the Britiſh government in this quarter was now ſo great, that no ſuch combination could again be formed, and Tippoo felt that its power could only be ſhaken by the aid of an European army. France was the only country from which he could hope to obtain an adequate force. By the events of the revolution, however, and by the preſſure of the war at home, the rulers of France had been prevented from attending to diſtant views and intereſts. Their ſettlements in India had been ſeized by the Britiſh, and they had ceaſed to retain any poſſeſſions beyond the Cape of Good Hope, excepting the iſlands of Mauritius and Bourbon. In the year 1797, Tippoo reſolved to endeavour to renew his intercourſe with the French by means of theſe iſlands. One Repaud, who had once been a lieutenant in the French navy, and had reſided for ſome time at Seringapatam, had miſled Tippoo into a belief that the French had a great force at the Mauritius, which could immediately be ſent to his aid in caſe of a war. He therefore fitted out a ſhip, of which he gave the command to Ripaud, and ſent two perſons in it as his miniſters, with powers to negociate with the French leaders at the Mauritius. But, at the ſame time, to avoid exciting the ſuſpicions of the Britiſh government in his neighbourhood, he directed his meſſengers to aſſume the character of merchants, to act in that capacity in public, and to conduct their political negociations with ſecrecy. They arrived at the Mauritius towards the cloſe of the year 1797, and opened their propoſals to Malartic the governor, for an alliance between Tippoo and the French nation, with the view of obtaining the aid of an European army. They were received with great joy, and veſſels were inſtantly diſpatched to France to communicate their propoſals to the Directory.

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He renews his intercourſe with the French.

In the mean time, Malartic the governor of the Mauritius, from folly, from treachery, or from a deſire to involve Tippoo, at all hazards, in a quarrel with the Britiſh, took a ſtep which ultimately was in a great meaſure the means of defeating the plans, and accompliſhing the ruin of that prince. On the 30th of January 1798, he publiſhed and diſtributed a proclamation, in which he recited the whole private propoſals of Tippoo, and invited all French citizens to enliſt in his ſervice. Copies of this proclamation were ſpeedily conveyed by different veſſels, touching at the Mauritius, to the continent of India, to Britain, and to all quarters of the world. Accordingly, as early as the 18th of June 1798, the ſecret committee of the Court of Directors of the Eaſt India Company in London wrote to their governor general in India, requiring him, in conſequence of this proclamation, to watch the conduct of Tippoo, and even to engage in hoſtilities, if the meaſure

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His conduct watched by the Britiſh.

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ſure ſhould appear neceſſary. Before that period, however, the government in India had been alarmed, by the ſame means, and was making preparations for war. This, however, was no eaſy matter. It is the nature of European power, in theſe countries, gradually to decline. The nature of the climate, the view of returning home, and the diſtance from the ſeat of government, ſpeedily introduce a relaxation of the efforts and the vigilance by which dominion was originally acquired. The troops require to be continually renewed by levies from the parent country; and if this precaution is neglected for a very ſhort time, or negligently attended to, they become unable to protect the extenſive territories ſuch as Britain now poſſeſſed in India. When Lord Mornington, the governor-general, enquired into the ſtate of the Britiſh army at Madras, and whether he might hazard an offenſive war againſt Tippoo; he was informed, that three, if not ſix months would be neceſſary to aſſemble the ſcattered diviſions of the army, and to prepare them to defend their own territory. It was added, that ſuch was the feeble ſtate of the Britiſh forces in that quarter, that it might even be unſafe to excite ſuſpicion in Tippoo by military preparations, as he might, in that caſe, ruin them by a ſudden attack. Lord Mornington, however, reſolved to encounter every hazard, and ordered immediate and active preparations in every quarter.

In the meanwhile, Tippoo did not truſt for ſucceſs to the aid of France alone. He endeavoured to bring an attack upon the Britiſh and their allies, or ſubjects, in India, from the north-weſt, by inviting Zemaun Shah to invade the country. This prince is at the head of a formidable kingdom, made up of provinces torn from both Perſia and India. It was founded about ſixty years ago by Ahmed Khaun Abdalla, an Affghan chief, who followed Nadir Shah on his invaſion of India in 1739. He himſelf afterwards invaded India no leſs than ſeven times; and, in particular, he overthrew, with dreadful ſlaughter, the united forces of the Mahratta empire, in the year 1761, on the plains of Paniput. He was ſucceeded, in 1773 by his ſon Timmur Shah, who died, and was ſucceeded by his own ſon, the preſent prince. The dominions of Zemaun Shah extend from the left bank of the river Indus, on the ſea-coaſt, as far northward as the latitude of Caſhmeer; and from eaſt to weſt they are 650 Engliſh miles in length, comprehending the provinces of Cabal, Candahar, Peiſhere, Ghizni, Gaur, Sigiſtan, and Koraſan. He uſually keeps in pay an army of 150,000 horſe, beſides infantry to garriſon his fortreſſes. In expectation of direct aid from France, by Bonaparte's expedition to Egypt, and of an important diverſion to be made by Zemaun Shah, Tippoo endeavoured to remain quiet, and to temporiſe with the Britiſh.

Since the firſt victories of Lawrence and of Clive, the native princes of India have been eager to introduce the European art of war among their ſubjects. For this purpoſe they retain European adventurers to command and diſcipline a part of their troops, and even endeavour to form a guard for their perſons of European ſoldiers. The Nizam, a prince in alliance with the Britiſh, though in a great meaſure under their influence, had long retained around his perſon a conſiderable body of French, and of troops under their management. Theſe, under the command of one Perou, now poſſeſſed great influence at Hydrabad, the capital of the Nizam. It was of much importance that theſe ſhould be removed out of the way, to enable the Britiſh to obtain the aid of this prince as an ally in the approaching conteſt with Tippoo. Lord Mornington procured this object to be accompliſhed with ſo much ſucceſs, that, on the 22d of October 1798, the French corps under Perou was ſurrounded and diſarmed without bloodſhed, and a Britiſh force was ſubſtituted as a guard to the Nizam in its ſtead. The military preparations being in a conſiderable ſtate of forwardneſs, Lord Mornington next warned Tippoo Sultan, in a letter dated the 8th of November 1798, of his having a knowledge of his hoſtile deſigns and connection with the French. He alſo propoſed to ſend an ambaſſador to treat about the means of reſtoring a good underſtanding between the ſtates. Tippoo avoided returning an anſwer till the 18th of December, and then merely denied the accuſation, and refuſed to receive the ambaſſador. On the 9th of January 1799, the Britiſh governor again urged in writing that the ambaſſador ſhould be received. No anſwer was returned for a month; and, in the mean time, an army of 5000 men having arrived from England, orders were iſſued to General Harris to advance at the head of the Madras army againſt the kingdom of Myſore. Tippoo now offered to receive the ambaſſador, providing he came without an attendance; but this conceſſion was not accounted ſufficient, and the army advanced. An army from Bombay was, at the ſame inſtant, advancing on the oppoſite ſide of his dominions. A part of Tippoo's forces encountered this army and were defeated; and within a few days thereafter, on the 27th of March, the reſt of his army was defeated by General Harris. When an European army in India is tolerably numerous, the detail of its military operations againſt the natives is by no means intereſting; for the inhabitants of theſe enfeebling and fertile regions can never be made, by any kind or degree of diſcipline, to poſſeſs that moral energy which enables men to encounter danger with coolneſs and ſelf-command. They can ruſh on death under the influence of rage or deſpair, but they cannot meet the hazard of it with calmneſs and recollection. It is ſufficient to remark that, on the 7th of April, General Harris ſat down before Seringapatam. On the 9th, Tippoo ſent a letter to this officer, alleging his own adherence to treaties, and enquiring into the cauſe of the war. He was anſwered by a reference to Lord Mornington's letters. On the 20th he made another attempt to negociate, by writing to General Harris, requeſting him to nominate commiſſioners to treat of a peace. In anſwer to this propoſal, certain articles were ſent to him as the only conditions that would be granted. By theſe he was required to ſurrender half his dominions, to pay a large ſum of money, to admit reſident ambaſſadors from the Britiſh and their allies, to renounce all connection with the French, and to give hoſtages for the fulfilment of theſe ſtipulations.

Frencl Revolut 1799.

391 General Harris a- vances a- gainſt hi

On the 28th of April Tippoo again wrote to General Harris, requeſting leave to treat by ambaſſadors; but his propoſal was refuſed, upon the footing that he was already in poſſeſſion of the only terms of peace which would be granted. Could Seringapatam have held out for little more than a fortnight longer, the invading army muſt have retreated. The rainy ſeaſon was

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about to commence; and, by ſome ſtrange effect of negligence or treachery, proviſions were ſo deficient in the camp, that it was only by reducing the troops to half allowance that they could be made to laſt till the 15th of May. On the 30th of April, the beſiegers began to batter the walls of Seringapatam; and a breach being made, the city was taken by aſſault on the 4th of May. One o'clock afternoon had been choſen for this purpoſe, as the hotteſt hour of the day, and conſequently the time when it would be leaſt expected. Tippoo was in his palace; but on being informed of the attack, he haſtened to the breach, and fell undiſtinguiſhed in the conflict. His treaſures, and the plunder of the city, which was immenſe, went to enrich the conquering army, after deducting a ſhare for the Britiſh government and Eaſt India Company. His kingdom immediately ſubmitted. The part of it which formed the ancient kingdom of Myſore, was beſtowed upon a deſcendant of the former race of its kings, whom Hyder Ally had deprived of the ſovereignty; the additional territories that had been conquered by Hyder Ally were divided between the Britiſh and their allies, the Nizam and the Mahrattas. The family of Tippoo were either taken in the capital, or voluntarily ſurrendered themſelves to the conquerors. They were removed from that part of the country, and allowed a conſiderable penſion.

In the mean time, Zemaun Shah had actually invaded India from the north-weſt. He advanced to the vicinity of Delhi, ſpreading terror and deſolation whereever he came. Had the French army in Egypt been able to detach a body of 15,000 men to the aſſiſtance of Tippoo, while all India was in the ſtate of alarm naturally produced by the approach of this northern invaſion, it is extremely probable that the Britiſh forces might ſpeedily have found themſelves deſerted by every ally, and ſunk under an unequal conteſt. But the actual reſult was very different. Satiſfied with the plunder he had obtained, Zemaun Shah ſoon withdrew; and the French army being detained in Egypt by the war with the Turks, and by the want of veſſels at Suez wherewith to reach India, Tippoo was left to contend, unaſſiſted, againſt the whole power of Britain, and of its allies in the eaſt. By the conqueſt and diviſion of his territory, the Britiſh power was left without a rival in that quarter of the world, and raiſed to ſuch a ſtate of impoſing ſuperiority, that if affairs are only preſerved in their preſent ſituation, by periodical ſupplies of European troops, no native prince, or even combination of princes, can henceforth bring it into danger. Thus, notwithſtanding the vaſt military efforts made by the people of France during this revolutionary war, yet all foreigners who truſted to their aid were ruined by placing confidence in them. In Italy, Germany, Switzerland, and Holland, the rapacity of the commiſſaries of the French government, ſoon rendered odious and intolerable the preſence of thoſe armies whoſe arrival had been eagerly deſired. In Ireland and in India, the promiſe and the hope of aſſiſtance which they were never able to beſtow, only ſerved to produce premature hoſtility, and to encreaſe and eſtabliſh the power of the Britiſh government.

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But to return to the domeſtic hiſtory of France, which has now become only an hiſtory of the uſurpation of Bonaparte.

French
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394
New conſtitution of
France.

In the middle of the month of December, the Conſuls, with their legiſlative committees, produced to the public their plan of a new conſtitution, which they preſented to the primary aſſemblies, and which is ſaid to have been accepted by them without oppoſition, like all the former conſtitutions. It is a very ſingular production, and neither admits of repreſentative government, nor indeed of any other form of political freedom. Eighty men, who elect their own ſucceſſors, poſſeſs, under the appellation of a *Conſervative Senate*, the power of nominating the whole legiſlators and executive rulers of the ſtate; but cannot themſelves hold any office in either of theſe departments. The ſovereignty is concentrated in one man, who, under the title of *Chief Conſul*, holds his power for ten years, and may be re-elected. The whole executive authority is entruſted to him, and he enjoys the excluſive privilege of propoſing new laws. He is aſſiſted by two other conſuls, who join at his deliberations, but cannot controul his will. The legiſlative power is entruſted to two aſſemblies: the one, conſiſting of 100 members, called a *Tribunate*; and the other, of a *Senate*, of 300 members. When a law is propoſed by the Chief Conſul, the Tribunate may debate about it, but have no vote in its enactment. The Senate votes for or againſt its enactment, but cannot debate about it. Neither the Conſuls, nor the members of the legiſlative bodies, nor of the conſervative ſenate, are reſponſible for their conduct. The miniſters of ſtate, however, who are appointed by the Chief Conſul, are reſponſible for the meaſures they adopt.

The people in the primary aſſemblies elect one-tenth of their number as candidates for inferior offices; perſons thus choſen, elect one-tenth of themſelves as candidates for higher offices; and theſe again elect a tenth of themſelves as candidates for all the higheſt offices of the ſtate. Out of this laſt tenth the Conſervative Senate muſt nominate the conſuls, legiſlators, and members of their own body. But this laſt regulation is to have no effect till the ninth year of the republic. In the mean time, the ſame committees that framed the conſtitution, appointed alſo the whole perſons who were to exerciſe the government. Bonaparte was appointed Chief Conſul, and Cambaceres and Lebrun ſecond and third Conſuls. Sieyes, with his uſual caution, avoided taking any active ſhare in the management of public affairs, and was appointed, or appointed himſelf, a member of his own Conſervative Senate; the whole being regarded as produced by him. As a gratuity for his ſervices, the Chief Conſul and his legiſlators preſented to him an eſtate belonging to the nation, called *Croſne*, in the department of Seine and Oiſe.

395
Abſolute
power of
Bonaparte.

Thus, after all their ſanguinary ſtruggles for freedom, did the ſon of a Corſican drive from their ſtations the repreſentatives of the French nation, and aſſume quiet poſſeſſion of the government of that country, with a power more abſolute than ever belonged to its ancient monarchs. The eſtabliſhed privileges of the clergy, the nobles, and the parliaments, always reſtrained, in ſome degree, the deſpotiſm of the kings of France; theſe being now deſtroyed, the will of Bonaparte could meet with no controul. Though an uſurper, however, he has not hitherto been a tyrant. He has rather attempted to induce the French nation to acquieſce in his authority, in conſequence of the mildneſs

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French Revolution 1800.

with which it has been exerciſed, and of the ability and reputation of the men whom he has employed in the public ſervice. He immediately ſent propoſals for negociating peace to the different powers at war with France. Great Britain refuſed to liſten to him on account of the probable inſtability of his government, and Auſtria appears to have given a ſimilar refuſal. It is indeed difficult to believe that he wiſhed his propoſals to be accepted. They were not addreſſed to the belligerent powers in the aggregate, but to each individually, as if his object had been to ſow diſſenſion and miſtruſt between the allies. When he made theſe propoſals, he did not even know whether the people of France would accept of the conſtitution which he had offered them; and he had taken no meaſures to procure a repeal of thoſe revolutionizing decrees which were the immediate cauſe of the war with England.

396 Difficulty of his ſituation.

His ſituation is, in the mean time, attended with great difficulties. The want both of an hereditary title, and of a national repreſentation as the baſis of his power, renders his character as an uſurper ſo obvious, that it is only by very cautious meaſures that his elevation can be maintained. If he is either unſucceſsful abroad, or compelled to preſs the people for money at home, there is little doubt that his fall muſt follow. Even independent of either of theſe events, it is a poſſible caſe that the violent Jacobins may recover their loſt energy, and by force or fraud deſtroy the man who has baffled all their projects. From the royaliſts he has leſs to fear; for the men of ardent ſpirits and violent paſſions belonging to that party, from whom alone great efforts can ever be expected, were early tempted to leave the country by the hopes held out to them by the coaleſced powers, which, by weakening, has hitherto prevented their party from becoming of much importance in the interior of France.

1800.

In the mean time, Bonaparte has been ſucceſsful in ſuppreſſing a new royaliſt revolt which had ariſen in La Vendee, and has made great exertions to begin the campaign with vigour. The low ſtate of the French finances, however, have much enfeebled all his efforts towards aſſembling very numerous armies. The army which he left in Egypt, after concluding a treaty with the Grand Vizier, by the terms of which they were to be landed ſafe in France, have ſeen reaſon to break the truce which had been agreed on. Kleber has attacked and completely defeated the main body of the Turkiſh army, while a detachment of that army has entered Cairo, and maſſacred, it is ſaid, every Frenchman found in the city, not ſparing the members of the National Inſtitute. The probable conſequence of this is, that no part of the army of Egypt will ever return to Europe.

397 Army of Egypt.

398 Recommencement of war in Europe.

War has been recommenced between the Auſtrians and France, both in Switzerland and in Swabia, and carried on with great vigour. Maſſena, after giving complete proofs of conſummate ſkill, and the moſt undaunted valour, has been for ſome time blocked up in Genoa; and unleſs he has been relieved by the vigorous exertions of the Chief Conſul, he muſt before this period (June the 12th have ſurrendered to the Auſtrian General Melas. The affairs of the French in that quarter ſeem indeed to be deſperate; but in Germany they have hitherto been ſucceſsful. Moreau has diſplayed his wonted abilities, and the gallant Kray has retreated before him, whether from neceſſity or to draw him into inextricable difficulties, a very ſhort time will evince.

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Since the above article was written, Moreau having driven the Auſtrian army almoſt to the gates of Vienna, the capture of that capital has only been prevented by a peace with the Emperor. Egypt has been retaken by the Britiſh in conjunction with the Turks, the French troops, agreeable to capitulation ſent home, and preliminaries of peace ſigned between Great Britain and France. Theſe events however are ſo recent that the particulars cannot be given in ſuch a work as this, but although the French at the cloſe of the revolution appear to be as far from the poſſeſſion of political liberty as at its commencement, yet the cloſe of ſuch a ſanguinary conteſt muſt be a great relief to the nations engaged in it. The effects of the war remain to be unfolded in future.

39 Errors the for part of article rected.

We cannot, however diſmiſs the momentous ſubject without correcting ſome errors into which we fell in the account of the riſe and progreſs of this revolution which was publiſhed in the *Encyclopædia*. We do not conſider theſe errors as diſgraceful to ourſelves; for in the midſt of commotions which have convulſed all Europe, it is hardly poſſible to arrive at the truth. When time ſhall have cooled the paſſions of men, and annihilated the parties which now divide the nation, the calm voice of Truth may be every where heard; but when the article referred to was written, the ears of every man was ſtunned with the clamour of faction.

So ſenſible of this are the editors of the only impartial periodical hiſtory* which we have, that they venture not to publiſh their volumes till ſeveral years have elapſed from the era of the tranſactions which theſe volumes record; whilſt their rivals—the panders of faction—ſeize the earlieſt opportunities of obtruding their partial ſtatements and falſe reaſonings on the public mind.

It cannot be ſuppoſed that one or two men, ſuperintending the publication of a work ſo extenſive, and treating of ſubjects ſo various, as ours, have leiſure or opportunity to examine, with much attention the correſpondence of ambaſſadors, or to expiſcate truth from the contradictory publications of the day. We are therefore obliged to draw our materials from ſuch works as profeſs to give a ſummary, but impartial, detail of what is acting on the theatre of the world; and by theſe works we have often been miſled. For the firſt error, however, which we ſhall notice in our former account of the riſe of the revolution, we cannot plead even this excuſe. We ought to have known, that the French clergy and French nobleſſe were not exempted from the payment of taxes; and, of courſe, we ought not to have aſſigned ſuch exemption as one of the cauſes of the Revolution. See that article, *Encycl.* nº 8. and 9.

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By a writer, to whoſe patriotic exertions this country is deeply indebted, it has been proved, with a force of argument which precludes all poſſibility of reply, that the exemption from taxes ſo loudly complained of was very trifling, that it was not confined to the nobility and clergy, and that it did not extend over the whole kingdom of France. "The *vingtiemes*, which may be conſidered as an impoſt merely territorial, was paid alike by the nobility and the *tiers-etat*. A great

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* *Old A nal Reg ſter.*

part of the clergy was indeed exempted; but their contributions, under a different form, conſtituted an ample equivalent. The duties upon the different articles of conſumption were of courſe paid by all the conſumers, except that in the *pays d'etat*, ſuch as Artois and Brittany; the two firſt orders were exempted from paying the tax upon liquors. But theſe exemptions cannot be deemed very important, when it is known, that in the province of Artois they did not exceed 800 guineas annually, even including the exemptions enjoyed by the privileged members of the *tiers-etat*." The Britiſh officers ſerving on board ſhips of war are exempted from the taxes paid by the other members of the ſtate on wine; and we believe no good ſubject has ever murmured at that exemption. The French nobility were ſubject to the poll tax.

" Of the *teilles*, the impoſt from which it has been falſely aſſerted that the nobility and clergy enjoyed a total exemption, there were two ſpecies; the one *perſonal*, the other *real*. In one part of the kingdom, the right of exemption was annexed to the property; in the other, to the quality of the proprietor. In the firſt caſe, the privilege was enjoyed by every claſs of perſons, by the tenants as well as the proprietor of a fief; whilſt the gentleman, whoſe eſtate was holden by a different tenure, was obliged to pay the tax. In thoſe provinces where the other cuſtom obtained, the exemption was confined to a certain extent of property, and to *that* only while it continued in the actual occupation of the privileged perſon; but as it very ſeldom happened that the French nobility kept any land in their own hands, and as the tax payable by the farmers was of courſe deducted from the rent, the *teilles* was, in this caſe, ultimately paid by the landlord. The ſame obſervations apply, with ſtill greater force, to the clergy, who always let their eſtates."

In a word, it appears from a formal declaration made by M Necker to the Conſtituent Aſſembly, that all the pecuniary exemptions enjoyed by the privileged claſſes did not exceed L.292,000; that the exemptions appertaining to the privileged perſons of the *tiers-etat* amounted to one half of that ſum; and the *drôits de controle*, or duty impoſed upon public deeds, and the high capitation tax (proportioned to their rank), paid by the nobility and clergy, made ample amends to the revenue for the partial exemptions which they enjoyed from other taxes. So far indeed were the *tiers-etat* from murmuring at the exemptions of the privileged orders, that, previous to the illuminiſm of the 18th century, they diſplayed, at every convention of the ſtates-general, the greateſt anxiety to maintain the rights of the nobility and clergy; and humbly ſupplicated their ſovereign to ſuffer no invaſion thereof, but to reſpect their franchiſes and immunities.*

Giſ- Letter Earl der- led.

We muſt likewiſe acknowledge, that in nº 11. of our article Revolution, we have drawn a very overcharged picture of the miſeries and oppreſſion of the French peaſants under the old government. It is indeed true, that they were obliged to ſerve in the militia, the eſtabliſhment of which was conducted in France nearly on the ſame principles as it is in England. The men were called out by ballot only for a few days in the year during peace, when they received regular pay; but if a militia forms the beſt conſtitutional defence of a ſtate, this ſurely ought not to have been conſidered as a grievance, eſpecially ſince married men were exempted from the ſervice. The nobility, too, were exempted from the riſk of being drawn, for the beſt of all reaſons—becauſe moſt of them had commiſſions in the regulars, and becauſe ſuch as had not were engaged in profeſſions, which rendered it impoſſible for them to ſerve in the militia. In France, as elſewhere, the peaſants would no doubt be averſe from this ſervice, and might look perhaps with an anxious eye to the ſuppoſed immunities of their privileged ſuperiors: but if mirth, good humour, and ſocial eaſe, may be conſidered as ſymptoms of felicity and content, theſe men ſurely were not miſerable; for theſe ſymptoms never appeared in any people ſo ſtrong as among the French peaſants. They were indeed liable to be called out by the intendants of the provinces to work a certain number of days every year on the public roads; but to this ſpecies of oppreſſion, if ſuch it muſt be called, the Scotch peaſants are liable, and were ſtill more ſo than at preſent, during that period when our parliamentary orators declare that the inhabitants of Britain enjoyed as much freedom as is conſiſtent with the public tranquillity. It ought to be remembered, too, that Louis XVI. whoſe higheſt gratification ſeems to have conſiſted in contributing to the eaſe and welfare of his ſubjects, thought he ſaw the neceſſity of aboliſhing the cuſtom of the *corvée*, and had made conſiderable advances towards the accompliſhment of that object ſome years before the commencement of the revolution.

402 The French monarch not deſpotic.

That the French monarch was deſpotic; that no man in the kingdom was ſafe; that nothing was unknown to the jealous inquiſition of the police; and that every man was liable, when he leaſt expected it, to be ſeized by *lettres de cachet*, and ſhut up in the gloomy chambers of the Baſtile—has long been common language in England, and language which we muſt confeſs that we have adopted (Revolution, nº 12.) without due limitations. The French government was certainly not ſo free as that of Britain; but he who underſtood it better than we do, and whoſe writings betray no attachment to arbitrary power, expreſsly diſtinguiſhes between it and *deſpotiſm*. " If (ſays Monteſquieu) France has, for two or three centuries paſt, inceſſantly augmented her power. ſuch augmentation muſt not be aſcribed to fortune, *but to the excellence of her laws*†." This, ſurely, is not the language of a man who thought himſelf governed by an arbitrary tyrant whoſe *caprice* is the law; nor will it be ſaid to be the language of one who was either afraid to ſpeak the truth or not maſter of his ſubject.

403 No change of the old conſtitution wiſhed by the people of France.

The inſtructions of all the different orders to their repreſentatives, before the fatal meeting of the States General under the unfortunate Louis, are drawn up in language ſimilar to that of this illuſtrious magiſtrate, and furniſh a complete proof that they knew themſelves to be ſafe under the government of their monarchs. " The conſtitution of the ſtate (ſay the clergy) reſults from the *fundamental laws*, by which the reſpective *rights* of the *king* and of the *nation are aſcertained*, and from which not the ſmalleſt deviation can be made. The firſt of theſe laws is, that the government of France is purely monarchical. The nation muſt preſerve inviolate the form of its government, which it acknowledges to be a *pure monarchy regulated by the laws*; and ſuch it will have it to remain."

† *De l' Eſprit des Loix*, liv. 20. c. 20.

French Revolution

On the 28th of November 1788, in a general committee of the nobles aſſembled at Verſailles, the Prince of Conti delivered a note to the preſident, which was ſanctioned by the concurrence of moſt of the other princes of the blood, and was ſuppoſed to ſpeak the general ſenſe of the nobility; in which it was inſiſted, that the *proſcription of all* NEW SYSTEMS *was neceſſary* to inſure the ſtability of the throne, of *the laws*, and of *order*; and that the conſtitution, *with the ancient forms*, ſhould be preſerved entire. In their inſtructions to their repreſentatives, they inſiſt that it ſhall be expreſsly and ſolemnly proclaimed, that the conſtitution of the French empire is ſuch, that its government is, and muſt remain, monarchical; that the king, as ſupreme chief of the French, is only ſubordinate to the fundamental law of the kingdom, according to which the conſtitution muſt be eſtabliſhed on the ſacred and immutable principles of monarchy, tempered by the laws; and this form of government cannot be replaced by any other conſtitution.

"Let our deputies (ſays the third eſtate), before they attend to any other object, aſſiſt in giving to France a truly monarchical conſtitution, which muſt invariably fix the *rights* of the *king* and of the *nation*. Let it be declared, that the monarchical is the only form of government admiſſible in France; and that in the *king alone*, as chief of the nation, is veſted the power of *governing according to the laws*." Is this the language of men groaning under the iron rod of deſpotiſm, or wiſhing to reduce the power of the crown?

Even after the power of the crown was almoſt annihilated, and the order of nobility done away, ſo far were theſe innovations from being acceptable to the enlightened part of the French nation, that in many departments of the kingdom they excited open inſurrections, whilſt the members of all the provincial parliaments oppoſed them with unanſwerable arguments furniſhed by the law. The chamber of vacation of the parliament of Toulouſe, in particular, proteſted againſt the proceedings of the States General, becauſe the deputies, who were empowered only to put an end to the ruinous ſtate of the finances, could not change the conſtitution of the ſtate without violating their inſtructions, and the faith ſworn to their conſtituents.*

404 Lettres de cachet.

That *lettres de cachet* were liable to abuſe, and that occaſionally they were groſsly abuſed, is certain. The uſe of them ought therefore to have been either annulled, or, which would have been infinitely better, ſubjected to ſuch rules as ſhould prevent all danger from them to the real liberties of the people; for the government would be of no uſe whatever which ſhould poſſeſs no power capable of being abuſed by deſpotiſm. Yet after all the noiſe that has been made about *lettres de cachet*, it is but juſtice to obſerve, that in the towers of the Baſtile, when it was taken by the mob, were found no more than ſeven priſoners; of whom four were confined for forgery; one was confined at the requeſt of his family on charges of the moſt ſerious nature; and two were ſo deranged that they were ſent next day, by thoſe philanthropiſts who had taken them out of comfortable chambers, to the mad houſe! That the chambers of the Baſtile were as comfortable as the chambers of a priſon could be, we are aſſured by M. Bertrand de Moleville, who can be under no inducement to deceive the Britiſh public, and whoſe opportunities of diſcovering the truth were ſuch as no man will call in queſtion.

Frenc Revolu

405 Blunde Necker

In our account of the opening of the States General, we have expreſſed too much deference to the character of M. Necker. To that man's irreſolute, if not treacherous, conduct, may, with truth, be attributed all the ſubſequent miſeries of France. It was about the mode of verifying their powers that the three orders of the ſtate firſt differed; but that mode ſhould have been defined by the miniſtry in the letters ſent to the different bailiwicks for the convention of the ſtates. Even this omiſſion might have been repaired after the arrival of the deputies at Verſailles; for none of them ſhould have been admitted into the hall of the ſtates, far leſs ſhould the king have met them there, till the Council had been ſatisfied of their being duly elected. Had either of theſe cautions been obſerved, the *tiers etat* never could have got the aſcendant over the other two orders, and the buſineſs of the nation would have been conducted as formerly in three different chambers. M. Necker's rejection of Mirabeau's advances ſhewed him to be very ill qualified to conduct the helm of affairs at ſuch a criſis; and his abſenting himſelf from the royal ſeſſion, a meaſure which he had adviſed, betrayed the utmoſt ingratitude to his gracious maſter.

40 Royal Seſſion

In our account of the royal ſeſſion, we were led into a miſtake, which calls loudly for correction. The circumſtances of that ſeſſion were very different from what they appeared to us when we wrote nº 24. and 25. of the article REVOLUTION. The royal ſeſſion was proclaimed in conſequence of the violent uſurpations of the *tiers-etat*, and the irreconcilable differences which ſubſiſted between that body and the two higher orders; and ſo far is it from being true that the preſident and members of the third eſtate found their hall *unexpectedly* ſurrounded by a detachment of guards, that their ſittings were only *ſuſpended*, for the beſt of all reaſons, with thoſe of the other orders. To be convinced of this, we need but to attend to the following proclamation which was made by the heralds, on the 20th of June, between ſeven and eight o'clock in the morning, in the ſtreets and croſs ways of Verſailles:

"June 20th. (By order of the King.) The King having reſolved to hold a royal ſitting in the States General, on Monday next the 22d of June, the preparations to be made in the three halls uſed by the aſſemblies of the orders, make it neceſſary that thoſe aſſemblies ſhould be ſuſpended until after the ſaid ſitting. His Majeſty will give notice, by another proclamation, of the hour of his going to the Aſſembly of the States on Monday."

M. Bailly, the preſident of the *tiers-etat*, had been made acquainted with the object of this proclamation, by a private letter which was ſent to him by the Marquis de Brezé at ſeven o'clock in the morning; and to which he replied, "that having received no orders from the King, and the aſſembly having been announced for eight o'clock, he ſhould attend where his duty called him."

He repaired, accompanied by a great number of the members of the *tiers-etat*, to the door of the hall of the States, demanded admiſſion; and on being refuſed by the officer on guard, according to his orders, with which he acquainted him, he declared that he proteſted againſt ſuch orders, and that he ſhould give a report of them to the Aſſembly. To do this he had not far to go,

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* See the proteſt at large in *Bertrand's Memoirs*, vol. iii. c. 13.

go, as three-fourths of the deputies of the *tiers-etat* were already collected round him, or in the avenue leading to the palace. There it was that, ſurrounded by an immenſe crowd of people, they declaimed in the moſt violent manner againſt this pretended act of deſpotiſm. "The National Aſſembly is to be diſſolved (ſaid they,) and the country to be plunged into the horrors of a civil war. *Want* reigns every where; every where the people ſee *famine* ſtaring them in the face. This we were about to put an *end to*, by rending the veil which covers the manœuvres of the monopoliſts, the engroſſers, and the whole tribe of miſcreants. The Louiſes XI. and XIII. the Richelieus, the Mazarins, the Briennes, attacked with their deſpotiſm only individuals or ſmall bodies; but here it is the whole nation that is made the ſport of the whims of a deſpotic miniſtry. "Let us meet upon the *Place d'Armes* (ſaid one of thoſe orators); there we ſhall recal ſome of the nobleſt days of our hiſtory, *the National Aſſemblies of the field of May*." "Let us aſſemble in the gallery of the palace (ſaid another;) there we ſhall preſent a new ſight, by ſpeaking the language of liberty, in that corrupt hall, where a little while ſince the head of him who ſhould have uttered that ſacred word would have been devoted to the executioner.—" No, no (ſaid a third,) let us go to Marli, and hold our ſitting on the Terrace:—let the King hear us; he will come from his palace, and will have nothing more to do than to place himſelf in the midſt of his people to hold the royal ſitting."

At the concluſion of theſe declamations, the ſole object of which was to alarm and exaſperate the people, the Aſſembly decided upon transferring their ſitting to the Tennis-court, in the ſtreet called *Rue du Vieux Verſailles*. There M. Bailly read the letter which he had received from M. de Brezé, and his anſwer to it; which he had ſcarcely done, when a ſecond letter from M. de Brezé was put into his hands, the contents of which were as follows:

"It was by the King's poſitive order, Sir, that I did myſelf the honour of writing to you this morning, to acquaint you that, his Majeſty purpoſing to hold a royal ſitting on Monday, and ſome preparations being requiſite in the three halls of the Aſſemblies of the orders, it was his intention that no perſon ſhould be admitted into them, and that the ſittings ſhould be ſuſpended till after that to be held by his Majeſty."

In this there was ſurely no marked diſreſpect to the repreſentatives of the people; but ſuch notions were countenanced by M. Necker, who appears indeed, on this occaſion, to have been in cloſe compact with the leaders of the mob. The popular violence that was employed to compel the majority of the clergy to join the *tiers-etat* is well known; and we have, in *Bertrand's Annals of the Revolution*, what amounts to evidence almoſt *legal*, and quite ſufficient to enforce conviction, that Necker directed that violence.

In our account of the commotions which were excited in Paris on the firſt diſmiſſion of that miniſter and his baniſhment from the kingdom, we have been led by our democratic journaliſts to give circulation to a groſs calumny publiſhed by them againſt the Prince de Lambeſc. (See REVOLUTION, n° 36 and 37.) The truth, which is ſo much diſguiſed in theſe two numbers, is as follows:

French Revolution.

408
Conduct of the Prince de Lambeſc vindicated.

"A detachment of the Royal Allemand, ſent to diſperſe the mob which was patroling the ſtreets in proceſſion with the buſts of Necker and the infamous Orleans, received a volley from the French guards as they were paſſing their quarters on the *Chauſſée d' Antin*, ſtopped to return it, and continued their march without quickening their pace. There were ſome ſoldiers killed and wounded on both ſides, but fewer of the regiment of Royal Allemand than on that of the French guards.

"The detachment marched to the Place Louis XV. and there found a body of dragoons who had been diſperſing the proceſſion. The two buſts were broken to pieces; and the populace in their fright taking refuge in the garden of the Thuilleries, the Prince de Lambeſc purſued them thither, at the head of the detachment of Royal Allemand, according to the orders which he received. This ſmall troop coming up to the head of the *Pont-tournant* (or turning bridge), at the extremity of the garden, found a kind of barricade, haſtily formed by chairs heaped upon one another: while they were removing this obſtacle, they received a ſhower of ſtones, broken chairs, and bottles, from the two terraces, between which the Prince de Lambeſc drew up his troop, keeping conſtantly at their head. Some guns and piſtols were diſcharged at them, which did no hurt; but ſeveral of the troopers were much bruiſed by the things that had been thrown at them, and an officer was ſeverely wounded by a ſtone.

"The Prince de Lambeſc, keeping at ſix paces from the bridge, oppoſed only a ſteady front to the aggreſſions of the populace. Seeing that this poſt became untenable, and that it was impoſſible for him any longer to reſtrain his troopers from repelling force by force, he gave the order for retreating out of the garden. At the ſame inſtant a cry was heard from all ſides of, *turn the bridge, turn the bridge*; and ſome perſons, in conſequence, ran and began to do it. The Prince de Lambeſc, juſtly fearing that a moſt bloody carnage would be the inevitable conſequence of it, ordered ſome piſtols to be fired in the air towards the bridge, to awe thoſe who were ſtriving to turn it. As the report of this volley did not deter them, he rode up himſelf, and with his ſabre ſtruck one of thoſe who were working hardeſt. The man ran off; and the Prince paſſing the bridge with his detachment into the Place Louis XV. drew up near the Statue, and being ſoon joined by the Swiſs regiment of Chateauvieux, took his poſt with this force near the *Garde-meuble*, where he remained ſome time, having placed the infantry before him. At ten at night part of the troops were diſmiſſed to their quarters, and the reſt ſent to Verſailles." Theſe facts being all judicially confirmed, prove how much the Prince de Lambeſc's conduct was calumniated by thoſe journaliſts whoſe detail we raſhly adopted.

409
True account of the taking of the Baſtile;

In our account of the taking of the Baſtile, miſled by our treacherous guides, the journaliſts, we have greatly magnified the military ſkill and proweſs of the aſſailants. That celebrated fortreſs was defended by a garriſon conſiſting of no more than 114 men, of whom 82 were invalids. It was attacked by 30,000 men and women, armed with muſkets and pikes, and furniſhed with a train of artillery which they had found at the *Hotel des Invalids*, given up to them by the timidity of the governor. Even this multitude would have been quickly repulſed from the Baſtile, if the governor of that ſtate-priſon, who had received no orders from the court, had been leſs reluctant to ſhed the blood of his rebellious countrymen; for the Pariſian mob had then diſplayed nothing of determined courage. A few diſcharges of muſquetry, and one of caniſter-ſhot from a ſingle canon, had thrown them into confuſion, and made them ſkulk behind the walls, when the ill-timed humanity of the governor made him enter into a treaty with the rebels, ſtipulating only that the garriſon ſhould not be maſſacred. How the ſtipulation was obſerved with reſpect to the governor himſelf, we have faithfully related; but we were miſtaken when we ſaid that the "French guards ſucceeded in procuring the ſafety of the garriſon." The guards, with the utmoſt difficulty, ſaved indeed ſome of them, but moſt of the invalids remaining in the courts of the caſtle were put to death in the moſt mercileſs manner.

410
And of the murder of M. de Fleſſelles.

Our account of the murder of M. de Fleſſelles (n° 40.) appears likewiſe to be very incorrect. This man was preſident of the Aſſembly of Electors at Paris (See Revolution, n° 45.), and had not quitted the *Hotel de Ville*, where their rebellious meetings were held, during the whole time of theſe dreadful commotions. He had even ſigned all their atrocious reſolutions, but became ſuddenly ſuſpected from the conſternation which he manifeſted at the ſight of ſo many horrors, and eſpecially at the cruel and treacherous murder of the governor of the Baſtile. The conſequence was, that he was treacherouſly murdered himſelf by one of the villains compoſing that aſſembly in which he preſided. "The electors (ſays M. Bertrand de Moleville) hoped to extenuate the horror of this aſſaſſination, by cauſing it to be conſidered as a natural and almoſt lawful vengeance for a treachery, the proof of which they pretended to have. In fact, they declared, that when M. de Launay, the governor of the Baſtile, was arreſted, a letter had been found in his pocket from M. de Fleſſelles, containing this expreſſion: 'I am amuſing the Pariſians with cockades and promiſes; hold out till night, and you will receive a reinforcement.' But this ſuppoſed letter, which, had it exiſted, they would not have failed to preſerve very carefully, was never ſeen by any body; and I heard M. Bailly himſelf ſay, in a viſit he paid me when he left the mayoralty, that he had no knowledge of it, and that it was not in his power to refer to any one who had told him that he had read it."

411
Ambition and cowardice of the Duke of Orleans.

In our account of the earlier tranſactions of the Revolution, we omitted to mention a very extraordinary inſtance of ambition to which the Duke of Orleans was incited by Count Mirabeau, but which that unnatural monſter wanted courage to carry into effect. During the commotions which prevailed in the capital on the diſmiſſal of M. Necker from the miniſtry, Orleans was perſuaded by Mirabeau to offer his ſervices as mediator between the king and his rebellious ſubjects; but to ſtipulate, at the ſame time, for his appointment to the high office of lieutenant-general of the kingdom as neceſſary to give his mediation due weight with the rebels. The real object of the profligate Count, in this dangerous propoſal, and which he did not deign even to conceal, was to pave the way for the infamous Duke ſtepping into the throne of his relation and virtuous ſovereign. He even went ſo far as to compoſe the ſpeech with which Orleans was to addreſs the king on the occaſion; but that coward, when he arrived at the palace, was ſo embarraſſed by the conſciouſneſs of his own wicked deſigns, that inſtead of aſking the office of lieutenant-general, he only requeſted permiſſion to retire into England!! A requeſt which was inſtantly granted.

This brought upon him the contempt and indignation of Mirabeau; but ſtill there was a party deſirous of placing him on the throne. This we think evident from an atrocious fact mentioned in all the journals, and confirmed by M. Bertrand. "When the king, on his firſt viſit to Paris (See n° 44.) had arrived at the *Champ Eliſées*, three or four guns were fired at once. It was never known whence they proceeded; but it is certain that an unfortunate woman in the crowd, who was in the direction of his Majeſty's carriage, was ſhot at the time, and fell dead on the ſpot." As the King's carriage held at the time exactly four perſons, M. Bertrand very naturally concludes that theſe four ſhots, fired at once in its direction, had been ordered and paid for; and we are unwilling to believe that at that period of the revolution there was any party diſpoſed to *pay* for the murder of the ſovereign but the Duke of Orleans and his infamous adherents. That he was equal to this wickedneſs cannot be doubted, when it is known that legal evidence was afterwards produced that he, with ſome other members of the Aſſembly, ſecretly directed the inſurrection of the 5th of October, and promoted the outrages of that and the ſucceeding day by the diſtribution of money and bread.*

412
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cated.

We have ſaid (n° 48,) the origin of the report of a train of gunpowder being laid by M. de Memmay, to blow into the air a number of patriots, has never been well explained. It was proved judicially, that at the period when the feaſt was given by M. Memmay to the inhabitants of Veſoul, he was ſetting vines in a ſtony ſoil, where he was often obliged to blow up the greater rocks. Some ſoldiers running through, and ferreting every where in the houſe and out houſes, unfortunately took a candle to the dark corner where the barrel of gunpowder was lodged, and ſet it on fire, in trying to ſee if it contained wine. Theſe facts, reported and atteſted in a memorial drawn up by M. Courvoiſier, ſo completely juſtified M. de Memmay, that the Aſſembly could not avoid teſtifying his innocence by a decree iſſued the 4th of June.

413
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In n° 70 we have ſaid that the National Aſſembly, after its removal from Verſailles to Paris, was in tolerable ſecurity; but M. Bertrand has proved, by evidence the moſt incontrovertible, that it did not think itſelf ſecure; and that if the miniſters had been capable of employing events to their own advantage, the powers of that factious body muſt have been recalled by its own conſtituents. The horrible outrages committed on the 5th and 6th of October had ſhocked all France. The wanton confiſcation of the property of the church, had demonſtrated to every man of ſound judgment, that under the new order of things no property could be ſecure; and by the deſertion of its more virtuous and moderate members, the aſſembly had become *a rump aſſembly*. It was therefore much alarmed when the intermediate commiſſion of the ſtates of Cambreſis entered, on the 9th of November, into a reſolution, in which, conſidering—"that certain decrees of the National Aſſembly

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* *Bertra*
Annals,
vol. ii.
ch. 13.

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Aſſembly are paving the way for the ruin of the kingdom, and the annihilation of religion; that if they have been able to place one ſpecies of property at the diſpoſal of the nation, men of all kinds of property may expect the ſame fate; they declare, from this moment, the power of the deputies of Cambreſis to the National Aſſembly to be null and revoked." Had M. Necker and his colleagues had addreſs to get ſimilar reſolutions entered into at the ſame time by the electors of all the bailiwicks of the kingdom, the Aſſembly muſt have been diſſolved, and France, even then, might have been ſaved; but theſe miniſters were themſelves nothing more than the humble and docile agents of the Aſſembly.

414 e ac- t of the ook,

There is no part of our former narrative more incorrect, or more likely to miſlead the public, than our account of the *red-book* (n° 75.) It is ſuch, however, as was then current, without any addition or aggravation by us. The villains (K) who, in direct contradiction to their own ſolemn promiſe, as well as to every principle of honour, made part of that book public, had the impudence to affirm, that, by the ſuppreſſion of the ſuperfluous penſions regiſtered in it, a ſaving would be made to the public *of near a fifth in the bulk of the expences of every year.* M. Bertrand, taking for granted the accuracy of their ſtatements, for the exaggeration of which, however, he urges arguments more than plauſible, proves, if arithmetical calculation affords proof, that by the ſuppreſſion of ſuch penſions as even *they* called ſuperfluous, the ſaving in the bulk of the annual expences could not poſſibly have amounted to more than *the two hundreth part!* It was not therefore without reaſon that M. Necker, in anſwer to their publication, ſaid, "I know not whether the books of the finances of any ſovereign in Europe can ſhew a ſimilar total."

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Our account of the mutiny of the ſoldiers at Nancy (n° 83).) is very inaccurate. Far from being excited by the officers, that mutiny was the natural conſequence of the abſurd decrees of the Aſſembly; which having declared *all men equal*, and made it criminal to puniſh diſobedient ſoldiers in that ſummary way, without which no armed force can be commanded, had completely diſorganiſed the army, and ſubſtituted for martial law patriotic exhortations, legiſlative decrees, and the novel juriſdiction of municipalities. The ſoldiers knew their own ſtrength, of which indeed they were continually informed by the friends of the revolution; and while they ſhook off the authority of their military commanders, they laughed at the impotent decrees of the Aſſembly. At Nancy they had impriſoned two general officers, and committed other outrages of the moſt ſerious nature. It was the duty of the Marquis de Bouillé, as governor of the province, to reduce the inſurgents by force, if force ſhould be found neceſſary; but he had accompliſhed his object without ſhedding blood, and was congratulating the two liberated generals, and ſome of the principal inhabitants, upon ſo happy a termination of the affair, when the populace, and many ſoldiers who had not followed their colours, fired upon the troops under his command, and killed fifty or ſixty men. The troops immediately returned the fire; and a great number of the rebellious mob and mutinous garriſon were of courſe put to the ſword. That ſuch able and firm conduct in Bouillé excited indignation among the Jacobins of Paris, is very probable; but even the king himſelf did not expreſs higher approbation of it than the National Aſſembly, who were duly ſenſible that it ſaved themſelves from deſtruction, which, had he failed in his enterpriſe, would have been inevitable. Three months afterwards, indeed, when the fabrication of counter-revolutionary plots became part of the daily buſineſs of this enlightened Aſſembly, ſome cenſures were thrown by the Jacobins upon the Marquis's conduct on this occaſion; and thoſe cenſures were loudly applauded.

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416 M. de Bouillé vindicated.

We have likewiſe been led, by our fallacious guides, to accuſe this gallant officer (n° 91.) of having laid open the country to the inroads of foreign armies; and we have given an incorrect account of the king's flight from Paris. There is no evidence whatever for the truth of the charge againſt the Marquis de Bouillé, and it is directly contrary to his general character. He was indeed a royaliſt, and would doubtleſs have cooperated with the Prince of Condé and the other emigrants in reſtoring the king to his lawful authority; but he was likewiſe a Frenchman and a patriot in the beſt ſenſe of the word; and he would have died in defence of the rights and independence of his country. He certainly meant to protect the king in his journey from Paris to Montmedi, where it was to terminate; and he had ſtationed troops of dragoons on the road for that purpoſe; but the unfortunate Louis had delayed his journey a day longer than was agreed upon; and even when he ſet out, neglected to ſend couriers before him to warn the troops of his approach. He thus travelled unprotected; and the conſequence was ſuch as we have related. Yet the gallant Bouillé tho' this journey was undertaken contrary to his advice, declared himſelf the author of it, in that letter in which he threatened the Aſſembly with vengeance of all Europe if they ſhould dare to touch a hair of the heads of the royal family.

417 Erroneous account in n° 90. corrected.

In n° 90, we have moſt unaccountably ſaid that the king was permitted to continue his journey to St Cloud. This is directly contrary to truth. The preſident, after hearing his complaint againſt thoſe who had prevented it, replied indeed in a ſpeech, containing ſome expreſſions of gratitude and affection, mixed with reflections on the refractory prieſts; but the Aſſembly determined nothing reſpecting the propriety of the journey. They did not even ſuffer a ſingle motion to be made on the ſubject; and threatened with impriſonment one of the members who propoſed to take it into conſideration! The king was therefore obliged to abandon this excurſion, though it was firſt undertaken from religious motives; and it was then that he ſeriouſly thought of attempting to elude the vigilance of his rebellious guards, and of taking up his reſidence at Montmedi.

418 Treaty of Pavia a forgery.

In n° 96. we have publiſhed, with doubts indeed of its authenticity, what was called the *treaty of Pavia*,

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(K) Theſe were the Marquis de Montcalm-Gozon, Baron Felix de Wimpſen, de Menou, Fretau, L. M. de Lepeaux, the Abbé Expilly, Camus, Goupil de Preſeln, Gautier de Biauzat, Treilhard, Champeaux-Palaſue, and Cottin.

and the *convention at Pilnitz*. The terms in which we introduced that ſcandalous fabrication to the notice of our readers, and the principles which we have uniformly avowed through the whole of this voluminous work, furniſh, we hope, ſufficient evidence that we could have no intention to deceive the public. Truth, however, demands of us to acknowledge, in the moſt explicit terms, that the pretended treaty of Pavia is not only a forgery, but a bungling forgery, defective in ſome of the moſt uſual diplomatic forms; and that the conferences at Pilnitz between the Emperor, the King of Pruſſia, and the Count d'Artois, related to objects very different from a partition of the French territories.

So early as the month of May 1791, a plan had been digeſted by the Emperor, the King of Pruſſia, and the King of Spain, with the concurrence of Louis XVI. for liberating that unfortunate monarch from the confinement in which he was kept in his own capital. The means to be employed were a coalition among the principal powers on the continent to lead armies in every quarter to the borders of France. During the alarm which ſo menacing an appearance could not but excite in that kingdom, a declaration by the houſe of Bourbon, complaining of the cruel and iniquitous treatment of its head, was to be circulated through France, and to be immediately followed by the manifeſto of the combined powers. This, it was preſumed, would furniſh a ſufficient reaſon, even to the National Aſſembly, for the king's going to the frontiers, and placing himſelf at the head of the army; but if it ſhould not, petitions were to be procured from the army and the provinces, requeſting his preſence, as the only means left of preventing a civil as well as foreign war. Had this meaſure, which was partly ſuggeſted by Mirabeau and partly by Montmorin and Calonne, been ſteadily purſued, there can be little doubt but it would have proved completely ſucceſsful. It was defeated, however, by the king's ill-concerted attempt to eſcape to Montmedi, and by a very imprudent and degrading letter which he was afterwards perſuaded to ſend to every foreign power.

419 Real convention at Pilnitz.

At Pilnitz, where the Emperor and the King of Pruſſia met, on the 25th of Auguſt, to ſettle between themſelves ſome intereſts too delicate to be adjuſted by the uſual diplomatic modes, an agreement was entered into by them to ſupport the cauſe of the French princes, to liberate the king, and to ſave, if poſſible, the monarchy. They delivered, accordingly, to the Count d'Artois the following declaration:

“ His Majeſty the Emperor, and his Majeſty the King of Pruſſia, having heard the deſires and the repreſentations of Monſieur and his Royal Highneſs the Count d'Artois, declare, conjointly, that they conſider the ſituation in which his Majeſty the King of France is at preſent placed, as a matter which concerns the intereſt of every ſovereign of Europe.—They hope that that intereſt will not fail to be acknowledged by the powers whoſe aſſiſtance is required; and that conſequently they will not refuſe to employ, in conjunction with their Majeſties, the moſt efficacious means, according to their abilities, to put the King of France in a ſituation to eſtabliſh in perfect liberty, the foundations of a monarchical government, equally agreeable to the rights of ſovereigns and the welfare of the French; then, and in that caſe, their Majeſties are determined to act promptly and by mutual conſent, with the forces neceſſary to obtain the end propoſed by all of them. In the mean time they will give orders for their troops to be ready for actual ſervice.

“ *Pilnitz, Auguſt 27th*, 1791.

“ Signed by the Emperor and the King of Pruſſia.”

Such was the agreement entered into at Pilnitz, which was ſo groſsly miſrepreſented by the French Jacobins, and by their zealous partizans in this country. Had not Louis XVI. accepted the conſtitution ſimply and unconditionally, the conſequence of this convention might have been the ſaving of the French monarchy, and the preſervation of peace in Europe; but that acceptance, ſo little looked for by the high contracting powers, completely thwarted their meaſures for a time; and before their armies were put in motion, the monarchy was overturned, and the monarch a priſoner.

420 The Frenc the aggre ſors in the war with Britain.

In our account of the origin of the war between Great Britain and France (nº 147, 148.), we have proved, by evidence which to ourſelves appears irreſiſtible, that the French regicides were the aggreſſors, and that the Britiſh miniſtry did all that could be done, conſiſtently with the independence of their own country, to maintain the relations of amity between the two nations. That we have interpreted fairly that decree of the Convention by which this kingdom was forced into the war, is rendered incontrovertible by a ſubſequent decree on the 15th of December, by which their generals were ordered to regulate their conduct in the countries which their armies then occupied, or *might afterwards occupy*. In the preamble to this decree, they expreſsly declared, that *their principles would not permit them to acknowledge any of the inſtitutions militating againſt the ſovereignty of the people*; and the various articles exhibit a complete ſyſtem of demolition. They inſiſt on the immediate *ſuppreſſion of all exiſting authorities*, the *abolition of rank and privilege* of every deſcription, and the *ſuppreſſion of all exiſting impoſts*. Nay, theſe friends to freedom even declare, that they will treat as enemies *a whole nation* (un peuple entier) which ſhall preſume to *reject liberty and equality*, or enter into *a treaty with a prince or privileged caſts!*

It is worthy of remark, that *the very day* on which this decree, containing a ſyſtematic plan for diſorganizing all lawful governments, paſſed the Aſſembly, the proviſional executive council wrote to their agent, Chauvelin, inſtructing him to diſavow all hoſtile intentions on the part of France, and to proclaim her deteſtation of the idea of a war with England! Yet the ſame proviſional council, in their comments on the 11th article of this decree, thus expreſs themſelves: “ The right of natural defence, the duty of ſecuring the preſervation of our liberty, and the ſucceſs of our arms, the univerſal intereſt of reſtoring to Europe a peace, *which ſhe cannot obtain but by* THE ANNIHILATION OF THE DESPOTS *and their ſatellites*, every thing impoſes on us the obligation of exerciſing all the *rigours of war*, and the *rights of conqueſt*, towards a people ſo fond of their chains, ſo obſtinately wedded to their degradation, as to refuſe to be reſtored to *their rights*, and who are the accomplices, not only *of their own deſpots*, but even of all the *crowned uſurpers*, who divide among themſelves the dominion of the earth and its inhabitants.” That Britain is one of thoſe countries which the aſſembly thought their armies might afterwards occupy, and that

that the great majority of Britons were a people towards whom their principles obliged them to exerciſe all the rigours of war, and the rights of conqueſt, is evident from the following extract of a letter, written on the 31ſt of December 1792, by Monge, a member of the council, and miniſter of the marine to the ſea-ports. "The King and his parliament mean to make war upon us. Will the *Engliſh republicans ſuffer it?* Already theſe free men ſhew their diſcontent, and the repugnance which they have to bear arms againſt *their brothers the French.* Well! we will fly to their ſuccour. We will make a deſcent on the iſland; we will lodge there 50,000 *caps of liberty;* we will plant there *the ſacred tree;* and we will ſtretch out our arms to our REPUBLICAN BRETHREN. *The tyranny of their government will be deſtroyed.*"

ntroduc- n to the *nals of French volution.*

As theſe two decrees of November and December 1792 have never been repealed, and as their object is ſo plainly avowed in the commentaries of the executive council, and in this letter of the miniſter of marine, they would alone ſufficiently authoriſe us to adopt as our own the following reflections of M. Bertrand de Moleville.* With theſe, as they give a conciſe but perſpicuous view of the riſe and progreſs of that revolution, or, to ſpeak more correctly, that ſeries of revolutions which has for ſeven long years oppreſſed, not France alone, but all Europe, we ſhall conclude this long article.

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"Popular inſurrections, and an army (ſays this able and uſeful writer), have hitherto been the uſual means, or chief inſtruments, of every revolution; but thoſe inſurrections being of the moſt ignorant and unthinking claſs of the people, were always fomented by a certain number of factious men, devoted to, and dependent upon, ſome ambitious chief, daring, brave, of military talents, ſole and abſolute conductor of every ſtep of the revolt, and maſter of all the means of the inſurrection. In the hands of this chief, the ſoldiers, or people armed, were but machines, which he ſet in motion or reſtrained according to his pleaſure, and of which he always made uſe to put an end to revolutionary diſorders and crimes, as ſoon as the object of the revolution was gained. So Cæſar and Cromwell, after they had uſurped the ſupreme power, loſt no time in ſecuring it to themſelves, by placing it on the baſis of a wiſe and well-regulated government; and they employed in quelling the troubles that had favoured their uſurpation, thoſe very legions, that ſame army, which they had uſed to excite them.

"This was not the caſe in France: there, the revolution, or rather the firſt of thoſe it experienced, and of which the others were the inevitable conſequence, was not, whatever be ſuppoſed, the reſult of a conſpiracy, or preconcerted plan, to overturn the throne, or to place an uſurper upon it. It was unexpectedly engendered by a commixture of weakneſs, ignorance, negligence, and numberleſs errors in the government. The States General, however imprudent their convocation may have been, would have produced only uſeful reforms, if they had found the limits of their power marked out by a hand ſufficiently firm to have kept them within that extent. It was, however, but too evident that, even before their opening, they were dreaded, and that conſequently they might attempt whatever they pleaſed. From that time, under the name of *Clubs,* various aſſociations and factions ſprang up; ſome more violent than others, but all tending to the ſubverſion of the exiſting government, without agreeing upon the form of that which was to be ſubſtituted: and at that juncture alſo the projects of the faction, whoſe views were to have the Duke of Orleans appointed lieutenant-general of the kingdom, began to appear.

"This faction, or more properly this conſpiracy, was indeed of the ſame nature as thoſe that had produced all former revolutions, and might have been attended with the ſame conſequences, had the Duke of Orleans been poſſeſſed of that energy of character, that bravery and daring ſpirit, requiſite in the leader of a party. The people had already declared in his favour, and he might very eaſily have corrupted and brought over a great part of the army, had he been equal to the command of it: but, on the very firſt occaſion of perſonal riſk, he diſcovered ſuch cowardice and meanneſs, that he defeated his own conſpiracy, and convinced all thoſe who had entered into it, that it was impoſſible to continue the revolution, either in his favour or in conjunction with him. The enthuſiaſm the people had felt for him ended with the efforts of thoſe who had excited it.

"Mr Necker, whom the multitude had aſſociated with him in their homage, ſtill preſerved for ſome time his adorers, and that little cabal which was for ever exalting him to the ſkies. But as he was inferior even to the Duke of Orleans in military talents and diſpoſitions, he was as little calculated to be the leader of a revolution, or of a great conſpiracy: for which reaſon his panegyriſts then confined themſelves in their pamphlets and placards, with which the capital was overrun, to inſinuating, that the only means of ſaving the ſtate was to declare Mr Necker *Dictator;* or at leaſt to confer upon him, under ſome title more conſiſtent with the monarchy, the authority and powers attached to that republican office. In fact, if after his diſmiſſion, in the month of July 1789, he had dared to make this a condition of his return to the miniſtry, it is more than probable that the king would have been under the neceſſity of agreeing to it, and perhaps of re-eſtabliſhing in his perſon the office of mayor of the palace. At that moment he might have demanded any thing: eight days later, he might have been refuſed every thing; and very ſoon after, he was reduced to ſneak out of the kingdom, in order to eſcape the effects of the general contempt and cenſure which he had brought upon himſelf.

"General La Fayette, who then commanded the Pariſian National Guard, gathered the wrecks of all this popularity, and might have turned them to the greateſt advantage, if he had poſſeſſed 'that reſolute character and heroic judgment' of which Cardinal de Retz ſpeaks, and 'which ſerves to diſtinguiſh what is truly honourable and uſeful from what is only extraordinary, and what is extraordinary from what is impoſſible.' With the genius, talents, and ambition of Cromwell, he might have gone as great a length; with a leſs criminal ambition, he might at leaſt have made himſelf maſter of the revolution, and have directed it at his pleaſure: in a word, he might have ſecured the triumph of whatever party he ſhould have declared himſelf the leader. But as unfit for ſupporting the character of Monk as that of Cromwell, he ſoon betrayed the ſecret of his incapacity

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to all the world, and was diſtinguiſhed in the crowd of conſtitutional ringleaders only by his three-coloured plume, his epaulets, white horſe, and famous ſaying—‘ Inſurrection is the moſt ſacred of duties when oppreſſion is at its height.’

“ The revolution, at the period when the faction that had begun it for the Duke of Orleans became ſenſible that he was too much a coward to be the leader of it, and when La Fayette diſcovered his inability to conduct it, was too far advanced to recede or to ſtop; and it continued its progreſs, but in a line that no other revolution had taken, viz. without a military chief, without the intervention of the army, and to gain triumphs, not for any ambitious conſpirator, but for political and moral innovations of the moſt dangerous nature; the moſt ſuited to miſlead the multitude, incapable of comprehending them, and to let looſe all the paſſions. The more violent combined to deſtroy every thing; and their fatal coalition gave birth to Jacobiniſm, that terrible monſter till then unknown, and till now not ſufficiently unmaſked. This monſter took upon itſelf alone to carry on the revolution; it directed, it executed, all the operations of it, all the exploſions, all the outrages: it every where appointed the moſt active leaders, and, as inſtruments, employed the profligates of every country. Its power far ſurpaſſed that which has been attributed to the inquiſition, and other fiery tribunals, by thoſe who have ſpoken of them with the greateſt exaggeration. Its centre was at Paris; and its rays, formed by particular clubs in every town, in every little borough, overſpread the whole ſurface of the kingdom. The conſtant correſpondence kept up between thoſe clubs and that of the capital; or, to uſe their own expreſſion, *des Sociétés populaires affiliées avec la Société mere*—‘ between the affiliated popular Societies and the parent Society,’ was as ſecret and as ſpeedy as that of free-maſons. In a word, the Jacobin clubs had prevailed in cauſing themſelves to be looked up to as the real national repreſentation. Under that pretence, they cenſured all the authorities in the moſt imperious manner; and whenever their denunciations, petitions, or addreſſes, failed to produce an immediate effect, they gained their point by having recourſe to inſurrection, aſſaſſination, and fire. While Jacobiniſm thus ſubjected all France to its controul, an immenſe number of emiſſaries propagated its doctrines among foreign nations, and prepared new conqueſts for it.

“ The National Aſſembly, the capital, indeed we may ſay all France, was divided into three very diſtinct parties. The moſt conſiderable in number, but unhappily the weakeſt through a deficiency of plan and reſolution, was the party purely Royal: it was adverſe to every kind of Revolution, and was ſolely deſirous of ſome improvements, with the reform of abuſes and pecuniary privileges:—the moſt able, and moſt intriguing, was the Conſtitutional party, or that which was deſirous of giving France a new monarchical conſtitution, but modified after the manner of the Engliſh, or even the American, by a houſe of repreſentatives. The third party was the moſt dangerous of all, by its daring ſpirit, by its power, and by the number of proſelytes it daily acquired in all quarters of the kingdom: it compriſed the Democrats of every deſcription, from the Jacobin clubs, calling themſelves *Friends of the Conſtitution*, to the anarchs and robbers.

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“ The Democratic party, which at firſt was only auxiliary to the Conſtitutional one, in the end annihilated it, and became itſelf ſubdivided into ſeveral other parties, whoſe fatal ſtruggles produced the ſubſequent revolutions, and may ſtill produce many more. But in principle, the Conſtitutionaliſts and the Democrats formed two diſtinct, though confederate, factions; both were deſirous of a revolution, and employed all the uſual means of accompliſhing it, except troops, which could be of no uſe to them, for neither of them had a leader to put at the head of the army. But as it was equally of importance to both that the king ſhould be deprived of the power of making uſe of it againſt them, they laboured in concert to diſorganiſe it; and the complete ſucceſs of that manœuvre was but too fully proved by the fatal iſſue of the departure of the royal family for Montmedi. The revolution then took a more daring and rapid ſtride, which was concluded by the pretended conſtitution act of 1791. The incoherence of its principles, and the defects of its inſtitutions, preſent a faithful picture of the diſunion of its authors, and of the oppoſite intereſts by which they were ſwayed. It was, properly ſpeaking, a compact between the faction of the Conſtitutionaliſts and that of the Democrats, in which they mutually made conceſſions and ſacrifices.

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Conſtitution of 1791 completes the firſt revol tion.

“ Be that as it may, this abſurd conſtitution, the everlaſting ſource of remorſe or ſorrow to all who bore part in it, might have been got over without a ſhock, and led back to the old principles of monarchical government, if the Aſſembly who framed it had not ſeparated before they witneſſed the execution of it; if, in impoſing on the king the obligation to maintain it, they had not deprived him of the power and the means; and above all, if the certain conſequence of the new mode of proceeding at the elections had not been to ſecure, in the ſecond aſſembly, a conſiderable majority of the Democratic againſt the Conſtitutional party.

“ The ſecond Aſſembly was alſo divided by three factions, the weakeſt of which was the one that wiſhed to maintain the conſtitution. The other two were for a new revolution and a republic; but they differed in this, that the former, compoſed of the Briſſotins and Girondiſts, was for effecting it gradually, by beginning with diveſting the king of popularity, and allowing the public mind time to wean itſelf from its natural attachment to monarchy; and the latter, which was the leaſt numerous, was eager to have the republic eſtabliſhed as ſoon as poſſible. Theſe two factions, having the ſame object in view, though taking different roads, were neceſſarily auxiliaries to each other; and the pamphlets, excitations to commotion, and revolutionary meaſures of both, equally tended to overthrow the conſtitution of 1791.

“ Thoſe different factions, almoſt entirely compoſed of advocates, ſolicitors, apoſtate prieſts, doctors, and a few literary men, having no military chief capable of taking the command of the army, dreaded the troops, who had ſworn allegiance to the conſtitution, and obedience to the king, and who moreover might be influenced by their officers, among whom there ſtill remained ſome royaliſts. The ſureſt way to get rid of all uneaſineſs on this ſubject, was to employ the army in defending the frontiers. For this purpoſe, a foreign war was neceſſary, to which it was known that the king and his council

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council were equally averſe. No more was wanting to determine the attack which was directed, almoſt at the ſame time, againſt all the miniſters, in order to compel them to retire, and to put the king under the neceſſity of appointing others more diſpoſed to ſecond the views of the parties. Unhappily this attempt was attended with all the ſucceſs they had promiſed themſelves; and one of the firſt acts of the new miniſtry was to declare war againſt the emperor. At the ſame time, the emigration that had been provoked, and which was almoſt every where applauded, even by the loweſt claſs of people, robbed France of the flower of the royal party, and left the king, deprived of his beſt defenders, expoſed to the ſuſpicions and inſults that ſprang from innumerable calumnies, for which the diſaſters at the beginning of the war furniſhed but too many opportunities.

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e ſecond
olution.

“In this manner was prepared and accelerated the new revolution, which was accompliſhed on the 10th of Auguſt 1792, by the depoſition and impriſonment of the king, and by the moſt flagrant violation of the conſtitution of 1791. The latter, however, was not entirely abandoned on that day; for the project of the Girondiſts, who had laid the plot of that horrible conſpiracy, was then only to declare the king's depoſition, in order to place the prince royal upon the throne, under the guidance of a regency compoſed of their own creatures; but they were hurried away much farther than they meant to go, by the violence with which the moſt furious of the Jacobins, who took the lead in the inſurrection, conducted all their enterpriſes. The prince royal, inſtead of being crowned, was ſhut up in the Temple; and if France at that moment was not declared a republic, it was leſs owing to any remaining reſpect for the conſtitution, than to the fear the legiſlative body was in of raiſing the army againſt it, and alſo the majority of the nation, who would naturally be angry to ſee a conſtitution which ſeemed to be rendered ſecure and ſtable by ſo many oaths, thus precipitately overthrown, without their having been conſulted.

“It was on theſe conſiderations that the opinion was adopted, that a National Convention ſhould be convoked, to determine the fate of royalty. Prompt in ſeizing all the means that might enſure the ſucceſs of this ſecond revolution, the Aſſembly, under pretence of giving every poſſible latitude to the freedom of elections, decreed, that all its members ſhould be eligible for the National Convention.

“From that moment the Girondiſts daily loſt ground, and the moſt flaming members of the Democratic party, ſupported by the club of Jacobins, by the new Commune of Paris, and by the Tribunes, made themſelves maſters of every debate. It was of the utmoſt importance to them to rule the enſuing elections; and this was ſecured to them by the horrible conſternation which the maſſacres of the 2d of September ſtruck throughout the kingdom. The terror of being aſſaſſinated, or at leaſt cruelly treated, drove from all the Primary Aſſemblies, not only the royaliſts and conſtitutionaliſts, but moderate men of all parties. Of courſe, thoſe aſſemblies became entirely compoſed of the weakeſt men and the greateſt villains exiſting in France; and from among the moſt frantic of them were choſen thoſe members of the Convention who were not taken from the legiſlative body. Accordingly, this third Aſſembly, in the firſt quarter of an hour of their firſt ſitting, were heard ſhouting their votes for the abolition of royalty, and proclaiming the republic, upon the motion of a member who had formerly been a player.

French
Revolution

424
The third
revolution.

“Such an opening but too plainly ſhewed what was to be expected from that horde of plunderers which compoſed the majority of the National Convention, and of whom Robeſpierre, Danton, Marat, and the other ringleaders, formed their party. That of the Briſſotins and Girondiſts ſtill exiſted, and was the only one really republican. Theſe ſemi-wretches, glutted with the horrors already committed, ſeemed deſirous of arreſting the torrent of them, and laboured to introduce into the Aſſembly the calm and moderation that were neceſſary to give the new republic a wiſe and ſolid organization. But the ſuperiority of their knowledge, talents, and eloquence, which their opponents could not diſpute, had no power over tigers thirſting for blood, who neither attended to nor ſuffered motions but of the blackeſt tendency. No doubt they had occaſion for atrocities upon atrocities to prepare the terror-ſtruck nation to allow them to commit, in its name, the moſt execrable of all, the murder of the unfortunate Louis XVI: and that martyrdom was neceſſary to bring about a third revolution, already brewing in the brain of Robeſpierre. Fear had greatly contributed to the two former: but this was effected by terror alone, without popular tumults, or the intervention of the armies; which, now drawn by their conqueſts beyond the frontiers, never heard any thing of the revolutions at home, till they were accompliſhed, and always obeyed the prevailing faction, by whom they were paid.

“By the degree of ferocity diſcovered by the members of the Convention in paſſing ſentence upon the king, and in the debates relative to the conſtitution of 1793, Robeſpierre was enabled to mark which of the deputies were likely to ſecond his views, and which of them it was his part to ſacrifice.

“The people could not but with tranſport receive a conſtitution which ſeemed to realiſe the chimera of its ſovereignty, but which would only have given a kind of conſtruction to anarchy, if the execution of this new code had not been ſuſpended under the pretext, belonging in common to all acts of deſpotiſm and tyranny, of *the ſupreme law of the ſafety of the ſtate*. This ſuſpenſion was effected, by eſtabliſhing the Proviſionary Government, which, under the title of Revolutionary Government, concentrated all the powers in the National Convention until there was an end to the war and all inteſtine troubles.

“Although the faction, at the head of which Robeſpierre was, had a decided majority in the Aſſembly, and might conſequently have conſidered themſelves as really and excluſively exerciſing the ſovereign power, he was a demagogue of too deſpotic a nature to ſtomach even the appearance of ſharing the empire with ſo many co-ſovereigns. He greatly reduced their number, by cauſing all the powers inveſted in the National Aſſembly by the decrees that had eſtabliſhed the revolutionary government, to be transferred to a committee, to which he got himſelf appointed, and where he was ſure of the ſole rule, by obtaining for colleagues men leſs daring than himſelf, though equally wicked; ſuch as Couthon, St Juſt, Barrere, and others like them. This committee, who had the aſſurance to ſtyle themſelves the *Committee of Public Safety*, very ſoon ſeized upon both the legiſlative and executive powers, and exerciſed them with the moſt ſanguinary tyranny ever yet heard of. The miniſters were merely their clerks; and the ſubjugated Aſſembly, without murmur or objection, paſſed all the revolutionary laws which were propoſed, or rather dictated, by them. One of their moſt horrible and deciſive conceptions was that of thoſe Revolutionary Tribunals which covered France with ſcaffolds, where thouſands of victims of every rank, age, and ſex, were daily ſacrificed; ſo that no claſs of men could be free from that ſtupefying and general terror which Robeſpierre found it neceſſary to ſpread, in order to eſtabliſh and make his power known. He ſoon himſelf dragged ſome members of his own party, ſuch as Danton, Camille des Moulins, and others, whoſe energy and popularity had offended him, before one of thoſe tribunals, where he had them condemned to death. By the ſame means he got rid of the chief leaders among the Briſſotines and Girondiſts; while he cauſed all the moderate republican party who were ſtill members of the Aſſembly, except thoſe who had time and addreſs to eſcape, to be ſent to priſon, in order to be ſentenced and executed on the firſt occaſion.

425 The fourth revolution produces

“ In this manner ended the third revolution, in which the people, frozen with terror, did not dare to take a part. Inſtead of an army of ſoldiers, Robeſpierre employed an army of executioners and aſſaſſins, ſet up as revolutionary judges; and the guillotine, ſtriking or menacing all heads indiſcriminately, made France, from one end to the other, ſubmit to him, by the means of terror or of death. Thus was this nation, formerly ſo proud, even to idolatry, of its kings, ſeen to expiate, by rivers of blood, the crime of having ſuffered his to be ſpilt who was the moſt virtuous of all their monarchs.

“ In the room of that famous Baſtile, whoſe celebrated capture and demolition had ſet only ſeven priſoners at liberty, two of whom had been long in a ſtate of lunacy, the colleges, the ſeminaries, and all the religious houſes of the kingdom, were converted into ſo many ſtate priſons, into which were inceſſantly crowded, from time to time, the victims devoted to feed the ever-working guillotines, which were never ſuffered to ſtand ſtill for a day, becauſe they were at once the chief reſource of ſupplies for the government, and the inſtrument of its ferocity. ‘ The guillotine coins money for the republic,’ was ſaid in the tribune by one of Robeſpierre's vileſt agents.* In fact, according to the juriſprudence of the Revolutionary Tribunals, the rich of every claſs, being declared ſuſpected perſons, received ſentence of death, for no other reaſon than that of giving the confiſcation of their property a ſhow of judicial form.

Barrere.

“ Still blood flowed too ſlowly to ſatisfy Robeſpierre; his aim was but partly attained by the proſcription of the nobles, the prieſts, and the wealthy. He fancied, not only an ariſtocracy of talents and knowledge, but of the virtues, none of which would his truſty orators and journaliſts admit, ſave that horrid *patriotiſm* which was eſtimated according to the enormity of the crimes committed in favour of the revolution. His plan was to reduce the French people to a mere plantation of ſlaves, too ignorant, too ſtupid, or too puſillanimous, to conceive the idea of breaking the chains with which he would have loaded them in the name of liberty; and he might have ſucceeded in it, had not his ambition, as impatient as it was jealous, too ſoon unveiled the intention of reſorting to the guillotine to ſtrike off the ſhackles with which an aſſembly of repreſentatives of the nation fettered, or might fetter, his power. He was about to give this deciſive blow, which he had concerted with the Commune of Paris, the Revolutionary Tribunal, the Club of Jacobins, and the principal officers of the National Guard, when the members of the Convention, who were marked out be the firſt ſacrificed, anticipated him at a moment when he leaſt expected it, by attacking himſelf in the Aſſembly, with energy ſufficient to rouſe all the ſections of the capital againſt him and againſt the Jacobins. The parties came to blows, and victory remained uncertain for ſeveral hours; but at length declared againſt Robeſpierre. In the ſpace of a day, that execrable monſter was dragged from the higheſt pitch of power ever attained by any tyrant, to the very ſcaffold that was ſtill reeking with the blood of his laſt victims. His principal accomplices in the Committee of Public Safety, in the Commune, in the National Guard, in the Revolutionary Tribunal, and many of his agents in the provinces, met the ſame fate. The Revolutionary Tribunals were ſuppreſſed, and the priſons thrown open to all whom they had caſt into them.

426 The con tution of *1795.*

“ This fourth revolution, in which the faction then eſteemed the moderate party overthrew the terroriſts, and ſeized the ſupreme power, was no leſs complete than thoſe which had preceded it, and produced the conſtitution of 1795. All France received as a great bleſſing a conſtitution that delivered them from the revolutionary government and its infernal policy. Beſides, it had, in ſpite of great defects, the merit of coming nearer than the two preceding ones, to the principles of order, of juſtice, and real liberty; the violation of which had, for five years before, been the ſource of ſo many diſaſters and ſo many crimes. The royaliſts, conſidering it as a ſtep towards monarchy, were unfortunately ſo imprudent as to triumph in it; and their joy, as premature as indiſcreet, alarmed the Aſſembly to ſuch a degree, that they paſſed the famous law, ordaining the Primary Aſſemblies to return two-thirds of the members of the Convention to the legiſlative body, which was to ſucceed that aſſembly. It was thus that the ſpirit of the Convention continued, for the firſt year, to be diſplayed in the two councils.

“ In the year following, the bias of the public mind, perhaps too haſtily turned towards royalty, ſhewed itſelf in the elections of the members for the new third, ſo clearly as to alarm the regicides who compoſed the Directory, and the Conventionaliſts, who ſtill made a third of the legiſlative body; nor did they loſe a moment in deviſing means for their defence. That which appeared the ſureſt to them was, to publiſh notices of plots among the royaliſts, and annex one or more denunciations, in terms ſo vague as to leave room for implicating, when neceſſary, all their adverſaries; while by the help of this impoſture they procured ſome ſecret information, artfully fabricated, and ever eaſily obtained through threats or rewards by thoſe who have at command the guillotine and the public treaſure.

“ This maſked battery was ready to be opened before the members of the new third took their ſeats.

rench volution

Theſe at firſt confined themſelves to the ſecuring of a conſtant majority in the two councils in favour of the moderate opinions; but in a little time every ſitting was marked by the repeal of ſome revolutionary law, or by ſome decree tending to reſtrain the executive authority within the limits fixed by the conſtitution.

427 e fifth olution. "The Directory, alarmed at the abridgment of their power, and dreading ſtill more ſerious attacks upon it, came to a reſolution of no longer poſtponing the blow they had been meditating againſt the legiſlative aſſembly: and they accompliſhed, in the manner related in n° 309. a fifth revolution, as complete as any of thoſe by which it was preceded. It differed indeed from them eſſentially in the facility and promptneſs with which it was effected, although the party which prevailed, that is to ſay, the majority of the Directory, and the minority of the Legiſlative Body, had to combat not only againſt the conſtitution, but againſt the opinion, and even againſt the indignation, of the public. That moral force, on which the majority of the two councils had unluckily placed all their reliance, vaniſhed in an inſtant before the phyſical force of a detachment of troops conſiſting of ſix or ſeven hundred men; ſo true is it, that the power of the public opinion, ridiculouſly exaggerated in theſe days, is and can be no more, under a firm and well ordered government, than a mere fancy. Men accuſtom themſelves too eaſily to take for public opinion the private opinions made public by certain writers, whoſe caution or audaciouſneſs depends always upon the energy or feebleneſs of the ſupreme authority. It is the ſame thing with popular commotions: they are eaſily excited under a weak government, which does not poſſeſs the wiſdom to prevent or the ſpirit to ſuppreſs them; but a vigorous, juſt, and ſtrict government has nothing to fear from them. The Directory, compelled to withdraw the larger body of troops, which they had thought neceſſary to enſure the revolution they were meditating, diſcovered, no doubt, great ability in ſecuring the two councils, by appearing to dread them: but it was chiefly to the energy of their meaſures, and to the concentration and promptneſs with which they were executed, that they owed their ſucceſs. Two days before, the legiſlative body might, without obſtruction, have impeached, arreſted, and even outlawed, the majority of the Directory, who were execrated by the public under the title of Triumvirate; and, if requiſite, they would have been ſupported by more than 30,000 armed citizens, who, with Pichegru and Villot at their head, would ſoon have diſperſed, and perhaps brought over, the feeble detachments of troops of the line which the Directory had at their command. The legiſlative body, relying too much upon its popularity, did not ſufficiently conſider, that the people whoſe impetuoſity is commonly deciſive when allowed to take advantage in attack, are always feeble on the defenſive, and totally unable to withſtand every aſſault made previous to an inſurrection, for it is always eaſy to prevent their aſſembling. It was on this principle that the Directory founded their operations, and the 5th of September too well proves how juſtly. That day reduced the legiſlative body, by the moſt degrading ſubjugation, to a mere diſguſting caricature of national repreſentation; it inveſted the Directory with the moſt arbitrary and tyrannic power, and reſtored the ſyſtem of Robeſpierre, under a form leſs bloody, but not leſs pernicious; for the Revolutionary Tribunals which that monſter had eſtabliſhed, were ſcarcely more expeditious than the military ones of the Directory. The power of arbitrary and unlimited tranſportation is, in time, as deſtructive as the guillotine, without poſſeſſing, like that, the advantage of exciting a ſalutary horror, which, by recovering the people from the ſtate of ſtupor and apathy, the conſtant effects of terror, gives them both recollection and force to break their chains. Though, in violating the moſt eſſential regulations of the conſtitution, the Directory obtained a temporary confirmation of their power, their example pointed out to Bonaparte and Sieyes the path which they purſued with infinite addreſs, and in which they accompliſhed a ſixth revolution."

Rey, || Rhode-Iſland.

428 The ſixth revolution, and conſular government.

How long the conſular government will continue, it is impoſſible to conjecture; but we may, without preſumption, venture to predict, that it cannot be permanent. To the Jacobins and original conſtitutionaliſts it muſt be more obnoxious than the old government; becauſe Bonaparte is more deſpotic than was Louis XIV; and the royaliſts, though they may prefer the vigorous and comparatively mild government of one man, whoſe talents are indiſputable, to the ferocious tyranny of the loweſt of the rabble, muſt look with indignation at a foreign adventurer ſeated on the throne of their ancient monarchy.

REY, *Cape*, or *Point*, on the N. coaſt of S. America, is 40 leagues W. by N. of Cape Three Points, and is N. by E. of Bocca del Drago.—*Morſe.*

REYES, *Angra dos*, on the S. E. coaſt of Brazil, in S. America, lies weſtward of Rio Janeiro, and 53 leagues weſt of Cape Frio. It affords good anchorage.—*ib.*

RHABDOLOGY, or RABDOLOGY, in arithmetic, a name given by Napier to a method of performing ſome of the more difficult operations of numbers by means of certain ſquare little rods. Upon theſe are inſcribed the ſimple numbers; then by ſhifting them according to certain rules, thoſe operations are performed by ſimply adding or ſubtracting the numbers as they ſtand upon the rods. See Napier's *Rabdologia*, printed in 1617. See alſo the article NAPIER's *Bones*.

RHODE-ISLAND is one of the ſmalleſt of the United States; its greateſt length being 47 miles, and its greateſt breadth 37; or about 1300 ſquare miles. It is bounded N. and E. by the commonwealth of Maſſachuſetts; S. by the Atlantic Ocean, and W. by Connecticut. Theſe limits comprehend what is called *Rhode-Iſland and Providence Plantations*; divided into 5 counties, viz. Newport, Providence, Waſhington, Briſtol, and Kent, which are ſubdivided into 30 townſhips, containing 68,825 inhabitants, of whom 948 are ſlaves. Narraganſet Bay makes up from S. to N. between the main land on the E. and W. and emboſoms many fertile iſlands, the principal of which are Rhode Iſland, Canonnicut, Prudence, Patience, Hope, Dyer's, and Hog-Iſlands. Block-Iſland is the ſouthernmoſt land belonging to the State. The harbours are Newport, Providence, Wickford, Patuxet, Warren, and Briſtol. Rhode-Iſland, from which the State takes half its name, lies between lat. 41 28, and 41 42 N. and between long. 71 17, and 71 27 W. from Greenwich; being about 15 miles long from N. E. to S. W. and about 3½ broad, on an average. It is divided into 3 townſhips, Newport,

port, Portſmouth, and Middletown. Perhaps no iſland in the world exceeds this in point of ſoil, climate, and ſituation. In its moſt flouriſhing ſtate it was called, by travellers, the Eden of America. But the change, which the ravages of war, and a decreaſe of buſineſs have effected, is great. Between 30,000 and 40,000 ſheep are fed on this iſland, beſides neat cattle and horſes. The State is interſected in all directions by rivers; the chief of which are Providence and Taunton rivers, which fall into Narraganſet Bay; the former on the weſt, the latter on the eaſt ſide of Rhode-Iſland. Rhode-Iſland is as healthy a country as any in America. The winters, in the maritime parts of the State are milder than in the inland country; the air being ſoftened by a ſea vapour, which alſo enriches the ſoil. The ſummers are delightful, eſpecially on Rhode-Iſland, where the extreme heats which prevail in other parts of America, are allayed by cool and refreſhing breezes from the ſea. The rivers and bays ſwarm with fiſh, to the amount of more than 70 different kinds; the markets are alive with them. Oyſters, lobſters, and other ſhell-fiſh abound in Narraganſet Bay. Travellers are generally agreed, that Newport is the beſt fiſh market in the world. This State produces corn, rye, barley, oats, and in ſome parts wheat, ſufficient for home conſumption; and the various kinds of graſſes, fruits, and culinary roots and plants in great abundance, and in perfection; cyder is made for exportation. The northweſtern parts of the State are but thinly inhabited, and are more rocky and barren than the other parts. The tract of land lying between North and South Kingſtown on the eaſt, and Connecticut on the weſt, called *Shannock* country, or *Purchaſe*, is excellent grazing land, and is inhabited by a number of wealthy farmers, who raiſe ſome of the fineſt neat cattle in New-England, weighing from 1600 to 1800 weight. They keep large dairies, and make butter and cheeſe of the beſt quality, and in large quantities for exportation. Iron ore is found in great plenty in ſeveral parts of the State. The iron-works on Patuxet river, 12 miles from Providence, are ſupplied with ore from a bed 4½ miles diſtant, which lies in a valley, through which runs a brook. The brook is turned into a new channel, and the ore-pits are cleared of water by a ſteam engine. At this ore-bed are a variety of ores, curious ſtones, and ochres. In the townſhip of Cumberland is a copper mine mixed with iron ſtrongly impregnated with load-ſtone, of which ſome large pieces have been found in the neighbourhood. No method has yet been diſcovered to work it to advantage. Abundance of lime-ſtone is found in this State, particularly in the county of Providence; of which large quantities of lime are made and exported. This lime-ſtone is of different colours, and is the true marble of the white, plain, and variegated kind. It takes as fine a poliſh as any ſtone in America. There are ſeveral mineral ſprings in this State; to one of which, near Providence, many people reſort to bathe, and drink the water. Newport and Providence are the chief towns of this State. The ſlave trade, which was a ſource of wealth to many of the people of Newport, and in other parts of the State, has happily been aboliſhed. The town of Briſtol carries on a conſiderable trade to Africa, the Weſt-Indies, and to different parts of the United States. But by far the greateſt part of the commerce of Rhode Iſland, is at preſent carried on by the inhabitants of the flouriſhing town of Providence, which had in 1791, 129 ſail of veſſels, containing 11.942 tons. The exports from the State are flaxſeed, lumber, horſes, cattle, beef, pork, fiſh, poultry, onions, butter, cheeſe, barley, grain, ſpirits, cotton and linen goods. The imports conſiſt of European and W. India goods, and logwood from the Bay of Honduras. Upwards of 600 veſſels enter and clear annually at the different ports in this State. The amount of exports from this ſtate to foreign countries, for one year, ending Sept. 30, 1791, was 470,131 dolls. 9 cents; in 1792, 698,084; in 1793, 616,416; and in 1794, 954,573 dollars. The inhabitants of this ſtate are progreſſing rapidly in manufactures. A cotton manufactory has been erected at Providence. Jeans, fuſtians, denims, thickſets, velvets, &c. &c. are here manufactured and ſent to the ſouthern ſtates. Large quantities of linen and tow cloth are made in different parts of this ſtate for exportation. But the moſt conſiderable manufactures in this ſtate are thoſe of iron; ſuch as bar and ſheet iron, ſteel, nail-rods, and nails, implements of huſbandry, ſtoves, pots, and other houſehold utenſils, the iron work of ſhipping, anchors, bells, &c. The conſtitution of this ſtate is founded on the charter granted by Charles II. in 1663; and the frame of government was not eſſentially altered by the revolution. The legiſlature of the ſtate conſiſts of two branches; a ſenate or upper houſe, compoſed of ten members beſides the governor and deputy-governor, called in the charter, *aſſiſtants*; and a houſe of repreſentatives, compoſed of deputies from the ſeveral towns. The members of the legiſlature are choſen twice a year; and there are two ſeſſions of this body annually, viz. on the firſt Wedneſday in May, and the laſt Wedneſday in October. This ſtate was firſt ſettled from Maſſachuſetts. Mr Roger Williams, a miniſter, who came over to New-England in 1631, was charged with holding a variety of errors, and was on that account forced to leave his houſe, land, wife and children, at Salem, in the dead of winter, and to ſeek a reſidence without the limits of Maſſachuſetts. Gov. Winthrop adviſed him to purſue his courſe to Nehiganſet, or Narraganſet Bay, which he did, and fixed himſelf at Secunk or Seekhonk, now Rehoboth. But that place being within the bounds of Plymouth colony, Gov. Winſlow, in a friendly manner adviſed him to remove to the other ſide of the river, where the lands were not covered by any patent. Accordingly, in 1636, Mr Williams and four others croſſed Seekhonk river, and landed among the Indians, by whom they were hoſpitably received, and thus laid the foundation of a town, which, from a ſenſe of God's merciful providence to him, he called *Providence*. Here he was ſoon after joined by a number of others, and, though they were ſecured from the Indians by the terror of the Engliſh, yet they, for a conſiderable time, ſuffered much from fatigue and want; but they enjoyed liberty of conſcience, which has ever ſince been inviolably maintained in this ſtate. So little has the civil authority to do with religion here, that no contract between a miniſter and a ſociety (unleſs incorporated for that purpoſe) is of any force. It is probably for theſe reaſons, that ſo many different ſects have ever been found here; and that the Sabbath and all religious inſtitutions, have been more neglected in this, than in any other of the New-England ſtates.—*Morſe.*

RHODE-ISLAND *Light-Houſe* was erected in 1749, in Beaver Tail, at the ſouth end of Canonnicut Iſland, for the ſafety and convenience of veſſels ſailing into the Narraganſet Bay and Harbour of Newport. The ground the light-houſe ſtands upon is about 12 feet above the ſurface of the ſea at high water. From the ground to the top of the cornice is 58 feet, round which is a gallery, and within that ſtands the lantern, which is about 11 feet high, and 8 feet diameter. High water at full and change, 37 minutes after 7 o'clock. N. lat. 41 28, W. long. 71 24.—*ib.*

RHODE *River*, the weſternmoſt water of the N. W. branch of Cape Fear river, in N. Carolina.—*ib.*

RHOMB SOLID, conſiſts of two equal and right cones joined together at their baſes.

RHYNBECK, or *Rhinebeck*, a poſt-town of N. York, ſituated in Dutcheſs county, on the E. ſide of Hudſon's river, oppoſite to Kingſton; 18 miles north of Poughkeepſie; 103 north of New-York, and 198 N. by E. of Philadelphia. The townſhip contains 3,662 inhabitants, of whom 542 are electors, and 421 ſlaves. It is bounded ſoutherly by Clinton, and northerly by Beekman. A very curious cavern has been lately diſcovered at a place in this town, called by the Indians, Sepaſcot.—*Morſe.*

RIALEXA, or *Rialeno*, a town of New Spain, ſituated on a ſmall river in Nicaragua, 5 miles from the ſea, where is a good harbour. It is unwholeſome by reaſon of marſhes in the vicinity. It is 60 miles W. of Leon, and the Lake Nicaragua. N. lat. 12 25, W. long. 89 10.—*ib.*

RICE (ſee that article, and ORYZA, *Encycl.*) is ſtrongly recommended, in a late publication, as the beſt corrective of *ſprit* flour, of which there is a great quantity in Scotland every year, and of courſe a great deal of unpleaſant and unwholeſome bread. The gentleman, who writes the ſhort paper alluded to, directs ten pounds of flour and one pound of ground rice, with the uſual quantity of yeſt, to be placed, for about two hours, before a fire, and then formed into bread in the common way. This addition of rice, beſides correcting the bad qualities of the damaged flour, adds, he ſays, much to its nutriment: and he is undoubtedly right; for the flour of rice, though very nutritious, is ſo dry, that it is difficult to make bread of it by itſelf. See *BREAD of Rice*, in this *Suppl.*

As rice is a favourite ſubſtitute for bread in years of ſcarcity, it may not be diſagreeable to our readers to know the method of cultivating the plant in thoſe countries where it is the principal food of the inhabitants. We have the following full and perſpicuous account of the Chineſe practice by Sir George Staunton.

"Much of the low grounds in the middle and ſouthern provinces of the empire are appropriated to the culture of that grain. It conſtitutes, in fact, the principal part of the food of all thoſe inhabitants, who are not ſo indigent as to be forced to ſubſiſt on other and cheaper kinds of grain. A great proportion of the ſurface of the country is well adapted for the production of rice, which, from the time the ſeed is committed to the ſoil till the plant approaches to maturity, requires to be immerſed in a ſheet of water. Many and great rivers run through the ſeveral provinces of China, the low grounds bordering on thoſe rivers are annually inundated, by which means is brought upon their ſurface a rich mud or mucilage that fertilizes the ſoil, in the ſame manner as Egypt receives its fecundative quality from the overflowing of the Nile. The periodical rains which fall near the ſources of the Yellow and the Kiang rivers, not very far diſtant from thoſe of the Ganges and the Burumpooter, among the mountains bounding India to the north, and China to the weſt, often ſwell thoſe rivers to a prodigious height, though not a drop of rain ſhould have fallen on the plains through which they afterwards flow.

Rice.

"After the mud has lain ſome days upon the plains in China, preparations are made for planting them with rice. For this purpoſe, a ſmall ſpot of ground is incloſed by a bank of clay; the earth is ploughed up; and an upright harrow, with a row of wooden pins in the lower end, is drawn lightly over it by a buffalo. The grain, which had previouſly been ſteeped in dung diluted with animal water, is then ſown very thickly on it. A thin ſheet of water is immediately brought over it, either by channels leading to the ſpot from a ſource above it, or when below it by means of a chain pump, of which the uſe is as familiar as that of a hoe to every Chineſe huſbandman. In a few days the ſhoots appear above the water. In that interval, the remainder of the ground intended for cultivation, if ſtiff, is ploughed, the lumps broken by hoes, and the ſurface levelled by the harrow. As ſoon as the ſhoots have attained the height of ſix or ſeven inches, they are plucked up by the roots, the tops of the blades cut off, and each root is planted ſeparately, ſometimes in ſmall furrows turned with the plough, and ſometimes in holes made in rows by a drilling ſtick for that purpoſe. The roots are about half a foot aſunder. Water is brought over them a ſecond time. For the convenience of irrigation, and to regulate its proportion, the rice fields are ſubdivided by narrow ridges of clay, into ſmall incloſures. Through a channel, in each ridge, the water is conveyed at will to every ſubdiviſion of the field. As the rice approaches to maturity, the water, by evaporation and abſorption, diſappears entirely; and the crop, when ripe, covers dry ground. The firſt crop or harveſt, in the ſouthern provinces particularly, happens towards the end of May or beginning of June. The inſtrument for reaping is a ſmall ſickle, dentated like a ſaw, and crooked. Neither carts nor cattle are uſed to carry the ſheaves off from the ſpot where they were reaped; but they are placed regularly in frames, two of which, ſuſpended at the extremities of a bamboo pole, are carried acroſs the ſhoulders of a man, to the place intended for diſengaging the grain from the ſtems which had ſupported it. This operation is performed, not only by a flail, as is cuſtomary in Europe, or by cattle treading the corn in the manner of other Orientaliſts, but ſometimes alſo by ſtriking it againſt a plank ſet upon its edge, or beating it againſt the ſide of a large tub ſcolloped for that purpoſe; the back and ſides being much higher than the front, to prevent the grain from being diſperſed. After being winnowed, it is carried to the granary.

"To remove the ſkin or huſk of rice, a large ſtrong earthen veſſel, or hollow ſtone, in form ſomewhat like that which is uſed elſewhere for filtering water, is fixed firmly in the ground; and the grain, placed in it, is ſtruck with a conical ſtone fixed to the extremity of a lever, and cleared, ſometimes indeed imperfectly, from the huſk. The ſtone is worked frequently by a perſon treading

treading upon the end of the lever. The ſame object is attained alſo by paſſing the grain between two flat ſtones of a circular form, the upper of which turns round upon the other, but at ſuch a diſtance from it as not to break the intermediate grain. The operation is performed on a larger ſcale in mills turned by water; the axis of the wheel carrying ſeveral arms, which, by ſtriking upon the ends of levers, raiſe them in the ſame manner as is done by treading on them. Sometimes twenty of theſe levers are worked at once. The ſtraw from which the grain has been diſengaged is cut chiefly into chaff, to ſerve as provender for the very few cattle employed in Chineſe huſbandry.

"The labour of the firſt crop being finiſhed, the ground is immediately prepared for the reception of freſh ſeeds. The firſt operation undertaken is that of pulling up the ſtubble, collecting it into ſmall heaps, which are burnt, and the aſhes ſcattered upon the field. The former proceſſes are afterwards renewed. The ſecond crop is generally ripe late in October or early in November. The grain is treated as before; but the ſtubble is no longer burnt. It is turned under with the plough, and left to putrefy in the earth. This, with the ſlime brought upon the ground by inundation, are the only manures uſually employed in the culture of rice."

RICH, *Cape*, on the W. ſide of the iſland of Newfoundland, towards the N. end, and in the N. E. part of the gulph of St Lawrence, having the iſle of St John and other ſmall iſles to the north. This cape or point uſed to be omitted in the French maps, ſeemingly becauſe it was the bounds of their privilege of fiſhing, which extended from hence northward, and round to Cape Bonaviſta.—*Morſe*

RICHARDSON's *Bay*, on the S. E. part of the iſland of Jamaica. The anchorage within it is between Morant river and Two Mile Wood.—*ib.*

RICHFIELD, a townſhip of New York, ſituated in Otſego county, taken from Otſego townſhip, and incorporated in 1792; 229 of its inhabitants are electors.—*ib.*

RICHFORD, the north eaſternmoſt townſhip of Franklin county Vermont; on Miſſiſconi river.—*ib.*

RICHLAND, a county of S. Carolina, Camden diſtrict; bounded S. and S. W. by Congaree and Broad rivers, and eaſt by Wateree river, which divides it from Kerſhaw and Clermont counties. It contains 3,930 inhabitants; of whom 2,479 are white, and 1,437 ſlaves.—*ib.*

Richland, a townſhip of Pennſylvania, in Buck's county.—*ib.*

RICHLIEU *Iſlands*, a cluſter of ſmall iſlands in the river St Lawrence, about 12 leagues above the town of Trois Rivieres, at the boundary of the government of Montreal. There are nearly 100 of them. N. lat. 46 22, W. long. 71 7.—*ib.*

Richlieu, the name of an ancient ſmall fortification built by the French, on the north bank of the river Sorel, at its junction with the river St Lawrence, oppoſite the iſlands of Richlieu.—*ib.*

RICHMAN's *Iſland*, on the coaſt of Cumberland county, Diſtrict of Maine, about northerly, four leagues from Wood Iſland, and a league weſt of Portland. Few veſſels put in here, except coaſters. There is a ſunken ledge S. E. half a mile from the north eaſt end of the iſland, which only ſhews itſelf when the wind blows freſh: But you need not go ſo near the iſland. Wood Iſland is in lat. 43 50 N. and long. 69 57 W.—*ib.*

RICHMOND, a townſhip on the weſt line of the State of Maſſachuſetts, in Berkſhire county, 17 miles W. by S. of Lenox, and 150 weſt of Boſton. Iron ore of the firſt quality is found here, but as it lies deep it is raiſed at a great expenſe. Ore of indifferent quality is found in many places. It abounds with lime-ſtone, coarſe, white, and clouded marble. The town was incorporated in 1775, and contains an iron-work, 3 griſt-mills, a fulling-mill, 2 ſaw-mills, and 1255 inhabitants.—*ib.*

Richmond, a townſhip of Cheſhire county, New-Hampſhire; ſituated on the Maſſachuſetts line, about 11 miles eaſt of Connecticut river, and 97 W. by S. of Portſmouth. It was incorporated in 1752, and contains 1380 inhabitants.—*ib.*

Richmond, a townſhip in Waſhington county, Rhode-Iſland, ſeparated from Hopkinton on the weſt by Ward's river a branch of Paucatuck river. It is about 19 miles weſt of Newport, and contains 1760 inhabitants.—*ib.*

Richmond, a county of New-York, comprehending all Staten-Iſland, Shooters-Iſland, and the Iſlands of Meadow, on the weſt ſide thereof. It is divided into the townſhips of Caſtletown, Northfield, Southfield, and Weſtfield. It contains 3,835 inhabitants; of whom 488 are electors, and 759 ſlaves.—*ib.*

Richmond, a county of N. Carolina, ſituated in Fayette diſtrict, bounded ſouth, by the State of S. Carolina, and north, by Moore county. It contains 5055 inhabitants, including 583 ſlaves. Chief town, Rockingham. The court-houſe, at which a poſt-office is kept, is 20 miles from Anſon court-houſe, 56 from Fayetteville, and 563 from Philadelphia.—*ib.*

Richmond, a county of Virginia, bounded N. and N. E. by Weſtmoreland, and S. and S. W. by Rappahannock river, which ſeparates it from Eſſex county. It contains 6,985 inhabitants, of whom 3,984 are ſlaves. The court-houſe, where a poſt-office is kept, is 273 miles from Philadelphia.—*ib.*

Richmond, the preſent ſeat of government of the State of Virginia, is ſituated in Henrico county, on the north ſide of James's river, juſt at the foot of the falls, and contains between 400 and 500 houſes, and nearly 4,000 inhabitants. Part of the houſes are built on the margin of the river, convenient for buſineſs; the reſt are upon a hill which overlooks the lower part of the town, and commands an extenſive proſpect of the river and adjacent country. The new houſes are well built. A large ſtate-houſe, or capitol, has lately been erected on the hill. This city likewiſe boaſts of an elegant ſtatue of the illuſtrious Waſhington, which was formed at Paris. The lower part of the town is divided by a creek, over which is a convenient bridge. A bridge between 300 and 400 yards in length, has been thrown acroſs James's river, at the foot of the fall, by Col. Mayo. That part from Mancheſter to the iſland is built on 15 boats. From the iſland to the rocks was formerly a floating bridge of rafts; but the enterpriſing proprietor has now built it of framed log piers, filled with ſtones. From the rocks to the landing at Richmond, the bridge is continued on framed piers filled with ſtones. This bridge connects the city with Mancheſter; and as the paſſengers pay toll, it produces a handſome revenue to Col. Mayo, who is the ſole proprietor. The public buildings, beſides the ſtate-houſe, are an Epiſcopal church, a court-houſe, gaol, a theatre, and 3 tobacco ware-houſes. The falls above the bridge are 7 miles in length. A noble canal is cutting, and nearly completed on the north ſide of the river, which is to terminate in a baſon of about two acres, in the town of Richmond. From this baſon to the wharves in the river, will be a land carriage of about a mile. The expenſe is eſtimated at £30,000 Virginia currency. The opening of this canal promiſes the addition of much wealth to Richmond. Veſſels of burden lie at City Point, 20 miles below, to which the goods from Richmond are ſent down in boats. It is 626 miles from Boſton, 374 from N. York, 176 from Baltimore, 278 from Philadelphia, 247 from Fayetteville, 497 from Charleſton, and 662 from Savannah. N. lat. 37 40, W. long. 77 50.—*ib.*

Richmond, a county of the Upper diſtrict of Georgia, in which is ſituated the city of Auguſta. It is ſeparated from S. Carolina, on the E. by Savannah river, and contains 11,317 inhabitants, of whom 4,116 are ſlaves.—*ib.*

Richmond, a town of the iſland of St Vincent's, in the Weſt-Indies. It is ſeated at the head of a deep bay, on the weſtern ſide of the iſland. Chateaubelair river runs on the ſouth ſide of the town, which gives name to the bay. Another river empties into the bay on the north ſide of the town.—*ib.*

RIDEAU, in fortification, a ſmall elevation of earth, extending itſelf lengthwiſe on a plain; ſerving to cover a camp, or give an advantage to a poſt.

Rideau is ſometimes alſo uſed for a trench, the earth of which is thrown up on its ſide, to ſerve as a parapet for covering the men.

RIDGEFIELD, a poſt-town of Connecticut, in Fairfield county, 10 miles ſouth-weſtward of Danbury, 78 ſouth weſt of Hartford, 51 north-eaſt of Kingſbridge, in the State of New-York, and 161 north-eaſt of Philadelphia. The townſhip of Ridgefield was called by the Indians *Caudotowa*, or high land. It well anſwers the name, for though it is 14 miles from the Sound, it affords a good proſpect of it, and of Long-Iſland. Of the latter, 40 miles in length is viſible, and veſſels may be ſeen as they paſs up the Sound. It was ſettled in 1709.—*Morſe.*

RIDLEY (Dr Gloſter), was of the ſame family with Dr Nicolas Ridley, Biſhop of London, and Martyr to the Reformation. (See Ridley, *Encycl.*) He was born at ſea, in 1702, on board the Glouceſter Eaſt Indiaman; to which circumſtance he was indebted for his Chriſtian name. He received his education at Wincheſter ſchool, and thence was elected to a fellowſhip at New college, Oxford, where he proceeded B. C. L. April 29. 1729. In thoſe two ſeminaries he cultivated an early acquaintance with the muſes, and laid the foundation of thoſe elegant and ſolid acquirements for which he was afterwards ſo eminently diſtinguiſhed as a poet, an hiſtorian, and a divine. During a vacancy in 1728, he joined with four friends, viz. Mr Thomas Fletcher (afterwards Biſhop of Kildare), Mr (afterwards Dr) Eyre, Mr Morriſon, and Mr Jennens, in writing a tragedy called "The Fruitleſs Redreſs," each undertaking an act on a plan previouſly concerted. When they delivered in their ſeveral proportions at their meeting in the winter, few readers would have known that the whole was not the production of a ſingle hand. This tragedy, which was offered to Mr Wilks, but never acted, is ſtill in MS. with another called "Jugurtha." Dr Ridley in his youth was much addicted to theatrical performances. Midhurſt, in Suſſex, was the place where they were exhibited; and the company of gentlemen actors to which he belonged conſiſted chiefly of his coadjutors in the tragedy already mentioned. He is ſaid to have performed the characters of Marc Antony, Jaffier, Horatio, and Moneſes, with diſtinguiſhed applauſe; a circumſtance that will be readily believed by thoſe who are no ſtrangers to his judicious and graceful manner of ſpeaking in the pulpit.

For great part of his life he had no other preferment than the ſmall college living of Weſtow in Norfolk, and the donative of Poplar in Middleſex, where he reſided. To theſe his college added, ſome years after, the donative of Romford in Eſſex. "Between theſe two places the curricle of his life had (as he expreſſed it) rolled for ſome time almoſt perpetually upon poſtchaiſe wheels, and left him not time for even the proper ſtudies of economy, or the neceſſary ones of his profeſſion." Yet in this obſcure ſituation he remained in poſſeſſion of, and content with, domeſtic happineſs; and was honoured with the intimate friendſhip of ſome who were not leſs diſtinguiſhed for learning than for worth.

In 1740 and 1741 he preached "Eight Sermons at Lady Moyer's Lecture," which were publiſhed in 1742, 8vo. In 1756 he declined an offer of going to Ireland as firſt chaplain to the Duke of Bedford; in return for which he was to have had the choice of promotion, either at Chriſt-church, Canterbury, Weſtminſter, or Windſor. His modeſty inducing him to leave the choice of theſe to his patron, the conſequence was, that he obtained none of them. In 1763, he publiſhed the "Life of Biſhop Ridley," in 4to, by ſubſcription, and cleared by it as much as brought him 800l. in the public funds. In the latter part of his life he had the misfortune to loſe both his ſons, each of them a youth of abilities. The elder, James, was author of "The Tales of the Genii," and ſome other literary performances. Thomas, the younger, was ſent by the Eaſt India Company as a writer to Madras, where he was no ſooner ſettled than he died of the ſmall-pox. In 1765, Dr Ridley publiſhed his "Review of Philips's Life of Cardinal Pole;" and in 1768, in reward for his labours in this controverſy, and in another which "The Confeſſional" produced, he was preſented by Archbiſhop Secker to a golden prebend in the cathedral church of Saliſbury (an option), the only reward he received from the great during a long, uſeful, and laborious life, devoted to the duties of his function. At length, worn out with infirmities, he departed this life in 1774, leaving a widow and four daughters. His epitaph, which was written by Biſhop Lowth with his uſual elegance, informs us, that for his merits the univerſity of Oxford conferred upon him the degree of D. D. by diploma, which is the higheſt literary honour which that learned body has to beſtow.

RIDLEY, a townſhip in Delaware county, Pennſylvania.—*Morſe.*

RIENZI (Nicolas Gabrini de), one of the moſt extraordinary men of the 14th century, was born at Rome, we know not in what year. His father, Lawrence Gabrini, was a mean vintner, or, as others ſay, a miller, and his mother a laundreſs. Theſe perſons, however, found the means of giving their ſon a liberal education; and to a good natural underſtanding he joined an uncommon aſſiduity, and made great proficiency in ancient literature. Every thing which he read he compared with ſimilar paſſages that occurred within his own obſervation; whence he made reflections, by which he regulated his conduct. To this he added a great knowledge in the laws and cuſtoms of nations. He had a vaſt memory: he retained much of Cicero, Valerius Maximus, Livy, the two Senecas, and Cæſar's Commentaries eſpecially, which he read continually, and often quoted by application to the events of his own times. This fund of learning proved the baſis and foundation of his riſe. The deſire he had to diſtinguiſh himſelf in the knowledge of monumental hiſtory, drew him to another ſort of ſcience, in which few men at that time exerted themſelves. He paſſed whole days among the inſcriptions which are to be found at Rome, and acquired ſoon the reputation of a great antiquary. Having hence formed within himſelf the moſt exalted notions of the juſtice, liberty, and ancient grandeur of the old Romans, words he was perpetually repeating to the people, he at length perſuaded not only himſelf, but the giddy mob his followers, that he ſhould one day become the reſtorer of the Roman republic. His advantageous ſtature, his countenance, and that air of importance which he well knew how to aſſume, deeply imprinted all that he ſaid in the minds of his audience.

Nor was it only by the populace that he was admired; he alſo found means to inſinuate himſelf into the favour of thoſe who partook of the adminiſtration. Rienzi's talents procured him to be nominated one of the deputies ſent by the Romans to Pope Clement VI. who reſided at Avignon. The intention of this deputation was to make his Holineſs ſenſible, how prejudicial his abſence was, as well to himſelf as to the intereſt of Rome. At his firſt audience, our hero charmed the court of Avignon by his eloquence and the ſprightlineſs of his converſation. Encouraged by ſucceſs, he one day took the liberty to tell the Pope, that the grandees of Rome were avowed robbers, public thieves, infamous adulterers, and illuſtrious profligates; who, by their example, authoriſed the moſt horrid crimes. To them he attributed the deſolation of Rome; of which he drew ſo lively a picture, that the Holy Father was moved, and exceedingly incenſed againſt the Roman nobility. Cardinal Colonna, in other reſpects a lover of real merit, could not help conſidering theſe reproaches as reflecting upon ſome of his family; and therefore found means of diſgracing Rienzi, ſo that he fell into extreme miſery, vexation, and ſickneſs, which, joined with indigence, brought him to an hoſpital. Nevertheleſs, the ſame hand that threw him down, raiſed him up again. The cardinal, who was all compaſſion, cauſed him to appear before the Pope, in aſſurance of his being a good man, and a great partizan for juſtice and equity. The Pope approved of him more than ever; and, to give him proofs of his eſteem and confidence, made him apoſtolic notary, and ſent him back loaded with favours.

Being returned to Rome, he began to execute the functions of his office; and by affability, candour, aſſiduity, and impartiality, in the adminiſtration of juſtice, he arrived at a ſuperior degree of popularity; which he ſtill improved by continued invectives againſt the vices of the great, whom he took care to render as odious as poſſible; till at laſt, for ſome ill-timed freedoms of ſpeech, he was not only ſeverely reprimanded, but diſplaced. From this time it was his conſtant endeavour to inſpire the people with a fondneſs for their ancient liberties; to which purpoſe he cauſed to be hung up in the moſt public places emblematic pictures, expreſſive of the former ſplendour and preſent decline of Rome. To theſe he added frequent harangues and predictions upon the ſame ſubject. In this manner he proceeded till one party looked on him only as a madman, while others careſſed him as their protector. At length he ventured to open himſelf to ſuch as he believed malecontents. At firſt he took them ſeparately; afterwards, when he thought he had firmly attached a ſufficient number to his intereſt, he aſſembled them together, and repreſented to them the deplorable ſtate of the city, over-run with debaucheries, and the incapacities of their governors to correct or amend them. As a neceſſary foundation for the enterpriſe, he gave them an inſight into the immenſe revenues of the apoſtolic chamber: He demonſtrated, that the Pope could, only at the rate of fourpence, raiſe a hundred thouſand florins by firing, as much by ſalt, and as much more by the cuſtoms and other duties. As for the reſt, ſaid he, I would not have you imagine that it is without the Pope's conſent I lay hands on the revenues. Alas! how many others in this city plunder the effects of the church contrary to his will!

By this artful lie, he ſo animated his auditors, that they declared they would make no ſcruple of ſecuring theſe treaſures for whatever end might be moſt convenient; and that they were devoted to the will of him their chief. Having obtained ſo much, to ſecure his adherents from a revolt, he tendered them a paper, ſuperſcribed, "an *oath* to procure the good eſtabliſhment;" and made them ſubſcribe and ſwear to it before he diſmiſſed them. By what means he prevailed on the Pope's vicar to give a tacit ſanction to his project, is not certainly known; that he did procure that ſanction, and that it was looked on as a maſterpiece of policy, is generally admitted. "The 20th of May, being Whitſunday, he fixed upon to ſanctify in ſome ſort his enterpriſe; and pretended, that all he acted was by particular inſpiration of the Holy Ghoſt. About nine, he came out of the church bare headed, accompanied by the Pope's vicar, ſurrounded by an hundred armed men. A vaſt crowd followed him with ſhouts and acclamations." The gentlemen conſpirators carried three ſtandards before him, on which were wrought devices, inſinuating, that his deſign was to re-eſtabliſh liberty, juſtice, and peace. In this manner he proceeded directly to the Capitol, where he mounted the roſtrum; and, with more boldneſs and energy than ever, expatiated on the miſeries to which the Romans were reduced: at the ſame time telling them, without heſitation, "that the happy hour of their deliverance was at length come, and that he was to be their deliverer, regardleſs of the dangers he was expoſed to for the ſervice of the Holy Father and the people's ſafety." After which, he ordered the laws of what he called the good eſtabliſhment to be read: "aſſured that the Romans would reſolve to obſerve theſe laws, he engaged in a ſhort time to re-eſtabliſh them in their ancient grandeur."

The laws of the good eſtabliſhment promiſed plenty and ſecurity, which were greatly wanted; and the humiliation of the nobility, who were deemed common oppreſſors. Such laws could not fail of being agreeable to a people who found in them theſe double advantages; wherefore, "enraptured with the pleaſing ideas of a liberty to which they were at preſent ſtrangers, and the hope of gain, they came moſt zealouſly into the fanaticiſm of Rienzi. They reſumed the pretended authority of the Romans; they declared him ſovereign of Rome; and granted him the power of life and death, of rewards and puniſhments, of enacting and repealing the laws, of treating with foreign powers; in a word, they gave him the full and ſupreme authority over all the extenſive territories of the Romans.

Rienzi, arrived at the ſummit of his wiſhes, kept at a great diſtance his artifice: he pretended to be very unwilling to accept of their offers, but upon two conditions; the firſt, that they ſhould nominate the Pope's vicar (the Biſhop of Orvieto) his copartner; the ſecond, that the Pope's conſent ſhould be granted him, which (he told them) he flattered himſelf he ſhould obtain. "On the one hand, he hazarded nothing in thus making his court to the Holy Father; and, on the other, he well knew, that the Biſhop of Orvieto would carry a title only, and no authority. The people granted his requeſt, but paid all the honours to him: he poſſeſſed the authority without reſtriction; the good Biſhop appeared a mere ſhadow and veil to his enterpriſes. Rienzi was ſeated in his triumphal chariot, like an idol, to triumph with the greater ſplendour. He diſmiſſed the people replete with joy and hope. He ſeized upon the palace, where he continued after he had turned out the ſenate; and, the ſame day, he began to dictate his laws in the Capitol." This election, though not very pleaſing to the Pope, was ratified by him; nevertheleſs, Rienzi meditated the obtaining of a title, excluſive of the papal prerogative. Well verſed in the Roman hiſtory, he was no ſtranger to the extent of the tribunitial authority; and as he owed his elevation to the people, he choſe to have the title of their magiſtrate. He aſked it, and it was conferred on him and his copartner, with the addition of deliverers of their country. Our adventurer's behaviour in his elevation was at firſt ſuch as commanded eſteem and reſpect, not only from the Romans, but from all the neighbouring ſtates. But it is difficult for a perſon of mean birth, elevated at once, by the caprice of fortune, to the moſt exalted ſtation, to move rightly in a ſphere wherein he muſt breathe an air he has been unaccuſtomed to. Rienzi aſcended by degrees the ſummit of his fortune. Riches ſoftened, power dazzled, the pomp of his cavalcades animated, and formed in his mind ideas adequate to thoſe of princes born to empire. Hence luxury invaded his table, and tyranny took poſſeſſion of his heart. The pope conceived his deſigns to be contrary to the intereſts of the holy ſee; and the nobles, whoſe power it had been his conſtant endeavours to depreſs, conſpired againſt him: they ſucceeded; and Rienzi was forced to quit an authority he had poſſeſſed little more than ſix months. It was to a precipitate flight that he was indebted, at this juncture, for his life; and to different diſguiſes for his ſubſequent preſervation.

Having made an ineffectual effort at Rome, and "not knowing where to find a new reſource to carry on his deſigns, he took a moſt bold ſtep, conformable to that raſhneſs which had ſo often aſſiſted him in his former exploits. He determined to go to Prague, to Charles king of the Romans, whom the year before he had ſummoned to his tribunal," and who, he foreſaw, would deliver him up to a Pope highly incenſed againſt him. He was accordingly ſoon after ſent to Avignon, and there thrown into a priſon, where he continued three years. The diviſions and diſturbances in Italy, occaſioned by the number of petty tyrants that had eſtabliſhed themſelves in the eccleſiaſtical territories, and even at Rome, occaſioned his enlargement. Innocent VI. who ſucceeded Clement in the papacy, ſenſible that the Romans ſtill entertained an affection for our hero, and believing that his chaſtiſement would teach him to act with more moderation than he had formerly done, as well as that "gratitude would oblige him, for the remainder of his life, to preſerve an inviolable attachment to the holy ſee (by whoſe favour he ſhould be re-eſtabliſhed)," thought him a proper inſtrument to aſſiſt his deſign of reducing thoſe other tyrants; and therefore, not only gave him his liberty, but alſo appointed him governor and ſenator of Rome. He met with many obſtacles to the aſſumption of this newly-granted authority; all which, by cunning and reſolution, he at length overcame. But giving way to his paſſions, which were immoderately warm, and inclined him to cruelty, he excited ſo general a reſentment againſt him, that he was murdered October 8, 1354.

"Such was the end of Nicholas Rienzi, one of the moſt renowned men of the age; who, after forming a conſpiracy full of extravagance, and executing it in the ſight of almoſt the whole world, with ſuch ſucceſs that he became ſovereign of Rome; after cauſing plenty, juſtice, and liberty, to flouriſh among the Romans; after protecting potentates, and terrifying ſovereign princes; after being arbiter of crowned heads; after re-eſtabliſhing the ancient majeſty and power of the Roman republic, and filling all Europe with his fame during the ſeven months of his firſt reign; after having compelled his maſters themſelves to confirm him in the authority he had uſurped againſt their intereſts—fell at length at the end of his ſecond, which laſted not four months, a ſacrifice to the nobility, whoſe ruin he had vowed, and to thoſe vaſt projects which his death prevented him from putting into execution."*

If the reader perceive any thing ſimilar at preſent to the riſe of this wonderful man to ſovereign authority, he may perhaps conſole himſelf with the hope that the modern conſul will in all probability fall like the modern tribune. Both roſe by diſplays of the moſt daring courage; the aſſociates of both were prieſts, who in the actual exerciſe of government were cyphers; both promiſed liberty and plenty to the people whom they ruled with abſolute ſway; and both have trampled upon the order of nobility.

RIGO *Iſland*, near the north-weſt part of the iſland of Porto Rico, in the Weſt-Indies, behind which is the principal harbour of the main iſland.—*Morſe.*

RIMAC, a river of Peru, which paſſes through the city of Lima, and falls into the ſea 6 miles below that city.—*ib.*

RINDGE, or *Ringe*, a town in the county of Cheſhire,

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* *Biog. Dict.* new edit.

ſhire, New-Hampſhire. It lies upon the Maſſachuſetts line, about 80 miles weſterly of Portſmouth, and 70 north-weſt of Boſton. Was incorporated in 1768. In 1775, it contained 542, and in 1790, 1143 inhabitants. In this townſhip are thirteen natural ponds of water of different ſizes, in which are pickerel, perch, trout, eels, &c. In this townſhip, northerly, is a mine lately diſcovered, which contains a kind of ochre of a Spaniſh brown. One half of the water of this town runs to the Merrimack, the other to Connecticut river.—*ib.*

RING, in aſtronomy and navigation, an inſtrument uſed for taking the ſun's altitude, &c. It is uſually of braſs, about nine inches diameter, ſuſpended by a little ſwivel, at the diſtance of 45° from the point of which is a perforation, which is the centre of a quadrant of 90° divided in the inner concave ſurface. To uſe it, let it be held up by the ſwivel, and turned round to the ſun, till his rays, falling through the hole, make a ſpot among the degrees, which marks the altitude required. This inſtrument is preferred before the aſtrolabe, becauſe the diviſions are here larger than on that inſtrument.

RINGO's-TOWN, in Hunterdon county, New-Jerſey, lies about 15 miles N. W. of Princeton.—*Morſe.*

RIOBAMBA, a juriſdiction of Peru, in the province of Quito, having a capital of its own name. The productions and manufactures of this province excel all the reſt of the provinces of Peru. Several parts of it are full of mines of gold and ſilver.—*ib.*

RIO *Bueno*, in the iſland of Jamaica, lies 14 miles eaſtward of Martha Brae, where a ſhip may lie, bringing the point N. N. W. in 8 or 9 fathoms water. The bank is ſteep. Eaſtward of this, 4 or 5 miles is Dry-Harbour.—*ib.*

RIO *Grande*, a captainſhip in the northern diviſion of Brazil, whoſe chief town is Tignares.—*ib.*

RIO *Grande*, a large river of Brazil, from whence the above captainſhip has its name. The Portugueſe ſay its entrance is difficult and dangerous, though wide and deep enough further in.—*ib.*

RIO *Grande*, a river of Terra Firma, S. America, which riſes near the equator, runs eaſtward, and falls into the North Sea, between Carthagena and St Martha. Alſo the name of a river of Brazil, which falls into the ſea at Natal los Reyes.

RIO *de la Hacha*, a town and province in the northern diviſion of Terra Firma.—*ib.*

RIO *de Patas*, on the coaſt of Brazil, lies 10 leagues to the ſouthward of St Catherine.—*ib.*

RIO *de la Plata*, a province in the S. diviſion of Paraguay, in S. America. Its chief town is Buenos Ayres.—*ib.*

RIO *de Puercos*, a harbour or anchorage ground on the northern ſide of the iſland of Cuba, ſouth-weſt of Bahia Honda.—*ib.*

RIO *Janeiro*, a rich and populous city of Brazil, having many elegant churches and handſome buildings, ſituated within a large and wide bay, in lat. 24 15 ſouth, and long. 43 30 weſt. It contains about 200,000 inhabitants, and is a place of conſiderable trade. It is alſo called St Sebaſtian.—*ib.*

RIO *Real*, a river of Brazil, running almoſt parallel with that of St Francis, dividing the captainſhip of Seregipe from that of Todos los Santos, and empties into the ocean 41 leagues to the northward of the bay of that name.—*ib.*

RIPPACANOE *Creek*, in the N. W. Territory, is a weſtern branch of Wabaſh river. The Kickapee Indian town lies near it. Its mouth is 20 miles above the Lower Weau towns.—*ib.*

RIPTON, a townſhip in Addiſon county, Vermont, 22 miles eaſt of Lake Champlain.—*ib.*

RIVANNA, a ſmall north-weſt branch of James's river in Virginia, whoſe head waters unite a few miles north of Charlotteſville, and empties into James's river, about 2 miles above Elk Iſland. It is navigable for canoes and batteaux to its interſection with the ſouth-weſt mountains, which is about 22 miles; and may eaſily be opened to navigation through thoſe mountains, to its fork above Charlotteſville.—*ib.*

RIVERHEAD, a townſhip of New-York, ſituated in Suffolk county in Long-Iſland. It was taken from the townſhip of Southold, and incorporated in 1792; 244 of its inhabitants are qualified electors.—*ib.*

RIVER *of the Weſt*, in the north-weſt part of N. America, empties into the ocean in about lat. 43 17 30 north, and long. 122 30 weſt. It is little known, except near its mouth.—*ib.*

RIVIERE, *Grande*, in Lower Canada, empties into the ocean through the northern ſhore of Chaleur Bay, about 6 leagues weſt north-weſt of Cape Deſpair. Here is a conſiderable cod fiſhery.—*ib.*

ROANOKE *Inlet*, on the coaſt of N. Carolina leads into Albemarle Sound. N. lat. 35 56, W. long. 76 14.—*ib.*

ROANOKE *Iſland* is on the ſouthern ſide of Albemarle Sound. The north point of the iſland is about 7 miles weſt of Roanoke Inlet.—*ib.*

ROANOKE, a long and rapid river, is formed by 2 principal branches. Staunton river, which riſes in Virginia, and Dan river, which riſes in N. Carolina. The low lands on this river are ſubject to inundations. It is navigable only for ſhallops, nor for theſe, but about 60 or 70 miles, on account of falls, which in a great meaſure obſtruct the water communication with the back country. It empties by ſeveral mouths into the S. W. end of Albemarle Sound. The planters on the banks of this river, are ſuppoſed to be the wealthieſt in North Carolina. The lower part of this river was formerly called *Mozattoe.*—*ib.*

ROANOKE *River, Little*, empties into Staunton river from the north, about 15 miles above the junction of Dan and Staunton rivers.—*ib.*

ROARING *River*, a boatable water of Tenneſſee State, which runs north-weſterly into Cumberland river, 12 miles ſouth-weſt of the mouth of Obas river.—*ib.*

ROBERDEAU, a ſmall fort which was erected in Bald Eagle, or Sinking Spring Valley, in Pennſylvania, during the late war. It was erected for the protection of thoſe who then worked at the lead mines. But the Indian war raging around them, they were forced to abandon the enterprize.—*ib.*

ROBERT *Bay*, on the eaſt coaſt of Newfoundland, ſeparated from Spaniſh Bay by a very narrow neck of land; and about E. N. E. 4 miles about the point from Port Grave.—*ib.*

ROBERT *Bay*, a gulf or bay of the iſland of Martinico in the Weſt-Indies, and one of the fineſt natural harbours

bours that can be imagined, being able to contain the largeſt fleet with ſuch convenience, that the ſhips may ride near enough the ſhore to reach it with a plank. It is about 2 leagues in depth, and is formed by the Point of the Galleons on the weſt, and Point Roſe on the eaſt.—*ib.*

ROBERVALLIAN LINES, a name given to certain lines uſed for the transformation of figures; thus called from their inventor Roberval, an eminent French mathematician, who died in 1675, aged 76 years. Theſe lines bound ſpaces that are infinitely extended in length, which are nevertheleſs equal to other ſpaces that are terminated on all ſides.

The Abbot Gallois, in the memoirs of the Royal Academy, anno 1693, obſerves, that the method of transforming figures, explained at the latter end of Roberval's Treatiſe of Indiviſibles, was the ſame with that afterwards publiſhed by James Gregory, in his *Geometria Univerſalis*, and alſo by Barrow in his *Lectiones Geometricæ*; and that, by a letter of Torricelli, it appears, that Roberval was the inventor of this manner of transforming figures, by means of certain lines, which Torricelli therefore called *Robervallian lines*. He adds, that it is highly probable that J. Gregory firſt learned the method in the journey he made to Padua in 1668, the method itſelf having been known in Italy from the year 1646, though the book was not publiſhed till the year 1692.

This account has been, we think, completely refuted by David Gregory in his vindication of his uncle, publiſhed in the Philoſophical Tranſactions of 1694. The Abbot, however, rejoined in the Memoirs of the French Academy of 1703; and it is but fair to obſerve, that Dr Hutton, ſpeaking of the controverſy, expreſſes himſelf as if he thought it undecided.

ROBESON, a county of N. Carolina, ſituated in Fayette diſtrict, and bounded ſouth-weſt by the State of S. Carolina. It contains 5326 inhabitants including 533 ſlaves. Chief town, Lumberton.—*Morſe.*

ROBIN HOOD's *Bay*, on the eaſt coaſt of Newfoundland, is frequented by ſmall veſſels, as they can fiſh here to advantage. It is not far from Trinity Harbour, and near to Fox Iſlands.—*ib.*

ROCA *Iſlands*, a cluſter of uninhabited iſlands off the north coaſt of Venezuela, in Terra Firma, about 40 leagues north-weſt by weſt of Tortugas.—*ib.*

ROCA PARTIDO, a ſmall iſland in the North Pacific Ocean, S. E. from La Meſa, and W. from the iſle La Nublada; and in about lat. 16 35 N. and long. 128 W.—*ib.*

ROCHE, *Cape de la*, on the N. ſide of the iſland of St Domingo, is about five leagues weſt of Old Cape Francois.—*ib.*

ROCH, *Riviere a la*, a river of the N. W. Territory, which runs a S. W. courſe, and empties into the Miſſiſſippi 95 miles above the Iowa Rapids.—*ib.*

ROCHER, *la praire du*, or *Rock Meadows*, on Miſſiſſippi river, 3 miles below the ſpot where Fort Chartres ſtood.—*ib.*

ROCHESTER, the north-weſternmoſt townſhip of Windſor county, Vermont, and contains 215 inhabitants.—*ib.*

Rochester, a townſhip of Maſſachuſetts, Plymouth county, 53 miles ſouthward of Boſton. It was incorporated in 1686, and contains 2,644 inhabitants.—*ib.*

Rochester, a conſiderable townſhip in Strafford county, New-Hampſhire, on the W. ſide of the northern branch of Piſcataqua river, 22 miles north-weſterly of Portſmouth, and 40 S. by E. of Middleton. It was incorporated in 1722, and contains 2,857 inhabitants.—*ib.*

Rochester, a townſhip in Ulſter county, New-York, extending W. to Delaware river. It is about 12 miles S. W. of Eſopus, and contains 1628 inhabitants, of whom 228 are electors, and 281 ſlaves.—*ib.*

ROCKAWAY, a ſmall poſt-town in Morris county, New-Jerſey, on the S. ſide of the river of its name, 15 miles N. by W. of Morriſtown, 21 S. E. of Newton, and 123 N. E. by N. of Philadelphia.—*ib.*

ROCKBRIDGE, a mountainous county of Virginia, bounded N. by Auguſta, and S. by James river, which divides it from Botetourt county. It contains 6,548 inhabitants, of which 682 are ſlaves. The Natural Bridge, ſo elegantly deſcribed by Mr Jefferſon, in his Notes on Virginia, is in this county.—*ib.*

ROCK FISH, a north-weſtern branch of James river, in Virginia, at the mouth of which is ſome indifferent marble, generally variegated with red, blue, and purple. It forms a large precipice, which hangs over a navigable part of the river. None of the marble has ever yet been worked.—*ib.*

ROCKFORD, a poſt-town of N. Carolina, 573 miles from Philadelphia.—*ib.*

ROCKHILL, a townſhip of Buck's county, Pennſylvania.—*ib.*

ROCKINGHAM, one of the five counties into which the ſtate of New-Hampſhire is divided. It lies on the S. E. part of the ſtate; having the Atlantic Ocean on the S. E. the county of Hillſborough on the W. Strafford on the N. and the ſtate of Maſſachuſetts on the S. It is about 60 miles long and 30 broad. It embraces the only ſea-port, and moſt of the commercial towns in the ſtate. It contains 46 townſhips, and 43,169 inhabitants. Chief towns, Portſmouth, Exeter, and Concord.—*ib.*

Rockingham, the north-eaſternmoſt townſhip in Windham county, Vermont, is ſituated on the weſt bank of Connecticut river, which ſeparates it from Walpole in New-Hampſhire. It contains 1235 inhabitants.—*ib.*

Rockingham, a county of Saliſbury diſtrict, N. Carolina, bounded eaſt by Caſwell and weſt by Stokes. On the banks of the Dan, which waters this county, are large tracts of fertile low land. A furnace and forge have been erected on Troubleſome Creek. Iron ore is found in many parts of the county. It contains 6,187 inhabitants, including 1,100 ſlaves.—*ib.*

Rockingham, the chief town of Richmond county, North Carolina. It is ſeated on an eminence, about 6 miles eaſt of Great Pedee river, and contains a court-houſe, gaol, and a few dwelling-houſes. It is 74 miles from Hillſborough, 40 from Bethania, and 536 from Philadelphia.—*ib.*

Rockingham, a mountainous county of Virginia, bounded north by Shenandoah, and ſouth by Auguſta. It contains 7,449 inhabitants, including 772 ſlaves.—*ib.*

Rockingham, a poſt-town and the ſeat of the courts of the above county, is ſituated on a branch of Shenandoah river, and contains a court-houſe, gaol, and about 30 houſes. It is 108 miles eaſt by north of the

Sweet Springs, 25 N. W. by N. of Staunton, 52 S. W. of Straſburg, in Pennſylvania, and 262 S. W. of Philadelphia.—*ib.*

ROCKY *Meadows*, called by the French *La Praire du Rocher*, on the eaſtern ſide of the river Miſſiſſippi, 12 miles northerly of Kaſkaſkias, and 3 ſoutherly of Fort Chartres. About 20 years ago, it contained 100 white inhabitants, and 80 negroes.—*ib.*

ROCKEMECKO, or *Rockomeſko*, a townſhip in Lincoln county, Diſtrict of Maine. In 1790, the plantations of New Sandwich, Livermore, and Rockomeſoo, contained 400 inhabitants.—*ib.*

ROCKONCAMA, a pond of about a mile in circumference, in the centre of Long Iſland, New-York ſtate, between Smithtown and Iſlip. It is continually ebbing and flowing; riſing gradually for ſeveral years until it has arrived to a certain height; and then falls more rapidly to its loweſt bed.—*ib.*

ROCKY *Point*, on the ſouth ſhore of Lake Erie, lies 80 miles from the bay of Sanduſky.—*ib.*

ROCKY, a ſmall river of N. Carolina, which empties into Yadkin river.—*ib.*

ROCKY *Mount*, or *Franklin Court-Houſe*, in Virginia, where is a poſt office, is 25 miles from Martinſburg, 40 from Liberty, and 133 from Philadelphia.—*ib.*

ROCKY *River*, in the N. W. Territory, falls into the eaſt ſide of Miſſiſſippi river, about 70 miles below the mouth of Mine river. A lead mine extends from the mouth of this river on the banks of the Miſſiſſippi, more than 100 miles upwards.—*ib.*

ROCO *Grande*, an iſland on the coaſt of the Spaniſh Main, in the W. Indies. N. lat. 11 5, W. long. 67 39.—*ib.*

RODNEY (Lord). In our ſhort ſketch of the life of that gallant officer (*Encycl.*), we mentioned with regret our not having heard of any monument being erected to his honour in his native country. We have ſince learned that there is a pillar upon the Brythen in Shropſhire, which was erected to his memory long before the publication of our article.

Having this great man again under our notice, we inſert with pleaſure the following extract of a letter, which we received from an obliging correſpondent ſoon after the publication of the volume which contains our biographical ſketch of the Admiral: "Whatever were Rodney's merits as a naval commander (ſays our correſpondent), there is a more brilliant part of his character which you have entirely neglected. Prior to his ſucceſs againſt the Spaniſh Admiral Don Langara, the Engliſh who had the misfortune to become priſoners of war to the Spaniards, were treated with the greateſt inhumanity, and it required more than a common ſtrength of conſtitution to exiſt for any length of time in a Spaniſh priſon. When the Spaniſh admiral fell into the hands of Rodney, he, his officers and ſeamen, expected to meet with the ſame treatment they had always inflicted, and which they would have inflicted on Rodney, his officers, and ſeamen, had the Spaniards been the victors; but, to their ſurpriſe, they found in Admiral Rodney (and, of courſe, in all that were under his command) a man who ſympathiſed in their misfortune, who miniſtered to their neceſſities, and, by a humane and polite behaviour to his priſoners, made an impreſſion on the minds of the Spaniards, which could not but have its effect in mitigating the ſufferings of the Engliſh in Spaniſh priſons: but he did not ſtop here; he took an opportunity, when their minds were expanded by gratitude (and in a ſtate to receive the full force of ſuch a repreſentation), to repreſent to them the miſerable condition of his countrymen who were priſoners in Spain, and obtained a promiſe (which, I believe, was punctually performed), that Engliſhmen, when priſoners in Spain, ſhould be made as comfortable as their ſituation would admit of. This was a piece of ſervice to his country which ſurely merits to be recorded, and which will exalt him as much in the opinion of good men as the moſt brilliant diſplay of *courage*, which is a quality as frequently diſcovered in the ſavage as in the cultivated mind."

RONNEY, *Point*, on the N. W. coaſt of N. America, is the N. point of Norton Sound. Sledge Iſland is S. E. ½ E. of it 4 leagues, between which and the continent is anchorage in 7 fathoms. This Point has its name in honour of the celebrated Admiral, Lord Rodney. N. lat. 64 30, W. long. 166 3.—*Morſe.*

RODRIGUES *Key*, on the coaſt of Florida, a pretty large mangrove iſland, one of the Tortugas, lying off Key Largo, and bears from Tavernies' Key N. N. E. ½ E. 5 miles. The roots of the trees are always overflowed. N. lat. 25, W. long. 81 17.—*ib.*

ROEBUCK (John, M. D.), was born at Sheffield in Yorkſhire in the year 1718. His father was a conſiderable manufacturer and exporter of Sheffield goods, who by his abilities and induſtry had acquired a competent fortune. John, his eldeſt ſon, the ſubject of this memoir, was intended by his father for carrying on his own lucrative buſineſs at Sheffield; but was, from his early youth, irreſiſtibly attached to other purſuits, more calculated to gratify his ambition, and give fuller play to his powers. Notwithſtanding this diſappointment in his favourite object, his father had liberality enough to encourage his riſing genius, and to give him all the advantages of a regular education.

After he had gone through the uſual courſe of the grammar ſchool at Sheffield, both his father and mother being ſtrict diſſenters, they placed their ſon for ſome years under the tuition of the late Dr Doddridge, who was at that time maſter of an academy at Northampton, and had juſtly acquired high reputation among the diſſenters, both as a divine and as an inſtructor of youth. Under the Doctor's care Mr Roebuck made great proficiency, and laid the foundation of that claſſical taſte and knowledge for which he was afterwards eminently diſtinguiſhed. It would appear that Dr Doddridge had been much pleaſed with the ardour and enthuſiaſm, in the purſuit of knowledge, diſcovered by his pupil; for Mr Roebuck, in an after period of his life, uſed frequently to mention the ſubjects of converſation and inquiries of various kinds, in which the Doctor had engaged him. It was during his reſidence at this academy that he contracted an intimate acquaintance with his fellow-ſtudents, Mr Jeremiah Dyſon, afterwards much known in the political world, and Mr Mark Akenſide, afterwards Dr Akenſide, which terminated only with their lives.

From the academy at Northampton he was ſent to the univerſity of Edinburgh, where he applied to the ſtudy of medicine, and particularly to that of chemiſtry, which about that time began to attract ſome attention in Scotland. While he reſided there, he diſtinguiſhed

himſelf

himſelf much among his fellow ſtudents in their literary ſocieties and converſations, by great logical and metaphyſical acuteneſs, and by great ingenuity and reſource in argumentation. The late ſagacious Dr Porterfield, to whom he had been introduced, obſerved and encouraged his riſing genius, and was greatly inſtrumental in promoting his improvement. There, too, he formed an intimate acquaintance with Mr Hume, Mr Robertſon, afterwards Dr Robertſon, Mr Pringle, afterwards Lord Alemoor, and ſeveral other perſons of literary eminence; a circumſtance which produced in his mind a partiality ever afterwards in favour of Scotland, and contributed not a little to his making choice of it for the chief field of his future exertions and induſtry.

After Mr Roebuck had gone through a regular courſe of medical education at Edinburgh, being now determined to follow the practice of phyſic, he next ſpent ſome time at the univerſity of Leyden, then in high reputation as the firſt ſchool of medicine in Europe. There, after the uſual reſidence and courſe of trials, he obtained a degree in medicine; and his diploma, dated 21ſt February 1743, has affixed to it the reſpectable names of Muſchenbroek, Oſterdyk, Van Royen, Albinus, Gaubius, &c. He left Leyden, after having viſited ſome part of the north of Germany, about the end of the year 1744.

Soon after his return from the continent, ſome circumſtances induced Dr Roebuck to ſettle as a phyſician at Birmingham. Before that time, Birmingham had begun to make a rapid progreſs in arts, manufactures, and population; and by the death of an aged phyſician, an opening was preſented to him, which afforded an immediate proſpect of encouragement in that line. His education, talents, and intereſting manners, were well calculated to promote his ſucceſs as a phyſician. He accordingly met there, at a period more early than he expected, with great encouragement; and was ſoon diſtinguiſhed, in that town and the country adjacent, for his ſkill, integrity, and charitable compaſſion, in the diſcharge of the duties of his profeſſion.

It appeared, however, ſoon after his reſidence was fixed at Birmingham, that his ſtudies and induſtry were turned to various objects beſides thoſe of his profeſſion. Strongly attached to the riſing ſcience of chemiſtry he conceived high views of extending its uſefulneſs, and of rendering it ſubſervient to the improvement of arts and manufactures. With this view, he fitted up a ſmall laboratory in his own houſe, in which he ſpent every moment of his time which he could ſpare from the duties of his profeſſion. There, in the true ſpirit of his great maſter Lord Bacon, of whoſe philoſophy he was an ardent admirer, he carried on various chemical proceſſes of great importance, and laid the foundation of his future projects on well-tried and well digeſted experiments.

The firſt efforts of his genius and induſtry, thus directed, led him to the diſcovery of certain improved methods of refining gold and ſilver, and particularly to an ingenious method of collecting the ſmaller particles of theſe precious metals, which had been formerly loſt in the practical operations of many of the manufacturers. By other chemical proceſſes, carried on about the ſame time in his little laboratory, he diſcovered alſo improved methods of making ſublimate, hartſhorn, and ſundry other articles of equal importance. After having received full ſatisfaction from the experiments upon which ſuch diſcoveries and improvement were founded, he next digeſted a plan for rendering them beneficial to himſelf, and uſeful to the public. A great part of his time being ſtill employed in the duties of his profeſſion, he found it neceſſary to connect himſelf with ſome perſon in whom he could repoſe confidence, and who might be, in other reſpects, qualified to give him ſupport and aſſiſtance in carrying on his intended eſtabliſhments. With this view, he choſe as his aſſociate Mr Samuel Garbet of Birmingham; a gentleman well qualified, by his abilities, activity, and enterpriſing ſpirit, for bearing his part in their future undertakings. Their firſt project was the eſtabliſhment of an extenſive laboratory at Birmingham, for the purpoſes above mentioned; which, conducted by Dr Roebuck's chemical knowledge, and Mr Garbet's able and judicious management, was productive of many advantages to the manufacturers of that place, and of ſuch emolument to themſelves, as contributed greatly to the boldneſs of their future projects. That laboratory has, ever ſince that time, continued at Birmingham, and is ſtill conducted by Mr Garbet. Dr Roebuck, long before his death, had given up his intereſt in it.

About this time, in 1747, the Doctor married Miſs Ann Roe of Sheffield, a lady of a great and generous ſpirit, whoſe temper and diſpoſition equally fitted her for enjoying the proſperous circumſtances of their early life, and for bearing her equal ſhare of thoſe anxieties and diſappointments in buſineſs which ſhaded, but did not obſcure, the later period of their lives.

Dr Roebuck's unremitted perſeverance in his chemical ſtudies, together with the ſucceſs that attended them, led him, ſtep by ſtep, to other reſearches of great public and private benefit.

The extenſive uſe of the vitriolic (ſulphuric) acid in chemiſtry, and the proſpect of its application to ſome of the mechanic arts, had produced a great demand for that article, and turned the attention of chemiſts to various methods of obtaining it. The late Dr Ward had obtained a patent for making it; and though the ſubſtances from which it might be obtained, as well as certain methods of obtaining it, had been known to others, and particularly pointed out by Lemery the Elder, and by Glauber, yet Dr Ward was the firſt, it is believed, who eſtabliſhed a profitable manufacture upon the diſcovery. Much, however, was wanting to render the acid of univerſal uſe in chemiſtry, and of extenſive utility in the arts, where great quantities of it were required. The price of it was high, ariſing from the great expenſe of the glaſs veſſels, which were made uſe of by Dr Ward in procuring it, and the frequent accidents to which they were liable in the proceſs.

Dr Roebuck had been for ſome time engaged in making experiments with a view to reduce the price, and at length diſcovered a method of preparing it, by ſubſtituting, in place of the glaſs veſſels formerly uſed, lead ones of a great ſize; which ſubſtitution, together with ſundry other improvements in different parts of the proceſs, completely effected his end.

After the neceſſary preparations had been made, Meſſrs Roebuck and Garbet eſtabliſhed a manufacture of the oil of vitriol at Preſtonpans, in Scotland, in the year 1749. This eſtabliſhment not a little alarmed Dr Ward, who attempted to defeat their plan, by taking out a patent for Scotland, in addition to the one he had formerly obtained. In this attempt he failed. Dr Roebuck's diſcovery was found not to come within the ſpecification of Dr Ward's patent.

The Preſtonpans company, convinced that patents are of little avail in preſerving the property of new inventions or diſcoveries, in conducting their vitriol works reſolved to have recourſe to the more effectual methods of concealment and ſecrecy. By that method they were enabled to preſerve the advantages of their ingenuity and induſtry for a long period of years, and not only ſerved the public at a much cheaper rate than had ever been done formerly, but, it is believed, they realized, in that manufacture, a greater annual profit from a ſmaller capital than had been done in any ſimilar undertaking. The vitriol work is ſtill carried on at Preſtonpans; but long before Dr Roebuck's death, he was obliged to withdraw his capital from it.

About this time Dr Roebuck was urged, by ſome of his friends, to leave Birmingham, and to ſettle as a phyſician in London, where his abilities might have had a more extenſive field of exertion. He had been early honoured with the acquaintance of the late Marquis of Rockingham, who, as a lover of arts, had frequently engaged him in chemical experiments at Rockingham-houſe. It was there, alſo, he became acquainted with the late Sir George Saville, and with ſeveral other perſons of rank and influence. His old friend and ſchool-fellow Mr Dyſon, too, by this time, had acquired conſiderable name and influence, and preſſed him much to take that ſtep. Under ſuch patronage, and with the energy of ſuch talents as Dr Roebuck poſſeſſed, there could be little doubt of his ſoon arriving at an eminent rank as a phyſician in London. But the chemical concerns, with which he was at that time deeply occupied, holding out to him a proſpect of a richer harveſt, determined him to give up the practice of medicine altogether, and to fix his reſidence for the greateſt part of the year in Scotland.

The ſucceſs of the eſtabliſhment at Preſtonpans, which had far exceeded their expectation, enabled the Doctor and his partner Mr Garbet to plan and execute other works of ſtill greater benefit and public utility. In the proſecution of his chemical ſtudies and experiments, Dr Roebuck had been led to beſtow great attention on the proceſſes of ſmelting iron ſtone, and had made ſome diſcoveries, by which that operation might be greatly facilitated, particularly by uſing pit-coal in place of charcoal. Mr William Caddel of Cockenzie, in the neighbourhood of Preſtonpans, a gentleman earneſtly intent upon promoting manufactures in Scotland, had, for ſeveral years, laboured, without much ſucceſs, in eſtabliſhing a manufacture of iron; a circumſtance which may have probably contributed to turn Dr Roebuck's attention more particularly to that ſubject. As the capital which he and his partner Mr Garbet could appropriate for carrying on the iron manufacture was not equal to ſuch an undertaking, and chiefly depended upon the profits of their other works, their firſt intention was to attempt a ſmall eſtabliſhment of that kind in the vicinity of their vitriol works at Preſtonpans. But the flattering proſpects of ſucceſs, ariſing from a courſe of experiments which Dr Roebuck had lately made, encouraged them to extend their plan, and to project a very extenſive manufactory of iron. A ſufficient capital was ſoon procured, through the confidence which many of their friends repoſed in their abilities and integrity. In fact, the eſtabliſhment which they made, or rather the capital which gave it exiſtence, was the united capital of a band of relations and friends, who truſted to Dr Roebuck and Mr Garbet the management of a great part of their fortune. When all previous matters had been concerted reſpecting their intended eſtabliſhment, the chief exertions of chemical and mechanical ſkill, neceſſary in the execution, were expected from Dr Roebuck. It fell to his ſhare alſo to fix upon the beſt and moſt favourite ſituation for erecting their intended works. With that view Dr Roebuck examined many different places in Scotland, particularly thoſe on both ſides of the Frith of Forth; and after a careful and minute compariſon of their advantages and diſadvantages, he at length made choice of a ſpot on the banks of the river *Carron* as the moſt advantageous ſituation for the eſtabliſhment of the iron manufacture. There he found they could eaſily command abundance of water for the neceſſary machinery; and in the neighbourhood of it; as well as everywhere both along the north and ſouth-coaſts of the Frith, were to be found inexhauſtible quarries of ironſtone, limeſtone, and coal. From Carron, alſo, they could eaſily tranſport their manufactures to different countries by ſea. The communication with Glaſgow at that time by land carriage, which opened up to them a ready way to the American market, was ſhort and eaſy.

Many other things, that need not be here enumerated, fell to Dr Roebuck's ſhare in preparing and providing for the introduction of this new manufacture into Scotland, particularly with reſpect to the planning and erection of the furnaces and machinery. To inſure ſucceſs in that department, nothing was omitted which ability, induſtry, and experience could ſuggeſt. With this view, he called to his aſſiſtance Mr Smeaton, then by far the firſt engineer in England. It was from him he received plans and drawings of the water-wheels and blowing apparatus, which, notwithſtanding all the mechanical improvements which have been made ſince, remain unrivalled in any of the other iron-works erected in Britain. This was the firſt introduction of Mr Smeaton into Scotland, and was the occaſion of various other diſplays of the ſkill and experience of that celebrated engineer in that part of the iſland. With the ſame view, and to the ſame effect, in a future period of his operations, he employed Mr James Watt, then of Glaſgow, and had the merit of rendering that inventive genius, in the mechanical arts, better known both in this country and in England.

The neceſſary preparations for the eſtabliſhment of the iron-works at Carron were finiſhed in the end of the year 1759; and on the 1ſt January 1760 the firſt furnace was blown; and in a ſhort time afterwards a ſecond was erected.

No period of Dr Roebuck's life required from him more vigorous and laborious exertions than that of the eſtabliſhment of the Carron works, and the firſt trials of the furnaces and machinery. His family and friends remember well the ardour and intereſt which he diſcovered; the inceſſant labour and watchfulneſs which he exerted on that occaſion. Every thing was untried, the furnaces, the machinery, the materials, the workmen; the novelty of the undertaking in that country, its extent and difficulty, and the great ſtake at iſſue, were circumſtances that muſt have occaſioned much ſerious thought and anxiety to the partner, upon the credit of whoſe knowledge and experience the work had been undertaken. But the Doctor had great powers and great reſources; and the firſt trial gave ſufficient indications of future ſucceſs.

For ſome time after the eſtabliſhment of the Carron works, Dr Roebuck continued to give his attention and aſſiſtance in the general management and ſuperintendance of them, and with him all meaſures of future operations were concerted. During this period, ſome alterations of great importance were ſuggeſted by him, and carried into effect. By carefully obſerving the progreſs of ſmelting in the furnaces, at firſt worked by bellows, beſides their being ſubject to various accidents, the Doctor diſcovered the neceſſity of rendering the blaſt both ſtronger and more equable; and propoſing, as a problem to Mr Smeaton, the beſt method of effecting that end, that celebrated engineer ſoon gave the plan of a blaſt by three or four cylinders, which was afterwards tried, and ſucceeded even beyond expectation.

When the buſineſs at Carron ſunk by degrees into a matter of ordinary detail, and afforded leſs ſcope for the Doctor's peculiar talents, he was unfortunately tempted to engage in a new and different undertaking; from the failure of which he ſuffered a reverſe of fortune, was deprived of the advantages reſulting from his other works, and during the remainder of his life became ſubjected to much anxiety and diſappointment.

The eſtabliſhment of the Carron works, and the intereſt Dr Roebuck had in their ſucceſs, had naturally turned his attention to the ſtate of coal in the neighbourhood of that place, and to the means of procuring the extraordinary ſupplies of it which the iron-works might in future require. With the view, therefore, of increaſing the quantity of coal worked in that neighbourhood, by an adventure which he thought would alſo turn out to his own emolument, he was induced to become leſſee of the Duke of Hamilton's extenſive coal and ſalt works at Borrowſtounneſs. The coal there was repreſented to exiſt in great abundance, and underſtood to be of ſuperior quality; and as Dr Roebuck had made himſelf acquainted with the moſt improved methods of working coal in England, and then not practiſed in Scotland, he had little doubt of this adventure turning out beneficial and highly lucrative. In this, however, he was cruelly diſappointed. The opening of the principal ſtratum of coal required much longer time, and much greater expenſe, than had been calculated; and, after it was opened, the perpetual ſucceſſion of difficulties and obſtacles which occurred in the working and raiſing of the coal, was ſuch as has been ſeldom experienced in any work of that kind. The reſult was, that after many years of labour and induſtry, there were ſunk in the coal and ſalt works at Borrowſtounneſs, not only his own, and the conſiderable fortune brought him by his wife, but the regular profits of his more ſucceſsful works; and along therewith, what diſtreſſed him above every thing, great ſums of money borrowed from his relations and friends, which he was never able to repay; not to mention that, from the ſame cauſe, he was, during the laſt twenty years of his life, ſubjected to a conſtant ſucceſſion of hopes and diſappointments, to a courſe of labour and drudgery ill ſuited to his taſte and turn of mind, to the irkſome and teaſing buſineſs of managing and ſtudying the humours of working colliers. But all theſe difficulties his unconquerable and perſevering ſpirit would have overcome, if the never-ceaſing demands of his coal-works, after having exhauſted the profits, had not alſo compelled him to withdraw his capital from all his different works in ſucceſſion; from the refining work at Birmingham, the vitriol work at Preſtonpans, the iron-works at Carron, as well as to part with his intereſt in the project of improving the ſteam-engine, in which he had become a partner with Mr Watt, the original inventor, and from which he had reaſon to hope for future emolument.

It would be painful to mention the unhappy conſequences of this ruinous adventure to his family and to himſelf. It cut off for ever the flattering proſpect which they had of an independent fortune, ſuited to their education and rank in life. It made many cruel encroachments upon the time and occupations of a man whoſe mind was equally fitted to enjoy the high attainments of ſcience, and the elegant amuſements of taſte. As the price of ſo many ſacrifices, he was only enabled to draw from his colliery, and that by the indulgence of his creditors, a moderate annual maintenance for himſelf and family during his life. At his death, his widow was left without any proviſion whatever for her immediate or future ſupport, and without the ſmalleſt advantage from the extraordinary exertions and meritorious induſtry of her huſband.

Dr Roebuck had, ſome years before his death, been attacked by a complaint that required a dangerous chirurgical operation. That operation he ſupported with his uſual ſpirit, and reſolution. In a ſhort time he was reſtored to a conſiderable ſhare of his former health and activity; but the effects of it never entirely left him, and ſeveral ſlighter returns of the complaint gradually impaired his conſtitution. He ſtill, however, continued, till within a few weeks of his death, to viſit his works, and to give direction to his clerks and overſeers. He was confined to his bed only a few days; and died on the 17th July 1794, retaining to the laſt all his faculties, his ſpirit and good humour, as well as the great intereſt which he took, as a man of ſcience and reflection, in the uncommon events which the preſent age has exhibited.

From a man ſo deeply and ſo conſtantly engaged in the detail of active buſineſs, many literary compoſitions were not to be expected. Dr Roebuck left behind him many *works*, but few *writings*. The great object which he kept invariably in view was to promote arts and manufactures, rather than to eſtabliſh theories or hypotheſes. The few eſſays which he left, enable us to judge of what might have been expected from his talents, knowledge, and boldneſs of invention, had not the active undertakings in which, from an early period of life, he was engaged, and the fatiguing details of buſineſs, occupied the time for ſtudy and inveſtigation. A compariſon of the heat of London and Edinburgh, read in the Royal Society of London June 29, 1775; experiments on ignited bodies, read there 16th Feb. 1776; obſervations on the ripening and filling of corn, read in the Royal Society of Edinburgh 5th June 1784—are all the writings of his, two political pamphlets excepted, which have been publiſhed. The publication of the eſſay on ignited bodies was occaſioned by a report of ſome experiments made by the Comte de Buffon, from which the Comte had inferred, that *matter* is heavier when hot that when cold. Dr Roebuck's experiments, made with great accuracy before a committee of the Royal Society at London, ſeem to refute that notion.

It is the works and eſtabliſhments projected and executed by Dr Roebuck, with the immediate and more remote effects of them upon the induſtry, arts, and manufactures of Scotland, which urge a juſt claim to the reſpect and gratitude of his country. This tribute is more due from the diſcerning part of mankind, as this ſpecies of merit is apt to be overlooked by the buſy or the ſuperficial, and to fail in obtaining its due reward. The circumſtances of Dr Roebuck were, in this reſpect, peculiarly hard: for though, moſt certainly, the projector and author of new eſtabliſhments highly uſeful to his country, and every day becoming more ſo, he was, by a train of unfortunate events, obliged to break off his connection with them, at an unſeaſonable time, when much was yet wanting to their complete ſucceſs, and thus he left others in the poſſeſſion, not only of the lucrative advantages now derived from them, but even in ſome meaſure of the general merit of the undertaking, to a conſiderable part of which he had the moſt undoubted claim.

The eſtabliſhment of the laboratory at Birmingham in the year 1747, the firſt public exhibition of Dr Roebuck's chemical talents, was at that particular period, and in the ſtate of the arts and manufactures at that time, highly beneficial, and ſubſervient to their future progreſs: and the continuance and ſucceſs of it, in that place, is a proof of the advantages which many of the manufacturers receive from it. Much had already been done, and many improvements made in arts and manufactures, chiefly by the ſuggeſtions of that ingenuity and experience which, in the detail of buſineſs, might be expected from the practical artiſt. Dr Roebuck was qualified to proceed a ſtep farther; to direct experience by principles, and to regulate the mechanical operation of the artiſt by the lights of ſcience. The effects of that eſtabliſhment extended, in a particular manner, to all that variety of manufactures in which gold and ſilver were required, to the preparing of materials, the ſimplifying of the firſt ſteps, to the ſaving of expence and labour, and to the turning to ſome account what had been formerly loſt to the manufacturer. It is well known that, while Dr Roebuck reſided at Birmingham, ſuch was the opinion formed of his chemical knowledge and experience by the principal manufacturers, that they uſually conſulted him on any new trial or effort to improve their ſeveral manufactures; and when he left that place, they ſincerely regretted the loſs of that eaſy and unreſerved communication they had with him on the ſubjects of their ſeveral departments.

On account of ſimilar circumſtances, the benefit to the public, from the eſtabliſhment of the vitriol works at Preſtonpans, in the extenſion and improvement of many of the arts, cannot now be exactly aſcertained. The vitriolic acid is one of the moſt active agents in chemiſtry, and every diſcovery which renders it cheap and acceſſible to the chemiſt muſt be greatly ſubſervient to the progreſs of that ſcience. By the eſtabliſhment at Preſtonpans, the price of that valuable acid was reduced from ſixteen to four pence *per* pound. It is to Dr Roebuck, therefore, that chemiſts are indebted for being in poſſeſſion of a cheap acid, to which they can have recourſe in ſo many proceſſes.

But Dr Roebuck's object in the proſecution of that ſcheme, was not ſo much to facilitate the chemiſt's labour, as to render that acid, in a much higher degree than it had formerly been, ſubſervient to many of the practical arts. By rendering the vitriolic acid cheap, great uſe came to be made of it in preparing the muriatic acid, and Glauber's ſalts from common ſalts. Its uſe has been farther extended to many metallic proceſſes; and it has lately been employed in ſeparating ſilver from the clippings of plated copper, the uſe of which is very extenſive.

The project and eſtabliſhment, however, of the iron-works at Carron, the moſt extenſive eſtabliſhment of that kind hitherto in Britain, muſt be conſidered as Dr Roebuck's principal work. The great and increaſing demand for iron in the progreſſive ſtate of arts, manufactures, and commerce in Britain, and the great ſums of money ſent every year to the north of Europe for that article, turned the attention of chemiſts and artiſts to the means of promoting the manufacture of iron, with the view of reducing the importation of it. No perſon has a better founded claim to merit, in this particular, than Dr Roebuck. The ſmelting of iron by pitcoal, it is indeed believed, had been attempted in Britain in the beginning of the laſt century. In the reign of James I. ſeveral patents ſeem to have been granted for making hammered iron by pitcoal, particularly to the Hon. Dud Dudley and Simon Starlevant. It does not appear, however, that any progreſs had been made in the manufacture in conſequence of theſe patents. In later times trials have been made by ſo many different perſons, and in ſo many different places in England, nearly about the ſame time, that it may be difficult to ſay where and by whom the firſt attempt was made, particularly as the diſcoverers of ſuch proceſſes wiſhed to conceal the knowledge they had gained as long as they could. But Dr Roebuck was certainly among the firſt who, by means of pitcoal, attempted to refine crude or pig iron, and to make bar iron of it, inſtead of doing it by charcoal, according to the former practice: And he was, without all queſtion, the perſon who introduced that method into Scotland, and firſt eſtabliſhed an extenſive manufacture of it. It is not meant to aſcribe to him the ſole merit of the eſtabliſhment at Carron. No man was ever more ready than he was to do juſtice to the abilities and ſpirit of his friends and partners Meſſrs Garbet, Caddell, &c. who firſt embarked with him in that great undertaking. But ſtill it may be ſaid with truth, that the original project of the iron-works at Carron, the chemical knowledge and experience on which they were founded, the complicated calculations which were previouſly required, the choice of the ſituation, the general conduct and direction of the buildings and machinery, the ſuggeſtion of many occaſional improvements, together with the removal of many unforeſeen obſtacles and difficulties, which occurred in the infant ſtate of that eſtabliſhment, were, in a great meaſure, the work and labour of Dr Roebuck. Nor can it, with the leaſt ſhadow of juſtice, detract from his merit, that a larger capital, and greater expence than was at firſt calculated, have been found neceſſary to bring the works at Carron to their preſent ſtate of perfection; or, that great alterations and improvements have taken place, during the courſe of forty years, in a great and progreſſive eſtabliſhment. In all works of that kind, the expenſe exceeds the calculation. The undertakers, even of the lateſt iron works which have been erected, notwithſtanding all the advantages obtained from recent experience, will be ready to acknowledge, that, in theſe reſpects, there is little room to blame the original projector of the firſt eſtabliſhment of that kind in Scotland. But the beſt, and moſt infallible proof of Dr Roebuck's merit, and of the ſound principles on which theſe works were eſtabliſhed, is the preſent proſperous ſtate of that eſtabliſhment, the great perfection of many branches of their manufactures, and particularly the many extenſive and flouriſhing iron-works which have ſince been erected upon the model of Carron in different parts of Scotland, at Cleugh, Clyde, Muirkirk, and Devon. It cannot be denied that all theſe works have ſprung from the eſtabliſhment at Carron, and are ultimately founded upon the knowledge and experience which have been obtained from them; for ſome of the partners, or overſeers of theſe new works, and many of the workmen, have been, at one time or another, connected with that of Carron. Hence, then, it is owing to the projector and promoter of the eſtabliſhment at Carron, that Scotland is, at this moment, benefited to the amount of many hundred thouſand pounds, in working up the raw materials of that manufacture found in the country itſelf, and which, previous to that eſtabliſhment, was of no value whatever. Such are the *preſent*, but ſcarcely any idea can be formed of the *future*, advantages to this country, which may be derived from the extenſion of the iron manufacture. About 60,000 tons of iron have been annually imported into Great Britain for more than twenty years paſt; and though there has been for ſome time about 20,000 tons of bar iron made in Britain by pitcoal, yet the foreign imported iron has ſuffered little or no diminution in quantity. This great conſumption of iron, no doubt, is owing to the various improvements of late years, and the general extenſion throughout all Europe of commerce and the arts. The manufacture of iron muſt therefore continue to increaſe; and Scotland, abounding everywhere in ironſtone, pitcoal, and in command of water for machinery, has the proſpect of obtaining the largeſt ſhare of it.

To the eſtabliſhment of the Carron works, and to the conſequences of that eſtabliſhment, may be aſcribed alſo the exiſtence of other public works in Scotland of great importance and utility. The opening of a communication by water betwixt the Forth and the Clyde had long been projected, and frequently the ſubject of converſation in Scotland, but nothing in fact had been attempted. The eſtabliſhment of the iron-works at Carron ſoon called forth ſufficient intereſt and enterpriſe to bring about the execution of this grand deſign. Some of the partners of the Carron company, foreſeeing the advantages they would derive from ſuch a communication, propoſed, at their own expence, to execute a ſmall canal; and, after taking the preparatory ſteps, actually applied to Parliament to obtain authority for that purpoſe. But the project of the ſmall canal not meeting with the approbation of ſome noblemen and gentlemen in that part of Scotland, they oppoſed the bill, and obliged themſelves to execute a greater canal, which has now been many years finiſhed, and is found to be of the greateſt advantage to the trade and commerce of Scotland. The merit of this undertaking is not meant to be aſcribed to Dr Roebuck, excepting in ſo far as it neceſſarily aroſe from the eſtabliſhment of the Carron company, of which he was the original projector; and it may reaſonably be doubted whether, without that eſtabliſhment, it would have yet taken place. Several other canals have, ſince that time, been executed in different parts of Scotland, and other very important ones are at preſent projected.

The different eſtabliſhments which Dr Roebuck made at Borrowſtounneſs in carrying on the coal and ſalt works there, though ultimately of no advantage to himſelf, were attended, during the courſe of thirty years, with the moſt beneficial effects upon the trade, population, and induſtry of that part of Scotland. They were the means alſo of adding very conſiderably to the public revenue. Previous to the time theſe works fell under Dr Roebuck's management, they produced no advantage either to the proprietor, to the adventurers, or to the public. But by his mode of conducting them upon a more extenſive plan, by opening up new ſeams of coal, and of better quality, he was enabled to export a very conſiderable quantity, to increaſe the quantity of ſalt, and of courſe the revenue ariſing from theſe articles. In theſe works, and in the management of a large farm, Dr Roebuck gave employment to near a thouſand perſons at Borrowſtounneſs and in the neighbourhood.

Nor was it ſolely by the different eſtabliſhments which he projected and executed, but by many other things neceſſarily connected with them, that Dr Roebuck's labours were beneficial to Scotland. Along with them he may be ſaid to have introduced a ſpirit of enterpriſe and induſtry, before that time little known in Scotland, which ſoon pervaded many other departments of labour, and gave birth to many other uſeful projects. He brought from England, then much farther advanced in arts and induſtry, many ingenious and induſtrious workmen, at great expenſe, who, by their inſtructions and example, communicated and diffuſed ſkill and knowledge to others. At all times Dr Roebuck held out liberal encouragement to riſing genius and induſtrious merit; and ſpared no expenſe in making trials of improvements and diſcoveries which were connected with the different projects and works which he was carrying on.

Such was the active and uſeful life of Dr Roebuck, a man of no common caſt, who united, in a very high degree, a great number of ſolid and brilliant talents, which, even ſeparately, fall to the lot of but few individuals. Diſtinguiſhed by an ardent and inventive mind, delighting in purſuit and inveſtigation, always aſpiring at ſomething beyond the preſent ſtate of ſcience and art, and eagerly preſſing forward to ſomething better or more perfect, he thus united energies the moſt powerful with the moſt unwearied and perſevering induſtry. To that peculiarity of imagination, ſo fitted for ſcientific purſuit, which readily combines and unites, which ſteadily preſerves its combinations before the eye of the mind, and quickly diſcovers relations, reſults, and conſequences, was added, in his character, great promptitude and firmneſs in deciſion. Strongly and early im-

Roebuck.

preſſed with the great importance of applying chemical and phyſical knowledge to the uſeful arts, to the melioration of civil life, he never loſt ſight of that favourite view, and diſcovered great boldneſs and reſource in the means and expedients which he adopted to promote it. He was certainly maſter of the beſt philoſophy of chemiſtry known in the earlier parts of his life; and though in every ſtage of that ſcience he marked and underſtood the progreſs of the diſcoveries, yet his numerous avocations did not permit him to follow them out by experimental proceſſes of his own. Upon that, and indeed almoſt upon every ſubject, his mind readily graſped the moſt uſeful and ſubſtantial points, and enabled him to throw out ſuch hints and hypotheſes as marked him the man of genius.

During the courſe of a regular education, both at Edinburgh and at Leyden, Dr Roebuck ſtudied the claſſic authors with great attention, particularly the hiſtorical and political parts of their works. Upon theſe ſubjects he had read much, ſelected with judgment, and was well acquainted with the facts and philoſophy of ancient governments. This taſte he carried with him, and improved in every period of his life, and in every ſituation. It abundantly rewarded him for the earneſtneſs and diligence with which it had been acquired. It became his favourite reſource, and indeed one of the chief enjoyments of his life. Poſſeſſing the happy talent of turning his mind from ſerious and fatiguing, to elegant and recreating purſuits, it was no uncommon thing with him to return from the laboratory or the coalpit, and draw relaxation or relief from ſome one or other of the various ſtores of claſſical learning.

No man was better acquainted with the hiſtory of his country than Dr Roebuck, or more admired and revered the conſtitution of its government. By temper and education he was a Whig, and at all times entered with great warmth into the political diſputes and controverſies which agitated parties in the different periods of his life. If the natural warmth of his temper, and his enthuſiaſm on theſe ſubjects, led him, on ſome occaſions, beyond the bounds of candid argumentation, his quick ſenſe of decorum, and his perfect habits of good manners, produced an immediate atonement, and reſtored the rights of elegant and poliſhed converſation.

The general acquaintance which Dr Roebuck had acquired with natural and experimental philoſophy, together with his claſſical and political knowledge, rendered him an agreeable companion to the learned almoſt of every department, and procured him the attachment and friendſhip of many of the firſt literary characters in Britain. With his friend Dr Black he lived till his death in cloſe habits of intimacy; and he often acknowledged, with much frankneſs, the advantages which he derived, in his various purſuits, from a free and unreſerved communication with that eminent chemiſt.

The amiable diſpoſitions of ſenſibility, humanity, and generoſity, which ſtrongly marked his character, in the general intercourſe of ſociety, were peculiarly preſerved and exerciſed in the boſom of his family, and in the circle of his friends. In the various relations of huſband, father, friend, or maſter, and in the diſcharge of the reſpective duties ariſing from them, it would not be eaſy to do juſtice to his character, or to determine in which of them he moſt excelled; nor muſt it be forgot, for it reflected much honour on his benevolent heart, that his workmen not only found him at all times a kind and indulgent maſter, but many of them, when their circumſtances required it, a ſkilful and compaſſionate phyſician, who cheerfully viſited the humbleſt receſſes of poverty, and who attached them to his ſervice by multiplied acts of generoſity and kindneſs.

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ROEBUCK *Iſland*, at the eaſtern extremity of Lake Ontario.—*Morſe.*

ROEMER (Olaus), a noted Daniſh aſtronomer and mathematician, was born at Arhuſen in Jutland, 1644; and at 18 years of age was ſent to the univerſity of Copenhagen. He applied aſſiduouſly to the ſtudy of the mathematics and aſtronomy, and became ſo expert in thoſe ſciences, that when Picard was ſent by Louis the XIV. in 1671, to make obſervations in the north, he was greatly ſurpriſed and pleaſed with him. He engaged him to return with him to France, and had him preſented to the king, who honoured him with the dauphin as a pupil in mathematics, and ſettled a penſion upon him. He was joined with Picard and Caſſini, in making aſtronomical obſervations; and in 1672 he was admitted a member of the Academy of Sciences.

During the ten years he reſided at Paris, he gained great reputation by his diſcoveries; yet it is ſaid he complained afterwards, that his coadjutors ran away with the honour of many things which belonged to him. Here it was that Roemer, firſt of any one, found out the velocity with which light moves, by means of the eclipſes of Jupiter's ſatellites. He had obſerved for many years, that when Jupiter was at his greateſt diſtance from the earth where he could be obſerved, the emerſions of his firſt ſatellite happened conſtantly 15 or 16 minutes later than the calculation gave them. Hence he concluded, that the light reflected by Jupiter took up this time in running over the exceſs of diſtance; and conſequently that it took up 16 or 18 minutes in running over the diameter of the earth's orbit, and 8 or 9 in coming from the ſun to us, provided its velocity was nearly uniform. This diſcovery had at firſt many oppoſers; but it was afterwards confirmed by Dr Bradley in the moſt ingenious and beautiful manner.

In 1681 Roemer was recalled to his native country by Chriſtian the Vth King of Denmark, who made him profeſſor of aſtronomy at Copenhagen. The king employed him alſo in reforming the coin and the architecture, in regulating the weights and meaſures, and in meaſuring and laying out the high roads throughout the kingdom; offices which he diſcharged with the greateſt credit and ſatisfaction. In conſequence he was honoured by the king with the appointment of chancellor of the exchequer and other dignities. Finally, he became counſellor of ſtate, and burgomaſter of Copenhagen, under Frederic the IV. the ſucceſſor of Chriſtian. Roemer was preparing to publiſh the reſult of his obſervations, when he died the 19th of September 1710, at 66 years of age: but this loſs was ſupplied by Horrebow, his diſciple, then profeſſor of aſtronomy at Copenhagen, who publiſhed, in 4to, 1753, various obſervations of Roemer, with his method of obſerving, under the title of *Baſis Aſtronomiæ*.—He had alſo printed various aſtronomical obſervations and pieces, in ſeveral volumes of the Memoirs of the Royal Academy of Sciences at Paris, of the inſtitution of 1666, particularly vol. 1. and 10. of that collection.

ROGERS *Road*, ſo called from the perſon under whoſe

whoſe direction it was made, in 1790. It leads through Clinton county, in New-York State into Canada; and is much uſed in winter, when paſſing the lakes is often dangerous, and always uncomfortable.—*Morſe*.

ROGERSVILLE, the chief town of Hawkins county, Tenneſſee. The road from Knoxville to Philadelphia, 652 miles, paſſes by Rogerſville, Roſs's Furnace, Abingdon, Engliſh's Ferry, on New-River, Big Lick, Peytonſburg, Rockbridge, Lexington, Staunton, New-Market, Wincheſter, Fredericktown, York, and Lancaſter.—*ib.*

ROLANDS *Table*, on the main land on the E. coaſt of the diſtrict of Gaſpee, in Lower Canada, and W. part of the Gulf of St Lawrence, is a flat mountain, which ſhews itſelf off to ſeaward; appears above ſeveral others, and ſerves to find out Iſle Percee, or Pierced Iſland, 15 miles from Cape Gaſpee. The iſland of Bonaventura is 3 miles beyond it.—*ib.*

ROLLING *Fork*, a main ſouthern branch of Salt river, in Kentucky. The towns of Lyſtra and Bealſburg ſtand on this river.—*ib.*

ROLLOCK (Robert), the firſt principal of the college of Edinburgh, was the ſon of David Rollock of *Poo-houſe*, or, as it is now written, *Powis*, in the neighbourhood of Stirling. He was born in 1555; and learned the rudiments of the Latin tongue under one Mr Thomas Buchanan, who kept, ſays Archbiſhop Spottiſwood, a famous ſchool at that time, and was, according to Dr Mackenzie, one of the moſt eminent grammarians in Scotland. Where Mr Buchanan kept his ſchool, neither of theſe authors has informed us.

From ſchool Mr Rollock was ſent, we know not in what year, to the univerſity of St Andrews, and admitted a ſtudent in St Salvator's college. His progreſs in the ſciences, which were then taught, was ſo great and ſo rapid, that he had no ſooner taken his degree of M. A. than he was choſen a profeſſor of philoſophy, and immediately began to read lectures in St Salvator's college. This muſt have been at a very early period of life; for he quitted St Andrews in the year 1583, when, according to Mackenzie, he had taught philoſophy for ſome time in that univerſity.

Not long before this period, the magiſtrates of Edinburgh having petitioned the king to erect a univerſity in that city, he granted them a charter under the great ſeal, allowing them all the privileges of a univerſity; and the college being built in 1582, they made choice of Mr Rollock to be their principal and profeſſor of divinity.

At what time he was admitted into holy orders, by whom he was ordained, or indeed whether he ever was ordained, has been the ſubject of ſome acrimonious controverſy; but it is a controverſy which we ſhall not revive; for, conſidering the manner in which orders were then conferred in Scotland, the queſtion in debate is of very little importance. It is certain that he became famous in the univerſity, and among his countrymen in general, for his lectures in theology, and for the perſuaſive power of his preaching; for Calderwood aſſures us, that, in 1589, he and Mr Robert Bruce, another popular orator, made the Earl of Bothwel ſo ſenſible of his ſinful and vitious courſes, that, upon the 9th of November, his lordſhip humbled himſelf upon his knees in the eaſt church in the forenoon, and in the high church in the afternoon, confeſſing before the people, with tears in his eyes, his diſſolute and licentious life, and promiſing to prove, for the future, another man.

In the year 1593, Principal Rollock and others were appointed by the ſtates of parliament to confer with the popiſh lords; and in the next year he was one of thoſe who, by the appointment of the general aſſembly of the church, met at Edinburgh in the month of May, and preſented to his majeſty a paper, entitled, *The dangers which, through the impunity of* EXCOMMUNICATED PAPISTS, TRAFFICKERS WITH THE SPANIARDS, *and other enemies of the religion and eſtate, are imminent to the true religion profeſſed within this realm, his Majeſty's perſon, crown, and liberty of this our native country.* His zeal againſt Papiſts was indeed ardent; and he ſeems to have adopted that judaical doctrine, which was embraced in ſome degree by all the reformers, that it is the duty of the civil magiſtrate to puniſh idolatry with death.

In the year 1595 he was nominated one of the commiſſioners for the viſitation of colleges. Theſe commiſſioners were empowered to viſit all the colleges in the kingdom, to inquire into the doctrine and life of the ſeveral maſters, the diſcipline uſed by them, the ſtate of their rents and living, and to make their report to the next aſſembly.

In 1596, the factious behaviour of ſome of the miniſters having drawn upon them the juſt reſentment of the king, our principal was employed, on account of his moderation, to ſoften that reſentment, and to turn his majeſty's wrath againſt the *Papiſts!* In the year 1597, he was choſen moderator of the General Aſſembly—the higheſt dignity in the Scottiſh church; and he had the influence to get ſome great abuſes redreſſed. Being one of fourteen miniſters appointed by this aſſembly to take care of the affairs of the church, the firſt thing which he did was to procure an act of the legiſlature, reſtoring to the prelates their ſeats in parliament. He had here occaſion for all his addreſs; for he had to reconcile to this meaſure, not only ſuch of the miniſters as abhorred all kinds of ſubordination in the church, but likewiſe many of the lay lords, who were not delighted with the proſpect of ſuch aſſociates in parliament as the Scotch prelates were at that period (A).

(A) The conſtitution of the Scotch church was, at this period, a ſtrange ſyſtem of inconſiſtency and contradiction. It was, in fact, preſbyterian; for eccleſiaſtical diſcipline was adminiſtered then, as at preſent, by kirk-ſeſſions, preſbyteries, and general aſſemblies; and there was not a reformed biſhop in the kingdom. Whether provincial ſynods were then in uſe, the writer of this note does not at preſent recollect. The king, however, who was meditating the reſtoration of epiſcopacy, conferred the eſtates, or part of the eſtates, belonging to the different ſees, upon the moſt eminent parochial miniſters, and dignified them with the title of biſhops; though it does not appear that they had any juriſdiction over their brethren; and though they were certainly not *ex officio* ſo much as moderators of the preſbyteries within the bounds of which their churches were ſituated. Theſe were the men for whom Mr Rollock exerted himſelf to obtain ſeats in the parliament.

Though he ſpent the greater part of his life in conducting the affairs of the church, we have the authority of Spottiſwood for ſaying, that he would have preferred retirement and ſtudy. To the buſtle of public life, eſpecially at that period of faction and fanaticiſm, his feeble conſtitution was not equal; and his inclination would have confined him to his college and his library. He was dreadfully afflicted with the ſtone; the torments of which he long bore with the fortitude and reſignation of a Chriſtian. He died at Edinburgh on the 28th of February 1598, in the 43d year of his age; having exhorted his brethren, with his dying breath, to carry themſelves more dutifully to their gracious ſovereign.

His works are, 1. A Commentary on the Firſt Book of Theodore Beza's Queſtions. 2. A Commentary on St Paul's Epiſtle to the Epheſians, 4to, Edinburgh, 1590. 3. A Commentary on the Prophet Daniel, 4to, Edinburgh, 1591. 4. A Logical Analyſis of St Paul's Epiſtle to the Romans, 8vo, Edinburgh, 1594. 5. Some Queſtions and Anſwers concerning the Covenant of Grace and the Sacraments, 8vo, Edinburgh, 1596. 6. A Treatiſe of Effectual Calling, 8vo, Edinburgh, 1597. 7. A Commentary on the Epiſtles of St Paul to the Theſſalonians and Philemon, 8vo, Geneva, 1597. 8. A Commentary upon Fifteen Select Pſalms, 8vo, Geneva, 1598. 9. A Commentary on the Goſpel of St John, with a harmony of the Four Evangeliſts upon the Death, Reſurrection, and Aſcenſion of Jeſus Chriſt, 8vo, Geneva, 1590. 10. Certain Sermons on Several Places of St Paul's Epiſtles, 8vo, Edinburgh, 1598. 11. A Commentary upon the Epiſtle to the Coloſſians, 8vo, publiſhed at Geneva, 1602. 12. A Logical Analyſis of the Epiſtle to the Hebrews, 8vo, Edinburgh, 1605. 13. A Logical Analyſis of the Epiſtle to the Galatians, 8vo, London, 1602. 14. A Commentary upon the Two Firſt Chapters of the Firſt Epiſtle of St Peter, 8vo, London, 1603. 15 and 16. A Treatiſe of Juſtification, and another of Excommunication, both in 8vo, London, 1604. All theſe work, except the ſermons, are in Latin. That Principal Rollock was held in high eſtimation in the college over which he preſided, is made at leaſt probable by the following epitaph:

Te Rollocce, extincto, Urbs mœſta, Academia mœſta eſt;
Et tota exequiis Scotia mœſta tuis.
Uno in te nobis dederat Deus omnia, in uno
Te Deus eripuit omnia quæ dederit.

ROMAN, *Cape*, on the coaſt of South Carolina. From hence to Charleſton light-houſe the courſe is W. S. W. ½ W. 21 leagues. N. lat. 33 5. W. long. 79 30.—*Morse.*

ROMAN, *Cape*, on the coaſt of Florida, is 20½ leagues N. W. by N. of Cape Sable, the S. W. point of the peninſula of Florida.—*ib.*

ROMAN, *Cape*, on the north coaſt of Terra Firma, is the north point of the peninſula which is the eaſt limit of the Gulf of Venezuela. Near to it on the north, are a number of rocks, and due north of it is the iſland of Oruba, or Aruba, belonging to the Dutch, 8 or 9 leagues diſtant.—*ib.*

ROMANO, or *Romano Cayo*, a ſmall iſland off the north ſhore of the iſland of Cuba. It is long and narrow, and at the eaſtern extremity of that cluſter of iſles called the King's Garden.—*ib.*

ROME, a poſt-town of New-York. Herkemer county, on Mohawk river, 8 miles weſt of Whiteſtown, and 376 miles from Philadelphia. This townſhip was taken from Steuben, and incorporated in 1796. Fort Stanwix, called alſo New Fort Schuyler, is in this town.—*ib.*

ROMNEY, the chief town of Hampſhire county, Virginia, contains about 70 dwelling-houſes, a brick court-houſe, and a ſtone-gaol. It is ſituated on the weſtern bank of the S. W. branch of Patowmac river, 50 miles W. by N. of Wincheſter, 25 N. E. by N. of Moorfields, and 18 S. W. of Old-Town, in Allegheny county, Pennſylvania. It is a poſt town, and is 242 miles W. by S. of Philadelphia.—*ib.*

ROMOPACK, a village in Bergen county, New-Jerſey, on Romopack river, 15 or 20 miles north of Patterſon.—*ib.*

ROMULUS, a military townſhip in New-York State, Onondago county, between Seneca and Cayuga Lakes. The high road to the ferry at Cayuga Lake runs through its northern part. It was incorporated in 1794; and has within its juriſdiction the townſhips of Junius and Galen, together with the lands lying weſt of Hannibal and Cato, north of the townſhip of Galen and S. of Lake Ontario, and that part of the lands reſerved to the Cayuga nation of Indians, weſt of Cayuga Lake. In the year 1796, 123 of its inhabitants were electors. —*ib.*

RONDE, or *Rhonde Iſland*, one of the Grenadines, dependent on the iſland of Grenada, in the Weſt-Indies; ſituated about mid-way between Cariacou and the north end of Grenada, about four leagues from each. It contains about 500 acres of excellent land, which are wholly applied to paſturage, and the cultivation of cotton.—*ib.*

ROPE *Ferry*, a ferry acroſs a bay in the town of New-London, in Connecticut; 4 miles S. W. by W. of New-London city, on the poſt-road to New-Haven. The bay ſets up from Long Iſland Sound, between Millſtone Point and Black Point in Lyme. In Auguſt, 1796, a bridge, 500 feet long, was built acroſs this ferry, 2 miles above Millſtone Point, where the water is 18 feet deep. The bridge is 24 feet broad, with a ſliding draw.—*ib.*

ROQUE, *Cape*, on the coaſt of Brazil, north-weſtward of Cape St Auguſtine. S. lat. 6 20, W. long. 37 30.—*ib.*

ROSA, a cape in the iſland of St Domingo, E. N. E. ¼ E. of Cape Dame Marie, the weſtern point of the iſland, diſtant about 7 leagues.—*ib.*

ROSA, or *St Roſe's*, an extenſive bay on the coaſt of Weſt-Florida, ſtretching about 30 miles to the north-eaſt, and is from 4 to 6 miles broad. The bar before it has only 7 or 8 feet water, where deepeſt; but within there is 16 or 17, as far as the Red Bluff on the main land. The peninſula between this bay and that of Penſacola, on the weſt, is from 1 to 3 or 4 miles broad. It is generally a very poor ſandy ſoil, producing, in ſome places, large pines and live oak. The largeſt river that falls into the bay is Chacta-Hatcha, or Pea river, which runs from the north-eaſt, and enters the eaſtern extremity of the bay through ſeveral mouths, but ſo ſhoal that only a ſmall boat or canoe can paſs them. Mr

Hutchins aſcended it about 25 leagues, where he found a ſmall party of the Couſſac Indians.—*ib.*

Rosa, or *Roſe Iſland*, extends along the mouth of the above bay, and is about 50 miles long, and no where above half a mile broad. The channel at the eaſt end of the iſland is ſo choaked up with a large ſhoal, in ſome places dry, that the deepeſt water is only 4 or 5 feet; and the channel between Roſe Iſland and the main is barely ſufficient for boats or pettiaugers.—*ib.*

ROSALIE, *Fort*, is ſituated in the weſtern territory of Georgia, in the Natchez country, on the eaſt ſide of the Miſſiſſippi, in lat. 31 40; 243 miles above New-Orleans.—*ib.*

ROSEAU, the capital of the iſland of Dominico, in the Weſt-Indies. It is now called Charlottetown, and is ſituated in St George's pariſh, about ſeven leagues from Prince Rupert's Bay. It is on a point of land on the ſouth-weſt ſide of the iſland which forms two bays, viz. Woodbridge's Bay on the north, and Charlotteville Bay to the ſouthward. Roſeau is about half a mile in length from Charlotteville to Roſeau river, and moſtly two furlongs in breadth, but is of an irregular figure. It contains more than 500 houſes, beſides cottages occupied by negroes. Whilſt in poſſeſſion of the French, it contained upwards of 1,000 houſes. N. lat. 15 25, W. long. 61 27.—*ib.*

ROSE, *St*, or *Jayna*. The eſtabliſhments in the plain of St Roſe, and thoſe on the banks of the Jayna, on the ſouth ſide of the iſland of St Domingo, are looked upon as depending on the city of St Domingo. They are reckoned to contain, at leaſt, 2,000 perſons; for the moſt part people of colour, free and ſlaves. The river Jayna is 3 leagues W. of that city. The pariſh of St Roſe or Jayna, which has in its dependency the ancient rich population of Bonaventure, is now reduced to a handful of individuals, whoſe employment is the breeding of cattle or the waſhing of gold ſand. Towards the ſource of the Jayna, and near the town of St Roſe, were the celebrated gold mines of St Chriſtopher; in the neighbourhood of which Columbus erected a fort by the name of St Chriſtopher.—*ib.*

ROSES Otter (or eſſential oil) or. In the *Encyclopædia*, under the word Roses, we have given one receipt for making this very high-priced perfume; and we ſhall here give another; which, whether it be as effectual or not, is at leaſt ſimpler and leſs expenſive. It is by an officer who was in the country where the *Otter* is prepared, and who aſſiſted in making it himſelf; and is as follows:

"Take a very large glazed earthen or ſtone jar, or a large clean wooden caſk; fill it with the leaves of the flowers of roſes, very well picked, and freed from all ſeeds and ſtalks; pour on them as much pure ſpring water as will cover them, and ſet the veſſel in the ſun, in the morning at ſun-riſe, and let it ſtand till the evening, then take it into the houſe for the night: expoſe it, in this manner, for ſix or ſeven ſucceſſive days, and, at the end of the third or fourth day, a number of particles, of a fine yellow oily matter, will float on the ſurface, which, in two or three days more, will gather into a ſcum, which is the otter of roſes. This is taken up by ſome cotton, tied to the end of a piece of ſtick, and ſqueezed with the finger and thumb into a ſmall phial, which is immediately well ſtopped; and this is repeated for ſome ſucceſſive evenings, or while any of this fine eſſential oil riſes to the ſurface of the water."

Dr Donald Monro, who communicated this receipt to the Royal Society of Edinburgh, ſays, that he has been informed, that ſome few drops of this eſſential oil have more than once been collected by diſtillation in London, in the ſame manner as the eſſential oils of other plants.

ROSEWAY, *Port*, a populous ſeaport town, on the ſouth-eaſt coaſt of Nova-Scotia, north-eaſt by eaſt of Cape Negro and Harbour.—*Morſe.*

Roseway *Iſland* lies at the mouth of Port Wager, on the ſouth-eaſt coaſt of Nova-Scotia.—*ib.*

ROSIA, *Cape*, in Penobſcot Bay, Diſtrict of Maine.—*ib.*

ROSIERS, *Cape*, the ſouth limit of the mouth of the river St Lawrence; from whence it is 90 miles acroſs to the north ſhore, meaſuring by the weſt end of the iſland of Anticoſti. This is the eaſternmoſt point of the diſtrict of Gaſpee, in Lower Canada. It has Florell Iſle and Cape Gaſpee on the ſouth. N. lat. 48 56, W. long. 63 40.—*ib.*

ROSSIGNOL, *Port*, on the ſouthern coaſt of Nova-Scotia, a harbour to the ſouth-weſt of Port de L'Heve.—*ib.*

Rossignol, a conſiderable lake in Nova-Scotia, between Liverpool and Annapolis. The Indians ſay it is the main ſource of Liverpool and Petit rivers. It has been a place of reſort for the Indians, on account of the favourable hunting grounds upon it.—*ib.*

ROTA Aristotelica, or *Ariſtotle's Wheel*, denotes a celebrated problem in mechanics, concerning the motion or rotation of a wheel about its axis; ſo called becauſe firſt noticed by Ariſtotle.

The difficulty is this. While a circle makes a revolution on its centre, advancing at the ſame time in a right line along a plane, it deſcribes, on that plane, a right line which is equal to its circumference. Now if this circle, which may be called the deferent, carry with it another ſmaller circle, concentric with it, like the nave of a coach wheel; then this little circle, or nave, will deſcribe a line in the time of the revolution, which ſhall be equal to that of the large wheel or circumference itſelf; becauſe its centre advances in a right line as faſt as that of the wheel does, being in reality the ſame with it.

The ſolution given by Ariſtotle, is no more than a good explication of the difficulty.

Galileo, who next attempted it, has recourſe to an infinite number of infinitely little vacuities in the right line deſcribed by the two circles; and imagines that the little circle never applies its circumference to thoſe vacuities; but in reality only applies it to a line equal to its own circumference; though it appears to have applied it to a much larger. But all this is nothing to the purpoſe.

Tacquet will have it, that the little circle, making its rotation more ſlowly than the great one, does on that account deſcribe a line longer than its own circumference; yet without applying any point of its circumference to more than one point of its baſe. But this is no more ſatiſfactory than the former.

After the fruitleſs attempts of ſo many great men, M. Dortous de Meyran, a French gentleman, had the

good

good fortune to hit upon a ſolution, which he ſent to the Academy of Sciences; where being examined by Meſſ. de Louville and Soulmon, appointed for that purpoſe, they made their report that it was ſatisfactory. The ſolution is to this effect:

The wheel of a coach is only acted on, or drawn in a right line; its rotation or circular motion ariſes purely from the reſiſtance of the ground upon which it is applied. Now this reſiſtance is equal to the force which draws the wheel in the right line, inaſmuch as it defeats that direction; of conſequence the cauſes of the two motions, the one right and the other circular, are equal. And hence the wheel deſcribes a right line on the ground equal to its circumference.

As for the nave of the wheel, the caſe is otherwiſe. It is drawn in a right line by the ſame force as the wheel; but it only turns round becauſe the wheel does ſo, and can only turn in the ſame time with it. Hence it follows, that its circular velocity is leſs than that of the wheel, in the ratio of the two circumferences; and therefore its circular motion is leſs than the rectilinear one. Since then it neceſſarily deſcribes a right line equal to that of the wheel, it can only do it partly by ſliding, and partly by revolving, the ſliding part being more or leſs as the nave itſelf is ſmaller or larger.—*Hutton's Dictionary*.

ROTTERDAM, or *Anamocoe Iſle*, one of the Friendly Iſlands, ſituated on the north of Amſterdam Iſle; remarkable for its fertility and the peaceable diſpoſition of the inhabitants.—*Morſe*.

ROTTERDAM, *New*, a new ſettlement on the north ſide of Oneida Lake, in the State of New-York.—*ib*.

ROUGE, *Cape*, or *Red Cape*, on the N. ſide of the iſland of St Domingo, in the W. Indies, lies 4 leagues weſtward of Point Iſabellica.—*ib*.

ROUGE *River*, in Louiſiana, is ſo called from its waters being of a red colour, and ſaid to tinge thoſe of the Miſſiſſippi in the time of the floods. It riſes in New-Mexico, and, after running about 600 miles, joins the Miſſiſſippi 187 miles above New Orleans, 56½ miles below Fort Roſalie; 30 miles from its mouth it receives Noir, or Black river. Near 70 leagues up Rouge river the French had a conſiderable poſt called Natchitoches. It was a frontier to the Spaniſh ſettlements, being 20 miles from Fort Adayes.—*ib*.

ROUGE *Chapeau*, or *Red Hat*, a cape on the coaſt of N. America. N. lat. 46 51, W. long. 55 26.—*ib*.

ROUND *Bay*, a fine bay, with good anchorage, on the weſt ſide of the iſland of St Lucia, in the W. Indies.—*ib*.

ROUND *Heads*, Indians inhabiting on Riviere aux Tetes Bowles, or Round Head river, in N. America. Warriors, 2,000.—*ib*.

ROUND *Iſland*, a ſmall iſland on the coaſt of Weſt-Florida, lies 5 miles north from, and oppoſite to, the middle of Horn Iſland, and is well timbered.—*ib*.

ROUND *Rock*, one of the Virgin Iſlands, north of Ginger Iſland. N. lat. 11 80, weſt long. 62 53.—*ib*.

ROWAN, one of the moſt populous counties of N. Carolina, in Saliſbury diſtrict; bounded north by Iredell, and ſouth by Cabarrus. It contains 15,828 inhabitants, including 1742 ſlaves.—*ib*.

ROWE, a townſhip in the north-weſtern corner of Hampſhire county, Maſſachuſetts; bounded north by the State of Vermont, and 130 miles north-weſt of Boſton. It is watered by Deerfield river, and contains 443 inhabitants.—*ib*.

ROWLEY, a townſhip of Maſſachuſetts, Eſſex county, having Newbury on the north-eaſt and contains two pariſhes, beſides a ſociety of Anabaptiſts. The inhabitants, 1772 in number, are moſtly farmers. Near its bounds with Newbury, ſome ſpecimens of black lead have been diſcovered, and it is thought there is a conſiderable body of it, which may be, hereafter, an object of conſequence. It is 5 or 6 miles north by weſt of Ipſwich, and 26 north by eaſt of Boſton, and was incorporated in 1639.—*ib*.

ROWNING (John), an ingenious Engliſh mathematician and philoſopher, was fellow of Magdalen College, Cambridge, and afterwards Rector of Anderby in Lincolnſhire, in the gift of that Society. He was a conſtant attendant at the meetings of the Spalding Society, and was a man of a great philoſophical habit and turn of mind, though of a cheerful and companionable diſpoſition. He had a good genius for mechanical contrivances in particular. In 1738 he printed at Cambridge, A Compendious Syſtem of Natural Philoſophy, in 2 vols 8vo; a very ingenious work, which has gone through ſeveral editions. He had alſo two pieces inſerted in the Philoſophical Tranſactions, viz. 1. A Deſcription of a Barometer, wherein the Scale of Variation may be increaſed at pleaſure; vol. 38. p. 39. And, 2. Directions for making a Machine for finding the Roots of Equations univerſally, with the Manner of uſing it; vol. 60. p. 240.—Mr Rowning died at his lodgings in Carey-ſtreet, near Lincoln's-Inn Fields, the latter end of November 1771, at 72 years of age.

Though a very ingenious and pleaſant man, he had but an unpromiſing and forbidding appearance; he was tall, ſtooping in the ſhoulders, and of a ſallow down-looking countenance.

ROXAS, *Haite de*, the heights in the diſtrict of Bayaguana, in the middle of the eaſtern part of the iſland of St Domingo, are ſo called. Here Valverde ſaw, after having long ſought for it in vain, a little quadruped, which in form and ſize reſembled a ſucking pig of a fortnight old, except that its ſnout was a little longer. It had but very little hair, which was as fine as that of the dogs called *Chineſe*. The town of Bayaguana is about 4 leagues ſouth-eaſt by eaſt of Baya.—*Morſe*.

ROXBOROUGH, a townſhip of Pennſylvania, ſituated in Philadelphia county.—*ib*.

ROXBURY, a pleaſant town in Norfolk county, Maſſachuſetts, one mile ſouth-weſt of Boſton. The townſhip is now divided into 3 pariſhes, and was ſettled in 1630. In the 3 pariſhes are 2,226 inhabitants. The firſt pariſh in this town has lately been connected with Boſton harbour by a canal. The Rev. John Eliot, the Apoſtle of the Indians, was the firſt miniſter who ſettled here. He tranſlated the Bible, and other pious books, into the Indian language; and founded many religious ſocieties among the Indians. Thoſe of *Natick* and *Maſhpee*, few in number, remain to this day. He died in 1670, after being paſtor 60 years.—*ib*.

ROXBURY, a townſhip in the weſtern part of Orange county, Vermont, having only 14 inhabitants.—*ib*.

ROXBURY, a townſhip of Morris county, New-Jerſey, on Muſconecunk river, 25 miles from its confluence with the Delaware, and 45 miles north of Trenton. Near it is a mineral ſpring.—*ib.*

ROXO, a cape near the S. W. part of Porto Rico Iſland, and due ſouth of Cape Rincon. N. lat. 18 11, W. long. 67 53.—*ib.*

ROYAL *Bay*, is a ſhort diſtance to the eaſt, ſoutherly of Boon's Point, at the north part of the iſland of Antigua in the Weſt-Indies.—*ib.*

ROYAL *Iſle*, a ſmall fertile iſland in the river St Lawrence; 60 miles below Lake Ontario. The French fort on it was taken by Gen. Amherſt, in 1760.—*ib.*

ROYAL's *River*, in Cumberland county, Maine, empties into Caſco Bay, in the townſhip of North-Yarmouth.—*ib.*

ROYALTON, a townſhip in Windſor county, Vermont, north-weſt of Hartford, on White river, and contains 748 inhabitants.—*ib.*

ROYALSTON, a townſhip of Maſſachuſetts, Worceſter county, 40 miles north-weſt by north of Worceſter, and 70 north-weſt of Boſton. It was incorporated in 1665, and contains 1,130 inhabitants. Miller's river runs through this town from the eaſt.—*ib.*

ROY ROYAN, in Bengal, the chief officer in the revenue department, next to the Dewan under the native government.

RUATAN, or *Rattan*, an iſland in the Bay of Honduras, 8 leagues from the Moſquito ſhore, and about 200 weſt by ſouth of the iſland of Jamaica. It is 30 miles long and 13 broad, naturally fortified with rocks and ſhoals, except the entrance into the harbour, which is ſo narrow that only one ſhip can paſs it at a time; the harbour is one of the fineſt in the world, and can afford ſafe anchorage for 500 ſail of ſhips. It was totally uninhabited until 1742, when the Britiſh, under the command of Major Crawford, began a ſettlement, in order to protect the log-wood cutters, and ſecure a trade with the Spaniards of Guatimala, for cochineal, indigo, &c. but it was ſoon abandoned. N. lat. 17 6, W. long. 88 12.—*Morſe.*

RUGELEY's *Mills*, in S. Carolina, are about 12 miles north of Camden, near the weſternmoſt branch of Lynche's Creek. Here Gen. Green retreated, in May, 1781, to wait for reinforcements, after his repulſe at Camden, and to prevent ſupplies reaching it.—*ib.*

RUISSEAU, *Grand*, a ſettlement on the eaſtern ſide of the river Miſſiſſippi, and in the N. W. Territory, which, with the villages of St Philip and Praire-du-Rochers, contained, in 1792, 240 inhabitants.—*ib.*

RUMI RAMBA, a plain near Quito in Peru, full of large fragments of rocks, thrown thither from a volcano, formerly in the famous mountain of Pichincha.—*ib.*

RUM *Key*, one of the Bahama Iſlands. N. lat. 23 52, W. long. 74 17.—*ib.*

RUMNEY, or *Romney*, a townſhip of New-Hampſhire, ſituated in Grafton county, on a north branch of Baker's river, about 7 or 8 miles north-weſt of Plymouth on the weſt ſide of the Pemigewaſſet. It was incorporated in 1767, and contains 411 inhabitants.—*ib.*

RUNAWAY *Bay*, on the north-weſt coaſt of the iſland of Antigua; ſituated between the fort on Corbizon's point to the north, and Fort Hamilton to the ſouth. Off it lie rocks and ſhoals.—*ib.*

RUNAWAY *Bay*, on the north coaſt of the iſland of Jamaica, weſtward of Great Laughlands river and Mumby Bay, and 9 or 10 miles eaſtward of Rio Bueno.—*ib.*

RUPERT, the north-weſternmoſt townſhip of Bennington county, Vermont. It contains 1,033 inhabitants.—*ib.*

RUPERT's *Bay*, at the north-weſt end of the iſland of Dominica, in the Weſt-Indies, affords good ſhelter from the winds, and is deep, capacious and ſandy. It is the principal bay of the iſland, and on it is erected the town of Portſmouth.—*ib.*

RUPERT's *Fort*, at the bottom of Hudſon's Bay, in N. America, is ſituated on a river of the ſame name, on the E. ſide of James's Bay; between Slade river on the north, and Nodway river on the ſouth. N. lat. 51 50, W. long. 80 5.—*ib.*

RUPERT's *Iſland*, the moſt weſterly of the 4 iſlands in the ſtraits of Magellan, which form the S. ſide of Royal Reach.—*ib.*

RUSSELL, a county of Virginia, bounded north by Greenbrier, and ſouth by Lee county. Before Lee was erected out of this county, it contained 3,338 inbitants, including 190 ſlaves.—*ib.*

RUSSELL, a townſhip in Hampſhire county, Maſſachuſetts, 15 miles weſt of Springfield, and 108 weſt by ſouth of Boſton. It was incorporated in 1792.—*ib.*

RUTHERFORD (John, M. D.), one of the illuſtrious founders of the medical ſchool in the univerſity of Edinburgh, was the ſon of the Rev. Mr Rutherford miniſter of Yarrow, in the county of Selkirk, North Britain. He was born on the 1ſt Auguſt 1695, and received the rudiments of his education at the pariſh ſchool of Selkirk; where, from his future proficiency, there is every reaſon to believe that he made a rapid progreſs in the knowledge of the Latin and Greek languages.

After the death of his father, he went to Edinburgh in 1708 or 1710, where, in the univerſity, he applied himſelf to the ſtudy of claſſical literature, mathematics, and natural philoſophy. The celebrated Dr Pitcairn was then ſo highly reſpected for his medical ſkill, that it is not improbable but that a laudable deſire of obtaining a portion of ſimilar fame may have turned the attention of young Rutherford to the ſtudy of medicine. Be that as it may, he engaged himſelf apprentice to Mr Alexander Neſbit, at that time an eminent ſurgeon in Edinburgh, with whom he remained till 1716, when he went to London. There he attended ſome hoſpitals, and the lectures read on anatomy by Dr Douglas, on ſurgery by André, and on materia medica by Strother.

After a year's reſidence in London, he returned to Edinburgh; and having ſettled his affairs in that city, he went to Leyden, which, from the lectures of Boerhaave, was then the moſt celebrated medical ſchool in Europe. In 1719 he went into France, and was at the end of July in that year admitted to the degree of M. D. in the univerſity of Rheims. He paſſed the following winter in Paris, chiefly for the ſake of Winſlow's private demonſtrations in anatomy; and in 1720 he returned to Britain.

In 1721 he ſettled as a phyſician in Edinburgh; and ſoon afterwards Drs Rutherford, Sinclair, Plummer, and Innes, purchaſed a laboratory, where they prepared compound medicines. This was an art then but little known in Scotland; and as a commercial ſpeculation, the laboratory muſt therefore have proved very advantageous to the partners. But they had higher objects in view than commerce. They demonſtrated, as far as they were then known, the operations of chemiſtry to a numerous audience; and ſoon afterwards, by the advice of their old maſter Boerhaave, they extended their lectures to the other branches of phyſic. In 1725 they were appointed joint profeſſors in the univerſity; where, we believe, each, for ſome time, read lectures in every department of medical ſcience, anatomy excepted, and carried forward their claſſes in rotation. The anatomical lectures were read by the elder Monro, who had been ſettled a year or two before them in Edinburgh, and whoſe eminence in that department is known to all Europe.

On the death of Dr Innes, a particular branch of medical ſcience was allotted to each of the other three profeſſors. Dr Plummer was appointed profeſſor of chemiſtry and materia medica, Dr Sinclair of the inſtitutes of phyſic, and Dr Rutherford of the practice; and thus was a regular medical ſchool eſtabliſhed in Edinburgh by Monro, Plummer, Sinclair, and Rutherford. The lectures on the inſtitutes and practice of phyſic were then, and for many years afterwards, delivered in Latin; and ſuch was Dr Rutherford's command of that language, that on every thing connected with medicine, he talked in it more fluently than in the language of his country.

Whether it was any improvement in the mode of medical education in Edinburgh to change the language of the lectures from Latin to Engliſh, is perhaps more than queſtionable. We have now diſperſed over the country a number of illiterate men, practiſing as ſurgeons, and even as phyſicians, who never could have boaſted of having gone through a regular courſe of medical inſtruction, had the lectures continued to be delivered in the language in which they were begun. Foreigners, too, would not have been under the neceſſity of learning a new language, before they could enter on the ſtudies, for the cultivation of which they came to Scotland; and though the medical claſſes might not have been ſo crowded perhaps as at preſent, the individuals compoſing them would have been at leaſt as reſpectable. Whether Dr Rutherford reaſoned in this way we know not; but he continued to lecture in Latin as long as he filled the practical chair.

About the year 1748 he introduced a very great improvement in the courſe of medical education. Senſible that abſtract lectures on the ſymptoms and the mode of treating various diſeaſes, of which the ſtudents know little but the names, could ſcarcely be of any benefit, he had for ſome time encouraged his pupils to bring patients to him on Saturday, when he inquired into the nature of their diſeaſes, and preſcribed for them in the preſence of the claſs. This gave riſe to the courſe of *clinical* lectures; the utility of which was ſo obvious, that it was enacted, by a decree of the ſenate of the univerſity, that no man ſhould be admitted to an examination for his doctor's degree, who had not attended thoſe lectures; to which an excellent hoſpital, then lately erected (ſee Edinburgh, in the *Encyclopædia*), gave the profeſſors every opportunity of doing ample juſtice. To men who mean to live by the practice of phyſic, and have no inordinate ambition to raiſe their fame by fanciful theories, this is perhaps the moſt valuable courſe of lectures that is given in Edinburgh; and if ſo, Dr Rutherford muſt be conſidered as one of the greateſt benefactors of the medical ſchool.

To untried theories in phyſic he was indeed no friend; and we have heard a favourite and very able pupil of his, who knew him well, and reſpected him highly, affirm that, to his knowledge, Dr Rutherford retained his profeſſorſhip longer than he otherwiſe would have choſen to do; merely that he might keep out a ſpeculatiſt, whom he knew to be aſpiring to the practical chair. Finding at laſt in the late Dr John Gregory (ſee Gregory, *Encycl.*) a ſucceſſor entirely to his mind, he reſigned to him in 1765, after having taught medicine in its different departments for upwards of forty years. He lived, after this period, loved by his friends, and revered by many eminent phyſicians, who had been his pupils, till 1779, when he died in Edinburgh, where he had ſpent the greater part of his life, in the 84th year of his age.

Rutherford, a county of Morgan diſtrict, N. Carolina, bounded north by Burke, and ſouth by the ſtate of South Carolina. In 1790 it contained 7,808 inhabitants, including 614 ſlaves; but a new county has been lately formed out of it.—*Morse.*

Rutherford-Town, the capital of the above county. It contains a courthouſe, a gaol, and a few dwellinghouſes.—*ib.*

RUTHSBOROUGH, a village in Queen Anne's county, Maryland, on Tuckhahoe Creek, 6 miles S. E. of Centerville, and 7½ N. W. of Greenſberough.—*ib.*

RUTLAND, a county of Vermont, bounded north by Addiſon county, eaſt by Windſor, ſouth by Bennington, and weſt by New-York. Otter Creek, and other ſtreams, water this county. It has alſo numerous lakes or ponds, well ſtored with fiſh; the chief of theſe, are Lakes Bombazon and St Auſtin; the former in Hubberton and Caſtleton, and the latter in Wells. It contains 25 townſhips, and 15,565 inhabitants. Here are 14 forges, 3 furnaces, and a ſlitting-mill.—*ib.*

Rutland, a poſt-town of Vermont, and capital of the above county, on Otter Creek, 55 miles from the mouth of that creek in Lake Champlain; 57 miles northerly of Bennington, 45 W. by N. of Windſor, and 359 N. E. by N. of Philadelphia. This town and Windſor, are to be alternately the ſeat of government for the ſtate. It contains a Congregational church, a courthouſe, and about 60 houſes. N. lat. 43 34 30, W. long. 72 50 30. The mean heat here, according to Dr Williams, is 43 6
Leaſt heat 21
Greateſt heat 92
This townſhip contains 1407 inhabitants. Pipe clay is found here, which has been wrought into crucibles that prove very durable.—*ib.*

Rutland, a townſhip of Maſſachuſetts, Worceſter county, 14 miles N. W. of Worceſter, and 56 W. of Boſton. The town was incorporated in 1722, and contains 1072 inhabitants.—*ib.*

RYE, a townſhip of New-Hampſhire, on the ſea-coaſt of Rockingham county, oppoſite the Iſle of Shoals, and

and 8 miles S. of Portſmouth. It was incorporated in 1719, and contains 865 inhabitants. The coaſt affords excellent ſalt hay.—*ib.*

Rye, a townſhip of New-York, Weſt-Cheſter county, on Long-Iſland Sound; 36 miles N. E. from New-York city. It contains 986 inhabitants, of whom 154 are qualified electors, and 123 ſlaves.—*ib.*

Rye, a townſhip in Cumberland county, Pennſylvania.—*ib.*

RYEGATE, the S. eaſternmoſt townſhip of Caledonia county, Vermont, and ſeparated from Bath in New-Hampſhire on the eaſt, by Connecticut river. It contains 187 inhabitants.—*ib.*

S.

SABLE, *Cape*, the ſouth-weſternmoſt point of the province of Nova-Scotia. N. lat. 43 24, W. long. 65 39. Variation of the needle, in 1787, 12 15 W. —*Morſe.*

Sable, *Cape*, the S. W. point of the peninſula of Florida; 33 leagues E. N. E. ¼ E. of the S. W. point of the Dry Tortuga Shoals. N. lat. 24 57, W. long. 81 52.—*ib.*

Sable, *Great* and *Little*, two rivers emptying into Lake Champlain from the weſt ſide. *Great Sable River* is not far from the Saranac, and is ſcarcely 60 yards wide. On this ſtream are remarkable falls. The whole deſcent of the water is about 200 feet, in ſeveral pitches, the greateſt of which is 40 feet perpendicular. At the foot of it the water is unfathomable. A large pine has been ſeen in a freſhet, to pitch over endwiſe, and remain ſeveral minutes under water. The ſtream is confined by high rocks on either ſide, a ſpace of 40 feet; and the banks at the falls are at leaſt as many feet high. In a freſhet, the flood wood frequently lodges, and in a few minutes the water riſes to full banks, and then burſts away its obſtructions, with the moſt tremendous craſhing.—*ib.*

Sable, an iſland ſouth-eaſt off Cape Breton 35 leagues. It is narrow, dreary, and barren. N. lat. 44 15, W. long. 60.—*ib.*

Sable *Point*, on the weſt ſide of the iſland of Newfoundland. N. lat. 50 24, W. long. 57 35.—*ib.*

SACATECOLULA, or *Lacateculula*, on the weſt coaſt of Mexico, 12 miles from Limpa river. There is a burning mountain near the town of the ſame name. The volcano of St Salvador, is more northerly about 30 miles, and 12 eaſtward of Bernal.—*ib.*

SAC, *Grande Riviere du Cul de*, a river of the iſland of St Domingo, which riſes in Montagne de la Selle, by two branches; takes a ſemicircular courſe of 12 leagues, and runs weſtward into the ſea, about two leagues northward of Port au Prince.—*ib.*

SACCHAROMETER, the name given, by Mr Richardſon of Hull, to an inſtrument invented by him for aſcertaining the value of worts, and the ſtrength of different kinds of malt liquors. In plain Engliſh, the name ſignifies a *meaſurer of ſweetneſs*; and therefore, if etymology were to be attended to, the inſtrument ſhould be employed merely as a meaſurer of the ſweetneſs of worts. It is in fact beſt adapted for this purpoſe, being merely an hydrometer contrived to aſcertain the ſpecific gravity of worts, or rather to compare the weight of worts with that of equal quantities of the water employed in the brewery where the inſtrument is uſed.

The principle which ſuggeſted the invention of the inſtrument to Mr Richardſon is as follows: The menſtruum or water, employed by the brewer, becomes heavier or more denſe by the addition of ſuch parts of the materials as have been diſſolved or extracted by, and thence incorporated with it: the operation of boiling, and its ſubſequent cooling, ſtill adds to the denſity of it by evaporation; ſo that when it is ſubmitted to the action of fermentation, it is more denſe than at any other period.

In paſſing through this operation of nature, a remarkable alteration takes place. The fluid no ſooner begins to ferment than its denſity begins to diminiſh; and as the fermentation is more or leſs perfect, the fermentable matter, whoſe acceſſion has been traced by the increaſe of denſity, becomes more or leſs attenuated; and in lieu of every particle thus attenuated, a ſpirituous particle, of leſs denſity than water, is produced: ſo that when the liquor is again in a ſtate of quietude, it is ſo much ſpecifically lighter than it was before, as the action of fermentation has been capable of attenuating the component parts of its acquired denſity; and, indeed, were it practicable to attenuate the whole, the liquor would become lighter or leſs denſe than water; becauſe the quantity of ſpirit produced from, and occupying the place of the fermentable matter, would diminiſh the denſity of the water in a degree bearing ſome proportion to that in which the latter had increaſed it.

From theſe facts, the reader, who is acquainted with hydroſtatical principles, will be able to conſtruct a ſaccharometer for himſelf. Brewers, who are ſtrangers to theſe principles, we muſt refer to Mr Richardſon's book for details, which our limits permit us not to give.

SACKVILLE, a townſhip of Nova-Scotia, Cumberland county, on Chegnecto Baſon, called by the French Beau Baſin, and Tintamare, and the N. ſide of the river au Lac.—*Morſe.*

SACO *Falls*, ſituated on Saco river, are 5 miles from the ſea. The river is here divided by Indian Iſland, conſiſting of about 30 acres of land, and on each ſide of it tumbles over a precipice of rocks, and mixes with the tide. The proſpect from the eaſt ſide of the iſland is very ſublime and majeſtic. From the beginning of the falls, to the tide below, the difference of height is above 40 feet. There are many corn and ſaw-mills; on the falls, and below the iſland is a fine baſon, where veſſels take in their cargoes. Salmon Falls are 10 miles above this.—*ib.*

Saco *River* is one of the three largeſt rivers in this diſtrict. The principal part of its waters fall from the White Mountains. Its courſe ſome diſtance from its ſource, is ſouthwardly; it then ſuddenly bends to the eaſt, and croſſes into the Diſtrict of Maine, and then makes a large bend to the N. E. and S. W. embracing the fine townſhip of Fryeburg, in the county of York. Its general courſe thence to the ſea is S. E. Great and Little Oſſapee rivers fall into it from the weſt. This river is navigable for ſhips to Saco Falls, about 6 miles from the ſea. Here the river is broken by Indian Iſland, over which is the poſt-road. A bridge is thrown over each of the branches. A number of mills are erected here, to which logs are floated from 40 or 50 miles above; and veſſels can come quite to the mills to take in the lumber. Four million feet of pine boards were annually ſawed at theſe mills before the war. The mouth of this river lies 4 miles E. of Cape Perpoiſe. There is a bar which will not allow a veſſel of above 100 tons burden to paſs, if fully loaded. Without the bar, and between Fletcher's Neck and the main land, is a pool, wherein veſſels of any ſize may lie at all ſeaſons of the year, and take in their ladings at pleaſure. On the weſt ſide of the river a ſmall neck of land divides it from the pool, which might be eaſily cut, and ſo ſave the hazard of paſſing the bar. On the branches of this river, as well as on the main ſtream, are a great many mills and valuable works; 30 miles from the ſea, a ſmall ſtream, iſſuing from Little Oſſapee pond, in New-Hampſhire, joins it; and 20 miles further up Great Oſſapee river, from another pond, in New-Hampſhire, ſwells the Saco, and impels its courſe. Proceeding up the Saco its ſource is found on the ſide of the White Mountains, in New-Hampſhire. From theſe mountains the waters run into Connecticut, Saco, and Androſcoggin rivers. Saco river meanders through the ancient Indian village of Peckwalket, 60 miles from the ſea. In 1775, a new river burſt into the Saco, from the White Mountains, and ſtill continues to aid Saco and a branch of it, called Ellis's river. A mixture of iron ore, gave the waters a red colour for a few days, and the people on the upper banks had a report, that the river was bloody, which they conſidered as an ill omen to the public concerns.—*ib.*

SACRAMENT, *St*, the S. weſternmoſt Portugueſe ſettlement in Brazil, being oppoſite to Buenos Ayres, on the ſouthern ſide of the river La Plata. It is alſo called *Sacramenti Colonia*, and was taken by the Spaniards in 1762, after a month's ſiege; but by the treaty of peace it was reſtored.—*ib.*

SACRIFICES *Iſland*, on the weſt coaſt of New-Mexico, is about 3 miles weſtward of a ſmall iſland called the Watering Iſland, and 12 miles from Coiula river.—*ib.*

SADDLE-BACK, an iſland in Hudſon's Bay, N. lat. 67 7, W. long. 68 13. It lies nearly due weſt of Terra Nieva.—*ib.*

Saddle *River*, a village in Bergen county, New-Jerſey.—*ib.*

SADSBURY, a townſhip in Cheſter county, Pennſylvania.—*ib.*

SAGADAHOCK was formerly the name of Kennebeck river, in the Diſtrict of Maine, after it receives Androſcoggin river.—*ib.*

Sagadahock, a great part of the Diſtrict of Maine was formerly ſo called. In the grant by King Charles II. to his brother the Duke of York, this territory was deſcribed in the following manner. "All that part of the main land of New-England, beginning at a certain place called St Croix, adjoining to New-Scotland in America, and from thence extending along the ſea-coaſt, to a certain place called Pimaquin, or Pemaquid, and ſo up the river thereof to its furtheſt head as it tends to the northward, and extending from thence to the river Quenebec, and ſo up by the ſhorteſt courſe to the river of Canada northward." This tract was called the Duke of York's Property, and was annexed to the government of New-York. At the revolution, in 1688, it reverted to the crown.—*ib.*

SAGAMOND, a river of the N. W. Territory, which has a ſouth-eaſt courſe, and enters Illinois river, 30 miles below Demi Quian river, and 135 from the Miſſiſſippi. It is 100 yards wide at its mouth, and is navigable for ſmall boats or canoes upwards of 180 miles.—*ib.*

SAGATUCK *River*, a ſmall river of Connecticut, which riſes in Ridgefield, in Fairfield county, paſſes through Reading and Weſton, and running ſouthward, ſeparates Fairfield from Norwalk, and empties into a harbour of its own name in Long-Iſland Sound.—*ib.*

SAGANAUM, or *Sagana Bay*, in the ſouth-weſt part of Lake Huron, is about 80 miles in length, and 18 or 20 miles broad. Around it live the Chippeway Indians.—*ib.*

SAGENDAGO, a head branch of Hudſon's river. Its mouth is about 20 miles weſt of Fort Anne.—*ib.*

SAGG HARBOUR, a poſt-town and port of entry in the State of New-York, Suffolk county, at the eaſt end of Long-Iſland. It contains a Preſbyterian church and about 50 houſes. The whale fiſhery from this harbour, produced 1,000 barrels of oil annually. Its exports in 1784 amounted to the value of 6,762 dollars. It is 12 miles north-weſt of Southampton, 107 eaſt of New-York, and 202 north-eaſt by eaſt of Philadelphia.—*ib.*

SAGITTA, in aſtronomy, the *Arrow* or *Dart*, a conſtellation of the northern hemiſphere near the eagle, and one of the 48 old aſteriſms.

SAGUANA, a bay in the north-eaſt corner of the Gulf of Mexico, on the coaſt of Florida, having numerous iſles on both ſides; Cayos del Pagoi on the ſouth-eaſt, and Farellon de Pagoi on the north-weſtward.—*Morſe.*

SAGUENAI, or *Sagueny*, a large river of Canada which riſes from Lake St John, and after purſuing an eaſterly courſe above 100 miles, empties through the weſt bank of the river St Lawrence, at the town and harbour of Tadouſſac. It is about three quarters of a mile wide at its mouth, and is from 80 to 90 fathoms deep, but higher up it is wider; and the narrowneſs of the channel greatly increaſes its rapidity, though it is navigable for the largeſt veſſels 25 leagues from its mouth. The harbour, called Port Tadouſſac, can afford convenient anchorage for 25 ſail of ſhips of war, and is well ſecured from all winds and ſtorms. It is deep, of a circular form, and ſurrounded at a diſtance with

with very high rocks, except at the entrance. A ſmall ſtream empties into it, ſufficient to water a fleet. The country in the vicinity abounds with marble.—*ib.*

SAGUENAY *River, Little*, a river of Labrador, which runs ſouthward, and empties into the St Lawrence a ſhort way eaſtward of the ſeven Iſles, and weſtward of Baſon river. N. lat. 50 18, W. long. 65.—*ib.*

SAHARA, or, as it is ſometimes written, ZAARA, the Great Deſert, is a vaſt ocean of ſand in the interior parts of Africa, which, with the leſſer deſerts of Bornou, Bilma, Barca, Sort, &c. is equal in extent to about one half of Europe. If the ſand be conſidered as the ocean, the Sahara has its gulphs and bays, as alſo its iſlands, or OASES, fertile in groves and paſtures, and in many inſtances containing a great population, ſubject to order and regular government.

The great body, or weſtern diviſion of this ocean, compriſed between Fezzan and the Atlantic, is no leſs than 50 caravan journeys acroſs, from north to ſouth; or from 750 to 800 G. miles; and double that extent in length: without doubt the largeſt deſert in the world. This diviſion contains but a ſcanty portion of iſlands (or oaſes), and thoſe alſo of ſmall extent: but the eaſtern diviſion has many, and ſome of them very large. Fezzan, Gadamis, Taboo, Ghanat, Agadez, Augela, Berdoa, are amongſt the principal ones: beſides which, there are a vaſt number of ſmall ones. In effect, this is the part of Africa alluded to by Strabo, when he ſays from *Cneius Piſo*, that Africa may be compared to a leopard's ſkin.

From the beſt inquiries that Mr Park could make when a kind of captive among the Moors at Ludamar, the Weſtern Deſert, he ſays, may be pronounced almoſt deſtitute of inhabitants; except where the ſcanty vegetation, which appears in certain ſpots, affords paſturage for the flocks of a few miſerable Arabs, who wander from one well to another. In other places, where the ſupply of water and paſturage is more abundant, ſmall parties of the Moors have taken up their reſidence. Here they live, in independent poverty, ſecure from the tyrannical government of Barbary. But the greater part of the deſert, being totally deſtitute of water, is ſeldom viſited by any human being; unleſs where the trading caravans trace out their toilſome and dangerous route acroſs it. In ſome parts of this extenſive waſte, the ground is covered with low ſtunted ſhrubs, which ſerve as land marks for the caravans, and furniſh the camels with a ſcanty forage. In other parts, the diſconſolate wanderer, wherever he turns, ſees nothing around him but a vaſt interminable expanſe of ſand and ſky; a gloomy and barren void, where the eye finds no particular object to reſt upon, and the mind is filled with painful apprehenſions of periſhing with thirſt. Surrounded by this dreary ſolitude, the traveller ſees the dead bodies of birds, that the violence of the wind has brought from happier regions; and, as he ruminates on the fearful length of his remaining paſſage, liſtens with horror to the voice of the driving blaſt; the only ſound that interrupts the awful repoſe of the deſert.

The few wild animals which inhabit theſe melancholy regions, are the antelope and the oſtrich; their ſwiftneſs of foot enabling them to reach the diſtant watering places. On the ſkirts of the deſert, where the water is more plentiful, are found lions, panthers, elephants, and wild boars.

Of domeſtic animals, the only one that can endure the fatigue of croſſing the deſert is the camel. It is therefore the only beaſt of burden employed by the trading caravans which traverſe, in different directions, from Barbary to Nigritia. The fleſh of this uſeful and docile creature, though to our author's taſte it was dry and unſavory, is preferred by the Moors to all others. The milk of the female, he ſays, is in univerſal eſteem, and is indeed pleaſant and nutritive.

That the deſert has a dip towards the eaſt, as well as the ſouth, ſeems to be proved by the courſe of the Niger. Moreover, the higheſt points of North Africa, that is to ſay, the mountains of Mandinga and Atlas, are ſituated very far to the weſt. The deſert, for the moſt part, abounds with ſalt. But we hear of ſalt mines only in the part contiguous to Nigritia, from whence ſalt is drawn for the uſe of theſe countries, as well as of the Mooriſh ſtates adjoining; there being no ſalt in the Negro countries ſouth of the Niger. There are ſalt lakes alſo in the eaſtern part of the deſert.

SAI, a large town on the banks of the Niger, or at leaſt very near to that river, which Mr Park ſays ſtrongly excited his curioſity. It is completely ſurrounded by two very deep trenches, at about two hundred yards diſtant from the walls. On the top of the trenches are a number of ſquare towers; and the whole has the appearance of a regular fortification. Inquiring into the origin of this extraordinary entrenchment, our author learned from two of the towns-people the following particulars; which, if true, furniſh a mournful picture of the enormities of African wars:

About fifteen years before our traveller viſited Sai, when the King of Bambarra deſolated Maniana, the Dooty of Sai had two ſons ſlain in battle, fighting in the king's cauſe. He had a third ſon living; and when the king demanded a further reinforcement of men, and this youth among the reſt, the Dooty refuſed to ſend him. This conduct ſo enraged the king, that when he returned from Maniana, about the beginning of the rainy ſeaſon, and found the Dooty protected by the inhabitants, he ſat down before Sai with his army, and ſurrounded the town with the trenches which had attracted our author's notice. After a ſiege of two months, the towns-people became involved in all the horrors of famine; and whilſt the king's army were feaſting in their trenches, they ſaw with pleaſure the miſerable inhabitants of Sai devour the leaves and bark of the Bentang tree that ſtood in the middle of the town. Finding, however, that the beſieged would ſooner periſh than ſurrender, the king had recourſe to treachery. He promiſed, that if they would open the gates, no perſon ſhould be put to death, nor ſuffer any injury, but the Dooty alone. The poor old man determined to ſacrifice himſelf, for the ſake of his fellow-citizens, and immediately walked over to the king's army, where he was put to death. His ſon, in attempting to eſcape, was caught and maſſacred in the trenches; and the reſt of the towns-people were carried away captives, and ſold as ſlaves to the different Negro traders. Sai is placed by Major Rennel in 14° N. Lat. and 3° 7′ Weſt. Long.

SAILING *Cove*, on the ſouth ſide of the iſland of Newfoundland, in the great bay wherein is ſituated the bay of Trepaſſi. It is 6 miles N. of Cape Pine.—*Morſe.*

SAINT Catherine, a Portugueſe iſland in the South Sea, not far diſtant from the coaſt of Brazil. It was viſited by La Perouſe, who aſcertained it to lie between 27° 19′ 10″, and 27° 49′ N. Lat. and its moſt northerly point to be in 49° 49′ longitude weſt from Paris. Its breadth from eaſt to weſt is only two leagues; and it is ſeparated from the main land by a channel only 200 toiſes broad. On the point which ſtretches fartheſt into this channel is ſituated the city of Noſtra-Senora del Deſtero, the capital of the government, and the place of reſidence of the governor. It contains at moſt 3000 ſouls, and about 400 houſes. Its appearance is exceedingly pleaſant. According to Frezier's account, this iſland ſerved, in 1712, as a retreat to vagabonds, who made their eſcape from different parts of the Brazils; who were only nominal ſubjects of Portugal, and who acknowledged no authority whatever. The country is ſo fertile, that they were able to ſubſiſt without any ſuccour from the neighbouring colonies: and they were ſo deſtitute of money, that they could neither tempt the cupidity of the governor-general of the Brazils, nor inſpire him with any deſire of ſubduing them. The ſhips that touched at the iſland gave them in exchange for their proviſions nothing but clothes and ſhirts, of which they were in the utmoſt want. It was not till about 1740 that the court of Liſbon eſtabliſhed a regular government in the iſland of St Catherine, and the parts of the continent adjacent. This government extends ſixty leagues north and ſouth from the river San Franciſco to Rio Grande; its population being about 20,000 ſouls; but there are ſo great a number of children in the different families, that probably it will ſoon be much more conſiderable. The ſoil is exceedingly fertile, and produces all ſorts of fruit, vegetables, and corn, almoſt ſpontaneouſly. It is covered with trees of everlaſting green; but they are ſo interwoven with briars and creeping plants, that it is impoſſible to get through the foreſts otherwiſe than by opening a path with a hatchet. Danger is beſides to be apprehended from ſnakes, whoſe bite is mortal. The habitations, both on the iſland and continent, are all cloſe to the ſea-ſide. The woods that ſurround them are delightfully fragrant, owing to the great number of orange trees and other odoriferous trees and ſhrubs that they contain. But, notwithſtanding all theſe advantages, the country is very poor, and totally deſtitute of manufactured commodities, ſo that the peaſants are almoſt naked, or elſe covered with rags. Their ſoil, which is very fit for the cultivation of ſugar, remains unproductive for the want of ſlaves, whom they are not rich enough to purchaſe. The whale fiſhery is very ſucceſsful; but it is the property of the crown, and is farmed by a company at Liſbon, which has three conſiderable eſtabliſhments upon the coaſt. Every year they kill about 400 whales; the produce of which, as well oil as ſpermaceti, is ſent to Liſbon by the way of Rio-Janeiro. The inhabitants are idle ſpectators of this fiſhery, from which they derive not the ſmalleſt advantage. La Perouſe gives a very amiable picture, however, of their hoſpitality to ſtrangers.

ST ANN, *Cape*, on the ſouth ſide of the river St Lawrence, near its mouth, and on the north coaſt of the diſtrict of Gaſpee, in Lower Canada; ſoutherly of Cape Chat. N. lat. 48 29, W. long. 63 43.—*Morſe.*

St Anne's, a ſettlement on the eaſt coaſt of Cape Breton Iſland, which has a harbour.—*ib.*

St Anne's *Iſlands*, 3 iſlands ſituated in the bay of St Louis de Maraguan, on the coaſt of Brazil, S. America.—*ib.*

SAL, *Rio Lagra de*, or *River of the Salt Lake*, on the coaſt of Brazil, about 39 miles ſouth-weſt of Salgado river.—*ib.*

SALADA, an iſland in the Weſt-Indies, whoſe north-eaſt point lies in lat. 10 59 N. and long. 64 12 W.—*ib.*

Salada, or *Salt River*, on the coaſt of Peru, is within the harbour of Pinas, on the N. Pacific Ocean.—*ib.*

SALAGUA, *Port*, on the weſt coaſt of New-Mexico, is near the rough head-land called San Tiago, and 8 leagues from the Valley of Colima. Here are 2 good harbours called Las Calletas, or the Creeks, where many ſhips may ride. That to the N. W. is very ſafe, and land-locked againſt all winds, though ſmaller than the other. Between Salagua and the White Rock (which joins the head-land) is the port of St Tiega. —*ib.*

SALAMANCA *de Bacalar*, a ſmall but flouriſhing town of Mexico, on the eaſt ſide of the iſthmus which joins the peninſula of Yucatan to the continent. It contains about 120 houſes, with a bad fort and a ſmall garriſon, to prevent contraband trade. N. lat. 17 2, W. long. 90 30.—*ib.*

SALAMANIE *Riviere*, a river of the N. W. Territory which empties into the Wabaſh from the N. N. E. 14 miles below the river, on the oppoſite ſide called Ecor a Amelins, and 265 miles above Poſt St Vincent. It riſes by two branches, which unite about 35 miles from its mouth, which lies in lat. 41 3 30 N. and long. 86 25 W.—*ib.*

SALEM, a Moravian ſettlement in the N. W. Territory, ſituated on Muſkingum river. It was forſaken in 1782, and plundered by the Indians, who were allies of the Britiſh army.—*ib.*

Salem, a Moravian ſettlement in the N. W. Territory, ſituated on the northeaſt branch of Monongahela river; 5 miles from Gnadenhutten, on the oppoſite ſide of the river, and 78 miles weſt of Pittſburg. Congreſs granted 4,000 acres of land to the United Brethren, or Moravians, Sept. 3, 1788, for the purpoſe of propagating the Chriſtian religion among the heathen.—*ib.*

Salem, *New*, a Moravian ſettlement of Chriſtian Indians, on Huron river, and near Pettquotting, on the ſouth ſide of Lake Erie. The plantations are on the weſt bank of the river, and the dwelling-houſes on the eaſt ſide, which is highland. In June, 1786, their new chapel was conſecrated, and is better built than that at Pillgerruh.—*ib.*

Salem, a county of New-Jerſey, bounded eaſt by Cumberland, and weſt by Delaware river. It is divided into 9 townſhips; thoſe on Delaware river are generally excellent for paſture, and have large dairies. The land affords, beſides, fine banked meadows, which produce flax, Indian corn, wheat, and other grain; but the people are ſubject to intermittent fevers. Here the Quakers have 4 meeting-houſes, the Preſbyterians 4, the Epiſcopalians 2, the Anabaptiſts 3, and the German Lutherans one. It contains 10,437 inhabitants.

ants. Alloway Creek, in this county, which runs into the Delaware, is navigable 16 miles for ſhallops, with ſeveral obſtructions of draw-bridges.—*ib.*

Salem, a poſt-town of New-Jerſey, and capital of Salem county, ſituated on a branch of Salem Creek, about 3½ miles from its confluence with Delaware bay. It contains a meeting-houſe for Baptiſts, one for Quakers, and one for Methodiſts; a court-houſe, gaol, and about 100 houſes, moſt of them built with brick, and many of them elegant. There is a wooden bridge over the creek, and ſo far veſſels of 40 or 50 tons burden can go up. It is 20 miles north-weſt of Bridgetown, 11 ſouth by weſt of Woodſtown, and 37 ſouth-weſt by ſouth of Philadelphia.—*ib.*

Salem, a townſhip of Vermont, Orleans county, at the ſouth end of Lake Memphremagog.—*ib.*

Salem, *New*, a townſhip in Rockingham county, New Hampſhire, in the ſouth-weſt corner of the county, adjoining Paiſtow, and divided from Methuen by the Maſſachuſetts line. It was incorporated in 1750, and contains 1218 inhabitants.—*ib.*

Salem, a port of entry and poſt-town of Maſſachuſetts, and the capital of Eſſex county, 4 miles north weſt of Marblehead, 19 north by eaſt of Boſton, and 365 north eaſt by north of Philadelphia. It is the ſecond town for ſize in the commonwealth, containing (in 1790) 928 houſes and 7921 inhabitants, and, except Plymouth, the oldeſt, was ſettled in 1628, by Governor Endicot, and was called by the Indians, *Naumkeag*. Here are a ſociety of Quakers, an Epiſcopal church, and 5 Congregational ſocieties. The town is ſituated on a peninſula, formed by two ſmall inlets of the ſea, called North and South rivers. The former of theſe paſſes into Beverly harbour, and has a draw-bridge acroſs it, built many years ago at private expenſe. At this place ſome part of the ſhipping of the town is fitted out; but the principal harbour and place for buſineſs is on the other ſide of the town, at South river, if that may properly be called a river which depends on the flowing of the ſea for the water it contains. So ſhoal is this harbour, that veſſels which draw more than 10 or 12 feet of water, muſt be laden and unladen at a diſtance from the wharves by the aſſiſtance of lighters. Notwithſtanding this inconvenience, more navigation is owned, and more trade carried on in Salem, than in any port in the commonwealth, Boſton excepted. The fiſhery, the trade to the Weſt-Indies, to Europe, to the coaſt of Africa, to the Eaſt Indies, and the freighting buſineſs from the ſouthern ſtates, are here all purſued with energy and ſpirit. A bank was eſtabliſhed and incorporated here in 1792. The enterpriſe of the merchants of this place is equalled by nothing but their indefatigable induſtry and ſevere economy. This latter virtue forms a diſtinguiſhing feature in the character of the people of this town. Some perſons of rank, in former times, having carried it to an unbecoming length, gave a character to the people in general, of a diſgraceful parſimony. But whether this reproach was ever juſtly applied in ſo extenſive a meaſure or not, nothing can be more injurious than to continue it at the preſent time; for it may juſtly be ſaid of the inhabitants of Salem at this day, that, with a laudable attention to the acquiſition of property, they exhibit a public ſpirit and hoſpitality, alike honourable to themſelves and their country. A general plainneſs and neatneſs in dreſs, buildings and equipage, and a certain ſtillneſs and gravity of manner, perhaps in ſome degree peculiar to commercial people, diſtinguiſh them from the citizens of the metropolis. It is indeed to be wiſhed that the ſober induſtry here ſo univerſally practiſed, may become more extenſive through the Union, and form the national character of Federal Americans. A court houſe, built in 1786, at the joint expenſe of the county and town, forms a principal ornament, and is executed in a ſtyle of architecture that would add to the elegance of any city in the Union. The ſupreme judicial court holds a term here the ſecond Tueſday of November, the courts of common pleas and ſeſſions, the ſecond Tueſday of March and September. A manufactory of duck and ſail-cloth was lately inſtituted here, and is proſecuted with much ſpirit. The melancholy deluſion of 1692, reſpecting witchcraft, originated in this town, in the family of the Rev. Mr Paris, the then miniſter, and here was the principal theatre of the bloody buſineſs. At the upper end of the town, at a place called, from the number of executions which took place there, *Gallows Hill*, the graves of the unhappy ſufferers may yet be traced. Though this unfortunate and diſgraceful buſineſs was chiefly tranſacted here, it is well known that the leading people, both of church and ſtate, in the colony, took an active part in it. Unjuſt therefore and highly abſurd it is to fix a peculiar odium on the town of Salem for what was the general weakneſs or crime of the country. The town of Salem is connected with Beverly by Eſſex bridge, upwards of 1500 feet in length, erected in 1789. It is high water here at full and change, 30 minutes after 11 o'clock. The works for the defence of the harbour conſiſt of a fort and citadel. A gate remains to be made and ſome repairs to the walls. N. lat. 42 30, W. long. 70 50 —*ib.*

Salem, a townſhip in Weſt-Cheſter county, New-York, bounded eaſterly and ſoutherly by the ſtate of Connecticut, and weſterly by Poundridge and Bedford townſhips and Croton river. It contains 1453 inhabitants; of whom 202 are electors, and 19 ſlaves.—*ib.*

Salem, a townſhip on the eaſt bounds of Waſhington county, New-York, bounded weſterly by Argyle, and ſoutherly by Albany county. It contains 2,186 inhabitants; of whom 368 are electors, and 22 ſlaves. —*ib.*

Salem, the name of two townſhips of Pennſylvania, the one in Luzerne county, the other in that of Weſt-moreland.—*ib.*

Salem, a poſt-town of North Carolina, Stokes county, on the W. ſide of Wack Creek, which with other ſtreams forms the Gargalis, and empties into Yadkin river. It contains above 100 houſes, regularly built, and chiefly occupied by tradeſmen. A paper-mill has been erected here by the Moravians, which is very uſeful. The Moravians formed this ſettlement in 1766. It is 16 miles S. E. of Ararat or Pilot mountain, 35 N. E. by N. of Saliſbury, and 531 S. W. by W. of Philadelphia.—*ib.*

Salem, the chief town of Surry county, in Saliſbury diſtrict, North-Carolina.—*ib.*

SALFORD, *Upper* and *Lower*, two townſhips in Montgomery county, Pennſylvania.—*ib.*

SALGADO, a river on the S. coaſt of Brazil, 13 leagues N. E. of Rio Lagoa de Sal, or Salt Lake river.

ver. It is navigable only for ſmall boats, but the harbour is very good, lying behind the ſands.—*ib.*

SALINAS, on the weſtern ſhore of the Gulf of Mexico, lies northward of Panuco river, and nearly under the tropic of Cancer. W. long. 99 30.—*ib.*

SALINAS, *Cape*, on the coaſt of Terra Firma, lies oppoſite the N. W. point of the iſland of Trinidad, which forms the paſſage called the Gulf of Paria; 30 leagues S. or S. by W. from Cape Tres Puntas, or Three Points.—*ib.*

SALINAS *Gulf*, on the weſt coaſt of Mexico, N. W. of the iſland of Cano, which is N. N. W. of Cape Baruco. The iſland Cano is in lat. 8 40 N.—*ib.*

SALINAS, *Great*, or *Salt Bay*, on the coaſt of Brazil, is ſouth-eaſt of Cape Cors. The entrance into the harbour is in lat. 3 40 ſouth, and N. E. from its mouth lie Salinas Shoals, or Baxos de Salina. It is a noted harbour for ſhips coming to load ſalt.—*ib.*

SALINAS, a harbour on the coaſt of Peru, between Partridge Strand and Guaco, which diſtance is 21 miles north of the Rock called Malteſi, the outermoſt of that group of rocks. This harbour affords nothing but ſhelter.—*ib.*

SALINAS, a point on the ſouth coaſt of the iſland of St Domingo, has to the N. N. W. the celebrated bay of Ocoa, which laſt is 18 leagues W. S. W. of the city of St Domingo.—*ib.*

SALINAS *Shoals*, due north from the ſhore of the north coaſt of Brazil 12 miles, but are joined to it by a reef of ſand 12 miles in length and about half a mile in breadth; and on which no large ſhips muſt venture. They lie off the harbour of Salinas; and ought to be attended to by ſhips that come out to the N. E. from that harbour.—*ib.*

SALINE, a hamlet, commonly called *The Saline*, in Louiſiana, ſituated on the weſt bank of the river Miſſiſſippi, at the mouth of a creek, 4 miles below St Genevieve. Here all the ſalt is made which is uſed in the Illinois country, from a ſalt ſpring which is at this place. It is near 9 miles S. W. by S. from Kaſkaſkias village.—*ib.*

SALINES, a bay near the S. E. point of the iſland of Martinico, and weſtward of the point ſo called.—*ib.*

SALISBURY, a fertile diſtrict of N. Carolina, which comprehends the counties of Rockingham, Guilford, Montgomery, Stokes, Surry, Iredell, Rowan, Cabarras, and Mecklenburg. It is bounded N. by the ſtate of Virginia, and S. by the ſtate of S. Carolina. Iron ore is found in ſeveral parts, and works have been erected which manufacture pig, bar-iron, &c. to conſiderable amount; tobacco of good quality is cultivated here, and the planters are wealthy. It contains 66,480 inhabitants, of whom only 8 138 are ſlaves.—*ib.*

SALISBURY, the capital of the above diſtrict, and a poſt-town, is ſituated in Rowan county, on the N. W. ſide of Cane Creek, about 5 miles from its junction with Yadkin river. It contains a court-houſe, gaol, and about 100 houſes. It is a flouriſhing place, in the midſt of a fine country, and lies about 25 miles S. of the Moravian ſettlements, 211 W. S. W. of Halifax, 110 W. S. W. of Hillſborough, 144 N. W. by W. of Fayetteville, and 567 S. W. of Philadelphia. N. lat. 35 47, W. long. 80 17.—*ib.*

SALISBURY, a townſhip in Eſſex county, Maſſachuſetts; is divided into two pariſhes. The moſt ancient ſettlement in this town, is in the lower pariſh, at which place the general court of the former province of Maſſachuſetts Bay was ſometimes held. The part of the town at preſent moſt flouriſhing, is a point of land formed by the junction of Merrimack and Powow rivers. Here is a village very pleaſantly ſituated on the bank of the Merrimack, where, before the revolution war, ſhip-building was carried on to a conſiderable extent, which though now much decreaſed, is ſtill not wholly laid aſide; and this, with its auxiliary trades, and ſome little navigation, owned and fitted here, give the place a very lively and buſy appearance. The continental frigate *Alliance*, was built at this place, under the direction of Mr Hacket, a very reſpectable naval architect. It is between 3 and 4 miles northerly of Newbury-Port, and 46 N. E. of Boſton. It was incorporated in 1640, and contains 1780 inhabitants.—*ib.*

SALISBURY, a townſhip of Vermont, on Otter Creek, in Addiſon county. Trout Pond, or Lake Dunmore, 5 miles long, and 2 broad, is in this town. It contains 446 inhabitants, and is 15 miles E. by N. of Mount Independence.—*ib.*

SALISBURY, a conſiderable agricultural townſhip in Hillſborough county, New-Hampſhire. It is ſituated on the weſt ſide of Merrimack river, at the mouth of Blackwater river, and oppoſite to Canterbury; 10 or 12 miles northerly of Concord. It was incorporated in 1768, and contains 1372 inhabitants.—*ib.*

SALISBURY, the *Wiatiac* of the Indians, is the north-weſternmoſt townſhip of Connecticut, Litchfield county, having Maſſachuſetts N. and New-York weſt. Here are ſeveral forges and iron-works and a paper-mill. During the late war ſeveral pieces of cannon were caſt in this town.—*ib.*

SALISBURY, a town of Delaware, Newcaſtle county, on the north ſide of Duck Creek, on the ſouth line of the county; 9½ miles S. E. of Noxtown, and 12 N. W. of Dover.—*ib.*

SALISBURY, the name of two townſhips in Pennſylvania, the one in Lancaſter county, the other in that of Northampton.—*ib.*

SALISBURY, a poſt-town of Maryland, ſituated on the eaſtern ſhore of Cheſapeak Bay, in Somerſet county, between the two principal branches of Wicomico river. It contains about 30 houſes, and carries on a conſiderable lumber trade. It is 5 miles ſouth of the Delaware ſtate line, 20 N. W. of Snow-Hill, 15 S. W. of Vienna, a port of entry, and 163 S. by W. of Philadelphia.—*ib.*

SALISBURY, a ſmall town of Virginia, 26 miles from Alexandria, 20 from Leeſburg, and 182 from Philadelphia.—*ib.*

SALISBURY, an iſland at the weſt end of Hudſon's Straits, eaſt of Nottingham Iſland. N. lat. 63 29, W. long. 76 47.—*ib.*

SALISBURY *Point* forms the north ſide of the mouth of Merrimack river, or Newbury harbour, in Maſſachuſetts. N. lat. 42 49, W. long. 70 54.

SALLAGUA, a harbour on the weſt coaſt of New Mexico, which affords good anchorage. N. lat. 18 52.—*ib.*

SALMON *Fall*, the name of Piſcataqua river from its head to the Lower Falls at Berwick.—*ib.*

SALMON *Falls*, in Saco river, on the line between the Diſtrict of Maine and the ſtate of New Hampſhire, 10 miles

miles above Saco Falls. The number of ſaw-mills on the river has neither deſtroyed nor leſſened the quantity of ſalmon in it. The mill-dams do not extend acroſs the river, and there is a curioſity in ſeeing the exertion of theſe fiſh in making their way up the falls: when the ſun ſhines clear in the morning, they are frequently ſeen engaged in this enterpriſe, moving from one rock to another, and reſting on each, in ſpite of the cataract which oppoſes their progreſs, until they have gained the ſtill waters above.—*ib.*

SALMON *Point*, on the eaſt coaſt of the iſland of Newfoundland, and N. E. of Claune Point, which is the north entrance into Conception Bay.—*ib.*

SALT. See CHEMISTRY *Index*, in this *Suppl.*

SALT-*Mines* of *Vielicza*, near Cracow in Poland, are very extraordinary caverns; for a deſcription of which we referred, in the article SALT (*Encycl.*) to M. Barniard in the *Journal de Phyſique* for the year 1786. Some of our readers have complained of this, and requeſted an account of them in the *Supplement*. With this requeſt we ſhall comply, by giving them Mr Wraxall's deſcription of theſe caverns.*

" After being let down (ſays he) by a rope to the depth of 230 feet, our conductors led us though galleries, which, for loftineſs and breadth, ſeemed rather to reſemble the avenues to ſome ſubterranean palace, than paſſages cut in a mine. They were perfectly dry in every part, and terminated in two chapels compoſed entirely of ſalt, hewn out of the ſolid maſs. The images which adorn the altars, as well as the pillars and ornaments, were all of the ſame tranſparent materials; the points and ſpars of which, reflecting the rays of light from the lamps which the guides held in their hands, produced an effect equally novel and beautiful. Deſcending lower into the earth by means of ladders, I found myſelf in an immenſe hall or cavern of ſalt, many hundred feet in height, length, and dimenſions, the floor and ſides of which were cut with exact regularity. A thouſand perſons might dine in it without inconvenience, and the eye in vain attempted to trace or define its limits. Nothing could be more ſublime than this vaſt ſubterranean apartment, illuminated by flambeaux, which faintly diſcover its prodigious magnitude, and leave the imagination at liberty to enlarge it indefinitely. After remaining about two hours and a half under ground, I was drawn up again in three minutes with the greateſt facility."

SALTA, a town of South-America, two-thirds of the way from Buenos Ayres to Potoſi; where immenſe numbers of cattle winter, and are fattened on their way to Potoſi.—*Morſe.*

SALTA, a town of South-America, in the province of Tucuman, 58 miles ſouth of St Salvador. It contains two churches, four monaſteries, and about 400 houſes. It is a place of great reſort on account of the large quantities of corn, meal, wine, cattle, ſalt, meat, fat, hides and other commodities, which are ſent from this place to moſt parts of Peru. S. lat. 25 20, W. long. 66 30.—*ib.*

SALTASH, a townſhip of Vermont, Windſor county, 12 miles weſt of Windſor. It contains 106 inhabitants.—*ib.*

SALT BAY, or *Baia Saluda*, called alſo *Salina*, is 30 miles north of Cape Tontoral, on the coaſt of Chili, and on the S. Pacific Ocean. It has a good ſhip-road, which is much reſorted to by coaſting veſſels, for loading ſalt as well as other produce. Good freſh water may be had near the road.—*ib.*

SALT *Iſland*, one of the ſmaller Virgin Iſles, and weſt of Cooper's Iſland. N. lat. 21 30, W. long. 71 3.—*ib.*

SALT *Iſland*, on the ſouth coaſt of the iſland of Jamaica, off Old Harbour, and N. N. E. of Portland Point.—*ib.*

SALT *Key*, a ſmall iſland in the W. Indies. N. lat. 21 30, W. long. 71 3.—*ib.*

SALT *Lick Town* lies 18 miles below the ſource of Big Beaver Creek, and 34 above the Mahoning town.—*ib.*

SALTPETRE (ſee *Nitre*, CHEMISTRY-*Index*, in this *Suppl.*) is an article of ſo much importance, and ſometimes ſo difficult to be had, that it is wonderful more attention is not beſtowed in endeavouring to diſcover ſome eaſy method to increaſe the quantity. Such a method has been long practiſed by the farmers of Appenzell in Switzerland. In ſo hilly a country, moſt houſes and ſtables are built on ſlopes, one ſide of the edifice reſting on the hill, and the other being ſupported by two ſtrong poſts, elevated two or three feet above the ground; ſo that the air has a free current under the building. Immediately under the ſtable a pit is dug, uſually occupying both in breadth and length the whole ſpace of ground covered by the building; and inſtead of the clayey earth which is dug out, the pit is filled up with ſandy ſoil. This is the whole proceſs, and all the reſt is done by nature. The animal water, which is continually oozing through the planks of the floor, having drenched the earth contained in the pit for the ſpace of two or three years, the latter is emptied, and the ſaltpetre is refined and prepared in the uſual manner.

That manner, however, is not the beſt; and the French chemiſts, during the inceſſant wars occaſioned by the revolution, have, for the ſake of ſupplying their armies with gunpowder, turned their attention to the beſt method of refining ſaltpetre. The following are directions given for this purpoſe by Chaptal, Champy, and Benjour.

The crude ſaltpetre is to be beaten ſmall with mallets, in order that the water may more eaſily attack every part of the maſs. The ſaltpetre is then to be put into tubs, five or ſix hundred pounds in each tub. Twenty *per cent.* of water is to be poured into each tub, and the mixture well ſtirred. It muſt be left to macerate or digeſt until the ſpecific gravity of the fluid ceaſes to augment. Six or ſeven hours are ſufficient for this firſt operation, and the water acquires the denſity of between 25 and 35 degrees. (Sp. gr. 1.21, and 1.306. aſcertained by Baumé's hydrometer. See HYDROMETER, *Suppl.*

The firſt water muſt then be poured off, and a ſecond portion of water muſt be poured on the ſame ſaltpetre amounting to 10 *per cent.*; after which the mixture muſt be ſtirred up, ſuffered to macerate for one hour, and the fluid drawn or poured off.

Five *per cent.* of water muſt then be poured on the ſaltpetre; and after ſtirring the whole, the fluid muſt be immediately drawn off.

When the water is drained from the ſaltpetre, the ſalt muſt be thrown into a boiler containing 50 *per cent.* of of boiling water. When the ſolution is made, it will mark between 66 and 68 degrees of the hydrometer. (Sp. gr. 1.844. and 1.898.)

The ſolution is to be poured into a proper veſſel, where it depoſits by cooling about two thirds of the ſaltpetre originally taken. The precipitation begins in about half an hour, and terminates in between four and ſix hours. But as it is of importance to obtain the ſaltpetre in ſmall needles, becauſe in this form it is more eaſily dried, it is neceſſary to agitate the fluid during the whole time of the cryſtallization. A ſlight motion is communicated to this liquid maſs by a kind of rake; in conſequence of which the cryſtals are depoſited in very ſlender needles.

In proportion as the cryſtals fall down, they are ſcraped to the borders of the veſſel, whence they are taken with a ſkimmer, and thrown to drain in baſkets placed on treſſels, in ſuch a manner that the water which paſſes through may either fall into the cryſtallizing veſſel, or be received in baſons placed underneath.

The ſaltpetre is afterwards put into wooden veſſels in the form of a mill-hopper or inverted pyramid with a double bottom. The upper bottom is placed two inches above the lower on wooden ledges, and has many ſmall perforations through which water may paſs to the lower bottom, which likewiſe affords a paſſage by one ſingle aperture. A reſervoir is placed beneath. The cryſtallized ſaltpetre is waſhed in theſe veſſels with 5 *per cent.* of water; which water is afterwards employed in the ſolution of ſaltpetre in ſubſequent operations.

The ſaltpetre, after ſufficient draining, and being dried by expoſure to the air upon tables for ſeveral hours, may then be employed in the manufacture of gunpowder.

But when it is required to uſe the ſaltpetre in the ſpeedy and immediate manufacture of gunpowder, it muſt be dried much more ſtrongly. This may be effected in a ſtove, or more ſimply by heating it in a flat metallic veſſel. For this purpoſe the ſaltpetre is to be put into the veſſel to the depth of five or ſix inches, and heated to 40 or 50 degrees of the thermometer (or about 135° of Farenheit). The ſaltpetre is to be ſtirred for two or three hours, and dried ſo much that, when ſtrongly preſſed in the hand, it ſhall acquire no conſiſtence, nor adhere together, but reſemble a very fine dry ſand. This degree of dryneſs is not required when the powder is made by pounding.

From theſe circumſtances, we find that two ſaline liquids remain after the operation; (1) the water from the waſhing; and (2) that from the cryſtallizing veſſels.

We have already remarked, that the waſhing of the ſaltpetre is performed in three ſucceſſive operations, in which, upon the whole, the quantity of fluid made uſe of amounts to 35 *per cent* of the weight of the crude ſaltpetre. Theſe waſhings are eſtabliſhed on the principle that cold water diſſolves the muriats of ſoda, and the earthy nitrats and muriats, together with the colouring principle, but ſcarcely attacks the nitrat of potaſh.

The water of theſe three waſhings therefore contains the muriat of ſoda, the earthy ſalts, the colouring principle, and a ſmall quantity of nitrat of potaſh; the amount of which is in proportion to that of the muriat of ſoda, which determines its ſolution.

The water of the cryſtallizing veſſels contains a portion of the muriats of ſoda, and of the earthy ſalts which eſcaped the operation of waſhing, and a quantity of nitrat of potaſh, which is more conſiderable than that of the former ſolution.

The waters made uſe of at the end of the operation, to whiten and waſh the cryſtals depoſited in the pyramidal veſſel, contain nothing but a ſmall quantity of nitrat of potaſh.

Theſe waters are therefore very different in their nature. The water of the waſhings is really a mother water. It muſt be collected in veſſels, and treated with potaſh by the known proceſſes. It muſt be evaporated to 66 degrees (or 1,848 ſp. gr.), taking out the muriat of ſoda as it falls. This ſolution is to be ſaturated with 2 or 3 *per cent.* of potaſh, then ſuffered to ſettle, decanted, and poured into cryſtallizing veſſels, where 20 *per cent.* of water is to be added to keep the whole of the muriat of ſoda ſuſpended.

The waters which are thus obtained by treatment of the mother water may be mixed with the water of the firſt cryſtallization. From theſe the marine ſalt may be ſeparated by ſimple evaporation; and the nitrat of potaſh, which they hold in ſolution, may be afterwards obtained by cooling.

The ſmall quantity of water made uſe of to waſh and whiten the refined ſaltpetre, contains nothing but the nitrat of potaſh: it may therefore be uſed in the ſolution of the ſaltpetre when taken from the tubs.

From this deſcription it follows, that a manufactory for the ſpeedy refining of ſaltpetre ought to be provided with (1) mallets or rammers for pounding the ſaltpetre; (2) tubs for waſhing; (3) a boiler for ſolution; (4) a cryſtallizing veſſel of copper or lead, in which the ſaltpetre is to be obtained by cooling; (5) baſkets to drain the cryſtals; (6) a wooden caſe or hopper for the laſt waſhing and draining the ſaltpetre; (7) ſcales and weights for weighing; (8) hydrometers and thermometers, to aſcertain denſities and temperatures; (9) rakes to agitate the liquor in the cryſtallizing veſſel; (10) ſkimmers to take out the cryſtals, and convey them to the baſkets; (11) ſyphons or hand-pumps to empty the boilers.

The number and dimenſions of theſe ſeveral articles muſt vary according to the quantity of ſaltpetre intended to be refined.

SALT *Petre Creek*, in Baltimore county, Maryland, falls into Gunpowder river on the weſtern ſide; 14 miles E. N. E. of Baltimore, in north lat. 39 20; and nearly 2 miles north-weſterly from the weſtern point of Gunpowder Neck.—*Morſe*.

SALT *Pond Bay*, on the ſouth coaſt of the iſland of Jamaica, eaſtward of Port Royal.—*ib*.

SALT *River*, in Kentucky, is formed by three principal branches, and empties through the ſouth-eaſt bank of the Ohio, by a mouth 80 yards, according to others 150 yards wide; 20 miles below the Rapids. It is navigable for boats about 60 miles. It has good lands on its head waters, but they are low and unhealthy; for 25 miles from its mouth, the land on each ſide is level and poor, and abounds with ponds. Between Salt and Green rivers there are two ſprings of bitumen, which, when analyzed, is found to be amber.—*ib*.

SALT *River*, on the north ſhore of the iſland of Jamaica, is nearly due ſouth from Point Galina.—*ib*.

Salt *River*, the arm of the ſea which ſeparates the iſland of Guadaloupe, in the Weſt-Indies into two parts, and communicates with the ocean on both ſides of the iſland. It is two leagues in length; 15 or 16 paces broad. The navigation is hazardous, nor will it admit veſſels above 25 tons.—*ib.*

SALT SPRING *River*, in the N. W. Territory, riſes near the E. line of the New-Jerſey Company's lands, and runs ſouth-eaſtward into Ohio river, 10 miles below the mouth of the Wabaſh, and nearly 30, by the courſe of the river, above the Great Cave. It runs above 56 miles; and 10 miles from its mouth is the ſalt ſpring, which gives name to the river.—*ib.*

SALUDA, a river of S. Carolina, which riſes on the borders of N. Carolina, and, taking a S. E. courſe, joins Broad river at the townſhip of Columbia, and forms the Congaree.—*ib.*

SALUT, *Port*, lies on the S. W. ſide of the S. peninſula of the iſland of St Domingo; about 14 leagues from Les Cayes, as the road runs, and only 7 in a ſtraight line S. W. of that town. N. lat. 18 6, W. long. 76 20.—*ib.*

SALVADORE, *St*, a town in the province of Tucuman, in S. America, and near the borders of Peru. It lies at the foot of a high mountain, which forms part of the eaſtern chain of the Andes. A little above the town is a conſiderable river, which afterwards empties into the river Leon. It has about 300 houſes, and is 63 leagues N. of St Jago del Eſtero. S. lat. 24 22, W. long. 66 27.—*ib.*

SALVADOR, *St*, a ſmall city of New Mexico, in the province of Guatimala, on a river 12 miles from the ocean. It has few houſes, and little trade. On the N. ſide of it, are lofty mountains, called the Chantales, inhabited by poor Indians. In the bottom, where the town ſtands, are plantations of ſugar-canes and indigo, with a few farms for rearing cattle. N. lat. 13 5, W. long. 90 3.—*ib.*

SALVADORE, *St*, the capital of Brazil, in S. America, called alſo the city of the Bay, is within the ſpacious Bay of All Saints, which is full of fruitful iſles. This city, which has a noble, ſpacious, and commodious harbour, is built on a high and ſteep rock, having the ſea upon one ſide, a lake forming a creſcent on the other. The ſituation makes it in a manner impregnable by nature, and it has very ſtrong fortifications. It is populous, magnificent, and beyond compariſon, the moſt gay and opulent, in all Brazil. Vaſt quantities of ſugar are made in its neighbourhood. S. lat. 13 15, W. long. 37 55.—*ib.*

SALVADORE DE BAYAMO, *St*, a town of the iſland of Cuba, on a river which runs into the head of the bay of Bayamo, about 30 miles N. W. by W. of the town.—*ib.*

SALVAGE, a dry rock off Cape Ann, on the coaſt of Maſſachuſetts. When it bears S. E. 2 leagues diſtant, you have 6 leagues N. W. to Newbury-Port bar, and N. ½ W. 11 leagues to Portſmouth. N. ½ E. 8 leagues to Iſle of Shoals.—*ib.*

SALVATEON *de Yguey*, a ſmall town in the iſland of St Domingo, 28 leagues E. of the city of St Domingo. It is famous for its ſugar-works and luxuriant paſtures, in which vaſt numbers of cattle feed. It is alſo called *Higuey*, or *Alta Gratia*.—*ib.*

SAMANA, a large bay at the E. end of the iſland of St Domingo. It opens to the N. E. between Cape Samana, (which is alſo called Cape Reſon or Cape Grondeur) on the N. and Cape Raphael ſouth-eaſt of the former, 7 leagues apart. Its mean breadth is about five leagues, and its length 20 leagues. Some mariners reckon Pointe d'Icaque, or Icaque Point, as the ſouthern point of the bay, which comes after Cape Raphael, and is only 13 leagues from the head of the bay, and lies in lat. 19 2 N. and long. 71 35 W. of Paris. This bay offers a ſafe ſhelter to the ſtouteſt ſquadrons. Lying to the windward of the iſland, it has the advantage over all the other places as a maritime poſt, which renders it capable of protecting the whole gulph of Mexico, to which it is in reality a key. The entrance is difficult, and very narrow; becauſe from the ſouthern ſide of its opening, runs a breaker, which advances in a point towards Port Baniſter, and between which, and the northern coaſt, nature has placed the rock or ſhallow, called the *Rebels*. This rock narrows the entrance, ſo that between it and the land, forming the N. ſide, in the interior of the bay, there is little more than 800 fathoms. Thus a battery on ſhore, and another on the rock, the *Rebels* would, by their croſs fire, completely defend the entrance againſt even the ſmalleſt veſſels; and a battery on the other ſide of the *Rebels* would effectually prevent any veſſel from entering between it and the breakers. —*ib.*

SAMBA BAY, or *Zamba*, on the N. coaſt of the Spaniſh Main, or Terra Firma, in S. America, is W. of St Martha's river.—*ib.*

SAMBALLAS, a rocky point remarkably long and low, on the N. ſide of the Iſthmus of Darien, which is ſo guarded with rocks and ſhoals, that it is very dangerous coming near it. N. lat. 9 40, W. long. 78 43. —*ib.*

Samballas, a multitude of ſmall iſlands, ſcattered at very unequal diſtances ſome only 1, ſome 2, ſome 3, and ſome 4 miles from the ſhore, and from each other, extending a conſiderable diſtance along the northern ſhore of the Iſthmus of Darien, and with the adjacent country, its hills and foreſts of perpetual verdure, form a charming proſpect from the ſea. There are navigable channels between moſt of the iſlands, through which ſhips may paſs, and range the coaſt of the iſthmus; the ſea between them and the ſhore being navigable from one end to the other, and affords every where good anchorage in firm ſandy ground, with good landing either on the iſlands or the main. Moſt of theſe iſlands are low, flat, and ſandy, covered with a variety of trees, and abound with ſhell-fiſh of ſeveral kinds. Some of them afford ſprings of freſh water, and convenient careening places. The long channel between the Samballas Iſlands and the iſthmus is from 2 to 4 miles in breadth, extending from Point Samballas to the Gulf of Darien and the coaſt of the iſthmus, full of ſandy bays, with many ſtreams of water.—*ib.*

SAMBOROUGH, *Cape* and *Iſland*, on the S. coaſt of Nova-Scotia, and weſtward of Chebuſto bay and harbour, on which is a light houſe for the direction of ſhips, in lat. 44 30 N. and long. 63 32 W. High water, at full and change, at 8 o'clock.—*ib.*

SAMGANOODHA, or *Samganoodha*, a harbour on the N. E. ſide of Oonalaſhka Iſland, on the N. W. coaſt of N. America, 10 miles E. of Egooſhak bay. Ships can lie here landlocked from all winds in 7, 6, and

and 4 fathoms water. It abounds with hallibut, ſalmon, &c. N. lat. 53 55, W. long. 166 30 15.—*ib.*

SAMILITAM, a river on the W. coaſt of New-Mexico, 12 miles from Point Artela on one ſide, and 6 farther to Copalita river. At its mouth is an Indian town, where a ſhip's company may find proviſions and freſh water.—*ib.*

SAMPTOWN, a village in Middleſex county, New-Jerſey, 2½ miles N. E. of Quibbletown, above 13 S. weſterly of Elizabethtown.—*ib.*

SAMPSON, a county of Fayette diſtrict, N. Carolina, bounded N. by Johnſon county, and S. by Bladen. It contains 6,065 inhabitants, including 1,183 ſlaves. The court-houſe, where a poſt-office is kept, is 36 miles from Fayetteville, 23 from Croſs Roads near Duplin court-houſe, and 543 from Philadelphia.—*ib.*

SANBALLET *Point*, near the mouth of the river Darien, and N. W. of the Iſland of Pines. It is 12 miles eaſtward of Port Scrivan.—*ib.*

SANBORNTOWN, a townſhip of New-Hampſhire, Strafford county, ſituated on the point of land at the confluence of Winnipiſiogee and Pemigewaſſet rivers. It was incorporated in 1770, and contains 1587 inhabitants. In this town is the appearance of an Indian fortreſs, conſiſting of 5 diſtinct walls, one within the other. Some pieces of baked earthen ware have been found here, from which it is ſuppoſed that the Indians had learned the potter's art.—*ib.*

SANCOTY *Head*, the E. point of Nantucket Iſland, on the coaſt of Maſſachuſetts. N. lat. 41 15, W. long. 69 58.—*ib.*

SANCTOS BAHIA, or *Saint's Bay*, on the coaſt of Brazil, where the land lies due E. and W. for 20 leagues. The city of Saints or dos Sanctos is ſituated on an iſland called Amiaz, on the W. ſide of the entrance into the harbour, as alſo the town of St Vincent: S. lat. 24, W. long. 45 15.—*ib.*

GUM-SANDARAC, is ſaid in the *Encyclopædia*, to be produced from a ſpecies of juniper. This was long the common opinion; but M. Schouſboe has lately proved (A) it to be a miſtake. The *juniperus communis*, from which many have derived this gum, does not grow in Africa; and Sandarac ſeems to belong excluſively to that part of the world. The gum ſandarac of our ſhops is brought from the ſouthern provinces of the kingdom of Morocco. About ſix or ſeven hundred quintals of it are exported every year from Santa Cruz, Mogador, and Saffy. In the language of the country it is called *el graſſa*. The tree which produces it is a *Thuia*, found alſo by M. Vahl in the kingdom of Tunis. It was made known ſeveral years ago by Dr Shaw, who named it *Cypreſſus fructu quadrivalvi, Equiſeti inſtar articulatis*; but neither of theſe learned men was acquainted with the economical uſe of this tree; probably becauſe, being not common in the northern part of Barbary, the inhabitants find little advantage in collecting the reſin which exudes from it.

M. Schouſboe, who ſaw the ſpecies of *thuia* in queſtion, ſays that it does not riſe to more than the height of twenty or thirty feet at moſt, and that the diameter of its trunk does not exceed ten or twelve inches. It diſtinguiſhes itſelf, on the firſt view, from the two other ſpecies of the ſame genus, cultivated in gardens, by having a very diſtinct trunk, and the figure of a real tree; whereas in the latter the branches riſe from the root, which gives them the appearance rather of buſhes. Its branches alſo are more articulated and brittle. Its flowers, which are not very apparent, ſhew themſelves in April; and the fruit, which are of a ſpherical form, ripen in September. When a branch of this tree is held to the light, it appears to be interſperſed with a multitude of tranſparent veſicles which contain the reſin. When theſe veſicles burſt in the ſummer months, a reſinous juice exudes from the trunk and branches, as is the caſe in other coniferous trees. This reſin is the ſandarac, which is collected by the inhabitants of the country, and carried to the ports, from which it is tranſported to Europe. It is employed in making ſome kinds of ſealing-wax, and in different ſorts of varniſh. In 1793 a hundred weight of it coſt in Morocco from 13 to 13½ piaſtres, which make from about L. 3. 5s. to L. 3. 7s. 6d. ſterling. The duty on exportation was about 7s. 6d. ſterling per quintal.

Sandarac, to be good, muſt be of a bright-yellow colour, pure and tranſparent. It is an article very difficult to be adulterated. Care, however, muſt be taken, that the Moors do not mix with it too much ſand. It is probable that a tree of the ſame kind produces the gum ſandarac of Senegal, which is exported in pretty conſiderable quantities.

SANDERS-RED (ſee PTEROCARPUS, *Encycl.*) is uſed as a dye ſtuff, but generally in a manner which is very diſadvantageous. In Crell's Chemical Annals are given, by Mr Vogler, the following directions for dyeing with this wood.

1. Into a ſolution of tin made with aquafortis (nitric acid), and mixed with three times as much ſalt water, put clean-waſhed wool, ſilk, linen, and cotton. After ſix hours, take them out, and waſh them carefully in three different quantities of clean cold water, wringing them well each time. Let them dry, and then put half the quantity of each article into the ſpirituous tincture of red ſanders, hereafter deſcribed in n° 6. letting them ſoak therein, without heat, from half an hour to an hour. To aſcertain the ſuperiority of his different proceſſes, the other half of each article muſt be boiled in the tincture of ſanders mixed with water, deſcribed in n° 7. a bare quarter of an hour. After being taken out, wrung, and dried in the ſhade, all of them will be dyed throughout of a fine rich poppy-colour.

2. Take three drams of powdered alum, and diſſolve it in twelve ounces of clean hot water. Into this ſolution, while yet warm, put ſome well-waſhed wool, ſilk, linen, and cotton. After ſuffering them to remain therein for the ſpace of twelve hours, take them out, waſh them well in three quantities of clean cold water (wringing them each time), and dry them. Then ſteep the half of each article in the cold ſpirituous tincture of ſanders (n° 6.), from half an hour to an hour; and boil the other half of each in the diluted tincture of ſanders (n° 7.) for the ſpace of ſix or ſeven minutes. After being taken out, wrung, and dried in the ſhade, they will be found to have acquired a very beautiful and rich ſcarlet colour.

3. Diſſolve

(A) In a Daniſh Journal, intitled, *The Phyſical, Medical, and Economical Library*, Part III. 1799.

3. Diſſolve three drams of blue vitriol, or vitriol of copper, in twelve ounces of hot water. Steep in this ſolution, for twelve hours, wool, ſilk, linen, or cotton; and having ſufficiently waſhed the ſtuff in clean cold water, immerſe the one half of it in the ſpirituous tincture of ſanders (n° 6.), from half an hour to an hour; and boil the other half of each for ſix or ſeven minutes in the diluted tincture, n° 7. Being then taken out, wrung, and dried in the ſhade, as before, they will have acquired a beautiful, rich, bright, crimſon colour.

4. Steep wool, ſilk, linen, and cotton, which has been well waſhed, during twelve hours, in a ſolution of three drams of white vitriol, or vitriol of zinc, in twelve ounces of hot water. After being taken out, well waſhed in clean cold water, and dried, immerſe one half of each in the cold ſpirituous tincture of ſanders (n° 6.) and boil the other half in the diluted tincture (n° 7.) as before. When taken out, wrung, and dried, they will be of a fine, rich, deep crimſon colour.

5. Diſſolve three drams of common green vitriol, or vitriol of iron, in twelve ounces of hot water: ſteep well-waſhed wool, ſilk, linen, and cotton, in the ſolution, for the ſpace of twelve hours. When taken out, waſhed ſeveral times in clean cold water, and dried, treat them, as in n° 4. and they will be generally found to be of a fine, rich, deep violet colour; though, on repeating his experiments, our author ſometimes found the colour a dark browniſh red.

The tincture in which the ſtuffs are to be dyed muſt be prepared in the following manner.

6. Take half an ounce of red ſanders wood, beat or ground to powder, as it is ſold at the colour ſhops or druggiſts. Having put it into a large glaſs bottle, pour upon it twelve ounces of malt ſpirit or common brandy; then cork the bottle, and ſet it in a moderately-warm place. In the ſpace of 48 hours, the ſpirit will have extracted all the colouring matter from the red ſanders, and thereby acquired a bright red colour. The bottle ſhould be often ſhaken during the digeſtion; and the tincture, thus prepared, may be uſed for dyeing without heat, and without ſeparating the powdered ſanders from the liquor. The articles to be dyed (after the application of the proper mordants, n° 1, 2, 3, 4, 5) are to be ſteeped in the tincture for half an hour, or a whole hour: they are then to be taken out, wrung, and dried in the ſhade. This tincture does not loſe its dyeing quality by age; but dyes ſubſtances, after being kept a long time, almoſt as well as when it is juſt made. Its colouring power is indeed weakened by the frequent immerſion and dyeing of different articles in it; and when that is the caſe, it muſt be again digeſted with ſome freſh ſanders-wood.

7. Mix the ſpirituous tincture of ſanders, juſt deſcribed, with from ſix to ten times as much clean cold water. The mixture was made by our author without any ſeparation of the colouring particles worth noticing; and in this diluted tincture, the various articles (having their proper mordants firſt applied, n° 1, 2, 3, 4, 5) were boiled, as before mentioned. Linen and cotton, by being dipped in glue-water, after the application of the mordants, acquire, in this diluted tincture, a much deeper and richer colour.

If a very fine and bright colour be deſired, the above ſpirituous tincture of ſanders ſhould not be too old, nor ſhould the digeſtion be protracted beyond 48 hours; for, after that period, the ſpirit appears to extract brown and yellow colouring particles from the wood. The powder of ſanders need not be ſeparated from the diluted tincture which is made uſe of by boiling; nor is it abſolutely neceſſary to waſh the articles in cold water after they are dyed; as the powder which adheres to them may eaſily be taken off by rubbing and ſhaking. M. Vogler, however, found it advantageous, after the articles were taken out of the dye, and wrung, to ſteep them for a few minutes in a cold ſolution of half an ounce of common ſalt, and a quarter of an ounce of alum, in 12 ounces of pure water. In this caſe, they ſhould afterwards be waſhed ſeveral times in clean cold water, then wrung and dried in the ſhade. By this method the colours are not only more beautiful, but are alſo more permanent. All the articles of wool, ſilk, linen, and cotton, which were dyed as is above mentioned, bore perfectly well the teſt of alkaline ley, ſoap, and acids; but, by expoſure to the open air and the ſun, the colours were more eaſily diſcharged, eſpecially from linen and cotton.

N. B. Red ſanders, by being ground to a fine powder, anſwers much better for dyeing by this proceſs, than when it is merely cut into ſmall pieces; but it muſt be remarked, that the powder of red ſanders which is ſold at the ſhops is ſometimes adulterated, by being mixed with other ſubſtances, and moiſtened with acids. The beſt kind is not light, but rather heavy; and is not of a dark red colour, but clear and bright.

SANDGATE, a mountainous townſhip of Bennington county, Vermont, 18 miles N. of Bennington. It contains 773 inhabitants.—*Morse.*

SAND-HILL *Bay*, is on the N. ſide of the peninſula, at the S. E. end of the iſland of St Chriſtopher's, in the W. Indies.—*ib.*

SANDISFIELD, a hilly townſhip in Berkſhire county, ſeparated from Litchfield county in Connecticut by the ſouth ſtate line; 22 miles S. by E. of the ſhire-town, and 135 W. by S. of Boſton. It was incorporated in 1762, and contains 1581 inhabitants.—*ib.*

SANDOWN, a townſhip in Rockingham county, New-Hampſhire, was taken from Kingſton and incorporated in 1756; and contains 561 inhabitants.—*ib.*

GOODWIN SANDS, famous ſand banks off the coaſt of Kent, lying between the north and ſouth Foreland; and as they run parallel with the coaſt for three leagues together, at about two leagues and a half diſtant from it, they add to the ſecurity of that capacious road the Downs; for while the land ſhelters ſhips with the wind from ſouth-weſt to north-weſt only, theſe ſands break all the force of the ſea when the wind is at eaſt-ſouth-eaſt. The moſt dangerous wind, when blowing hard on the Downs, is the ſouth-ſouth-weſt. Theſe ſands occupy the ſpace that was formerly a large tract of low ground belonging to Godwyn Earl of Kent, father of King Harold; and which being afterwards given to the monaſtery of St Auguſtin at Canterbury, the abbot neglecting to keep in repair the wall that defended it from the ſea, the whole track was drowned, according to Salmon, in the year 1100, leaving theſe ſands, upon which ſo many ſhips have ſince been wrecked.

SANDUSKY, a fort in the N. W. Territory, ſituated on the ſouth ſide of the bay of the ſame name, at the ſouth-weſt end of Lake Erie.—*Morse.*

SANDUSKY *Lake*, or *Bay*, at the ſouth-weſtern ſide of

Lake Erie, is a gulf ſhaped like a ſhoe, and entered from the lake by a very ſhort and narrow ſtrait. Its length is 17 miles, its greateſt breadth 7 miles. From the north-weſt part of this lake, there is a portage of only a mile and a quarter to Portage river, a ſmall river which runs into Lake Erie. The fort ſtands oppoſite to the gut. N. lat. 41 51, W. long. 83 3 30.—*ib.*

Sanduſky *River*, a navigable water of the N. W. Territory, which riſes near a branch of the Great Miami, between which is a portage of 9 miles. It purſues a north-eaſt courſe, and empties into the ſouth-weſt corner of Sanduſky Lake. The Indians, by the treaty of peace at Greenville, Auguſt 3, 1795, have ceded to the United States a tract of land 6 miles ſquare upon Sanduſky Lake, where a fort formerly ſtood, and two miles ſquare at the Lower Rapids of Sanduſky river. It is a conſiderable river, with level land on its bank, its ſtream gentle all the way to its mouth, where it is large enough to receive ſloops.—*ib.*

SANDWICH, a townſhip in the northern part of Strafford county, N. Hampſhire, north of Winnipiſiogee Lake. It was incorporated in 1763, and contains 905 inhabitants.—*ib.*

Sandwich, Maſſachuſetts, a poſt-town at the bottom of Cape Cod, in Barnſtable county. It extends the whole breadth of the cape, and is 18 miles S. E. of Plymouth, and about 59 miles S. of Boſton. There is a little decent group of houſes, on the eaſt ſide of the cape, and a pretty ſtream of water running through it. Incorporated 1639; inhabitants 1991. It is near the place where the propoſed canal is to commence from Barnſtable to Buzzard's bay. The Indian town *Kitteaumut*, or *Katamet*, was ſituated on Buzzard's bay; and *Mannamit* was the name of a place near the bottom of Buzzard's bay. There is a place on the ſame bay, on Sandwich ſide, called *Pokeſet*, uſually called by the Indians *Poughkeeſte*. It is the ſecond pariſh in Sandwich. There is an Indian territory, called *Herring Pond*, in the neighbourhood of Sandwich, about 5 miles N. W. from this village, and ſo extending from thence along ſhore to Monument Ponds, all included within the townſhip of Plymouth. It contains about 120 ſouls, one half of whom are mixed. The Indian name of this territory is not generally known. They appear to have been conſidered as a diſtinct tribe, now known by the name of the Herring Pond Indians.—*ib.*

Sandwich, *New*, a plantation in Lincoln county, Diſtrict of Maine, containing 297 inhabitants.—*ib.*

Sandwich, or *Hawkes River*, is two miles within Chebucto Harbour in Nova-Scotia.—*ib.*

Sandwich, a ſmall river at the bottom of Barnſtable Bay, in Barnſtable county, Maſſachuſetts.—*ib.*

SANDY *Bay*, at the E. end of the iſland of Jamaica; ſouthward of Mulatto river, and 6 miles N. of Manchaneel Harbour.—*ib.*

Sandy *Bay*, at the N. W. extremity of the ſame iſland, W. of Stoddard Bay, and E. of Green Iſland. *Little Sandy Bay*, on the S. E. part of the iſland is about a league W. of Point Morant. *Sandy Cays* lie off the entrance of Port Royal Harbour.—*ib.*

Sandy *Cove*, to the north-weſtward round the point of Cape Ann, on the coaſt of Maſſachuſetts, and lies between two headlands. N. lat. 42 45, W. long. 70 30.—*ib.*

Sandy *Harbour*, on the E. ſide of the iſland of St Lucia, near the S. E. point of the iſland, where a ſmall river empties into the ocean.—*ib.*

Sandy *Hill*, a ſmall delightful village in New-York ſtate, two miles north of Fort Edward, on a high hill, overlooking Hudſon's river from the eaſt.—*ib.*

Sandy *Hook*, or *Point*, in the townſhip of Middleton, in New-Jerſey, forms a capacious harbour, thence and from the inlet paſſes to New-York, about 25 miles diſtant. From Montauk Point, on Long-Iſland, to the Hook, is S. W. by W. ¾ W. 14 leagues, and then W. by S. 22 leagues. The pilots are obliged to keep a good and ſufficient whale-boat ready at the Hook. High water at full and change, 37 minutes after 6 o'clock. The light-houſe, on the north point of the Hook, lies in lat. 40 30 N. and long. 74 2 W. At the firſt diſcovery of America, few or no cod fiſh were to be found ſouthward of the banks of Newfoundland, and Sable Iſland. About 30 years ago they were diſcovered off Sandy Hook, and they have ever ſince become more plenty on the fiſhing grounds off the Neverſink, in 6, 7, and 8 fathoms water.—*ib.*

Sandy *Iſland*, a ſmall iſland off the weſt coaſt of the iſland of Antigua, about two miles from the ſhore.—*ib.*

Sandy *Point*, the S. eaſtern extremity of Barnſtable county, Maſſachuſetts; called *Point Care*, by Goſnold. The courſe to Nantucket light-houſe, is S. S. W. 3 leagues. N. lat. 41 24, W. long. 69 35.—*ib.*

Sandy *Point*, in the iſland of Tobago. N. lat. 11 6, W. long. 60 37.—*ib.*

Sandy *Point*, the moſt weſterly point of the iſland of St Chriſtopher's; called alſo *Beltates Point*.—*ib.*

Sandy *Point*, near the ſouth-eaſt part of the iſland of St Lucia, and forms the ſouthern limit of Sandy Harbour.—*ib.*

Sandy *Point*, near the ſouth-eaſt point of the iſland of Antigua, on the larboard ſide of the opening into Willoughby Bay.——*ib.*

Sandy *Point*, the north-eaſt point of Nantucket Iſland, on the coaſt of Maſſachuſetts. N. lat. 41 23, W. long. 70.—*ib.*

Sandy *Point*, a town of the iſland of St Chriſtopher's, on the ſouth-weſt ſide of the iſland, in St Anne's pariſh, and in Fig-tree Bay. It is a port of entry, and is defended by Charles Fort, and Brimſtone Hill, both near the town.—*ib.*

Sandy *River*, in the Diſtrict of Maine, riſes in Cumberland county, conſiſts of many ſmall branches; runs a N. E. courſe, and empties into Kennebeck river, at the N. W. corner of the townſhip of Norridgewalk.—*ib.*

Sandy *River*, the plantations in Lincoln county Diſtrict of Maine, of this name, in 1790, were as follow:

	Inhabitants.
Mouth of Sandy river . .	327
Sandy river No. 1 . . .	494
———— No. 2 . . .	130
No. 3 and 7 mile Brook	350
25 mile Pond and Titcomb Town .	264

—*ib.*

SANDYSTON, a townſhip of New-Jerſey, Suſſex county, on Delaware river, at the foot of the Blue Mountains, about 11 miles above Walpack, and about as far N. W. of Newton. It contains 519 inhabitants, including 26 ſlaves.—*ib.*

SANFORD,

SANFORD, a poſt-town of the Diſtrict of Maine, nine miles from Waterbury court-houſe, 15 from Berwick, and 447 from Philadelphia. It is in York county 98 miles N. of Boſton, and the townſhip contains, in all, 1802 inhabitants.—*ib.*

SANFORD, a townſhip of New-York, Dutcheſs county. There are 239 of the inhabitants qualified electors.—*ib.*

SANGALLAN, or *Gallan Cape*, called *Cangallan* by the Britiſh ſeamen; is ſituated on the coaſt of Peru, N. N. W. of the iſland of Labos, and 3 miles N. W. of Carette Iſland. On the S. ſide of the cape is a very good harbour, much frequented by the coaſting ſhips from Panama and Lima. Off this cape it is very bluſtering and ſtormy.—*ib.*

SANGERFIELD, a townſhip of New-York, ſituated in Herkemer county, which contains 1459 inhabitants, of whom 238 are electors. This town was divided by act of the legiſlature, 1797.—*ib.*

SANGUAY, a famous mountain in the eaſtern chain of the Andes, in the juriſdiction of Macas, in the province of Quito. It is of a prodigious height, and the greateſt part of the whole ſurface covered with ſnow. From its ſummit iſſues a continual fire, and the exploſions are ſometimes heard at Quito, though 135 miles diſtant. The country adjacent to this volcano, is totally barren, occaſioned by the enormous quantity of ſtones and cinders ejected from the mountain.—*ib.*

SAN *Juan de las Lanos*, a town of S. America, at the foot of the mountains of Popayan, which is watered by a head branch of Oronoko river.—*ib.*

SAN *Miguel de Ibarra*, a juriſdiction of Peru, in the province of Quito, containing 8 pariſhes. Moſt of the farms have plantations of ſugar-canes and cotton. The farms ſituated in a leſs hot part of the juriſdiction are ſown with maize, wheat and barley. Here are alſo great numbers of goats, but not many ſheep. The Indians here weave a conſiderable quantity of cloth and cotton. The mines of ſalt here have ſome mixture of nitre, which renders it not ſo proper for ſalting meat; and accordingly that made at Guyaquil is preferred, though much dearer. Near the village of Mira, are great numbers of wild aſſes, which increaſe very faſt, and are not eaſily caught. They have all the ſwiftneſs of horſes, and aſcend and deſcend hills and mountains with eaſe. But the moſt remarkable circumſtance related of theſe animals is, that as ſoon as they have carried the firſt load, their celerity and dangerous ferocity leave them, and they ſoon contract the ſtupid look and dullneſs peculiar to all the aſinine ſpecies.—*ib.*

SAN *Miguel de Ibarra*, the capital of the above juriſdiction. It ſtands on a large plain between two rivers. The pariſh church is a large and elegant ſtructure, and well ornamented. It contains 3 convents, a college, a nunnery, and about 12,000 ſouls. N. lat. 0 25 W. long. 76 20.—*ib.*

SANSANDING, a town in Africa, ſituated near the banks of the Niger, in Lat. 14° 24′ N. and 2° 23′ W. Long. It is inhabited by Moors and Negroes to the number of from eight to ten thouſand. The Negroes are kind, hoſpitable, and credulous; the Moors are at Sanſanding, as everywhere elſe in the interior parts of Africa, fanatical, bigotted, and cruel.

SANSONATE *Port*, or *Sanſonette*, on the weſt ſide of New-Mexico, 21 miles from the river Maticalse. Point Remedios is the ſouthern limit or opening of the port.—*Morſe.*

SANTA, a rapid river, flowing through a valley of the ſame name in Peru, about 230 miles N. of Lima. It is near a quarter of a league broad at the place where it is uſually forded, which is near the town of the ſame name, forming 5 principal ſtreams, which run during the whole year with great rapidity. The velocity of the current, even when the waters are low, has been found to be a league and an half in an hour.—*ib.*

SANTA, a town of Peru, ſituated on the banks of the river of the ſame name on the road from Paita to Lima, and about 230 miles north of that city. It is inhabited by 50 poor families, conſiſting of Indians, mulattoes, and meſtizoes. S. lat. 8 57 36, weſt long. 79 30. It was originally built on the ſea-coaſt, from which it is now half a league diſtant, and was large and populous, but being pillaged by the Engliſh in 1685, it was abandoned.—*ib.*

SANTA BARBARY, on the ſouth ſide of the eaſt end of the iſland of Curacoa, in the Weſt-Indies, is the beſt harbour in the iſland, where the Dutch have a town and fort.—*ib.*

SANTA CLARA, an iſland in the bay of Guyaquil, on the northern part of the coaſt of Peru. From this iſland to Punto Arena, the weſternmoſt point of Puna Iſland, is 7 leagues E. N. E. S. lat. 3 30, weſt long. 80 36.—*ib.*

SANTA CRUZ, a conſiderable town in the iſland of Cuba, having a good harbour at the bottom of the bay of Matanzas, 63 miles eaſt of the Havannah. N. lat. 23 11, weſt long. 81 5.—*ib.*

SANTA CRUZ, or *St Croix*, a large iſland lying in the Pacific Ocean, 1850 leagues weſt of Lima, in ſouth lat. 10 15, ſouth-eaſt of the iſland of Arſacides, diſcovered by Mendana in 1595, and ſince by Carteret in 1767, and by him called *Egmont Iſland*. It is reckoned to be 90 or 100 leagues in circumference. Great and unprovoked cruelties were committed upon theſe friendly and hoſpitable Iſlanders by Mendana's men, for which Mendana cauſed two of his principal officers to be beheaded, and another to be hanged. The natives of this iſland are as black as the negroes of Africa, their hair woolly, and ſtained with different colours. Their faces and bodies are tattaowed. Their only covering is a leaf of a certain tree, their ornaments, arms, and boats, are not unlike thoſe of the inhabitants of *Tierra Auſtral*. The country is fertile and very populous, abounding in eatable roots, 6 or 7 ſpecies of bananas, plenty of cocoa trees, almonds, nuts, cheſnuts, a ſort of apple, ſugar-canes, ginger, bread-fruit, &c. Hogs, geeſe, fowls, partridges, ring and turtle doves, herons, ſwallows, and a great variety of birds; and on the coaſt a great plenty and variety of fiſh. There are here no noxious inſects, which are common in other iſlands of the torrid zone. In a word, the Iſland of Santa Cruz, and others of the ſame group, offer the moſt valuable reſources to navigators who traverſe the Great Pacific Ocean, ſouth of the line.—*ib.*

SANTA CRUZ *de la Sierra*, a large juriſdiction in the kingdom of Peru, but thinly inhabited by Spaniards. The miſſions of Paraguay are in this juriſdiction.—*ib.*

SANTA CRUZ *de la Sierra*, the capital of the above juriſdiction,

juriſdiction, ſituated at the foot of a mountain, on the banks of the ſmall river Guapay, about 56 miles north-eaſt of La Plata, and near the borders of Paraguay. It is thinly inhabited; the houſes are of ſtone, thatched with palm leaves. The valley, in which the city ſtands, produces all kinds of grain and fruits, and the woods and uncultivated mountains afford great quantities of honey and wax. S. lat. 19 25, weſt long. 62 30.—*ib.*

SANTA FE, a town of New Mexico, in N. America. N. lat. 35 32, weſt long. 106 35 —*ib.*

SANTA FE *Bay*, on the north coaſt of S. America, weſtward of Comana Gulf.—*ib.*

SANTA *Iſland*, or *Holy Iſland*, on the coaſt of Peru, is oppoſite to the port of Ferol. It is 3 miles from the port and city of Santa, and as far from Ferol, which is eaſtward of it.—*ib.*

SANTA *Maria*, a river of the Iſthmus of Darien, which is navigable 8 or 9 leagues, and ſo far the tide flows; but above that its two branches will only admit canoes. It empties into the Gulf of St Michael in the Pacific Ocean. The town of its name is about 6 leagues from its mouth; and is conſiderable on account of the gold mines in its neighbourhood, which are worked to great advantage, but the country about it is low, woody, and very unhealthy. N. lat. 7 30, weſt long. 82 20.—*ib.*

SANTA *Port*, on the coaſt of Peru, is north-eaſt of Santa Iſland, in the mouth of a river of the ſame name. —*ib.*

SANTA MARTHA, a province of Terra Firma, S. America, bounded eaſt by Rio de la Hacha, and weſt by Carthagena.—*ib.*

SANTA MARTHA, the capital of the above province, and the ſee of a biſhop, was formerly very populous, but is now much decayed, occaſioned by the Spaniſh fleets not touching there, as they anciently uſed to do. There are large ſalt ponds four and an half miles from the town, from which good ſalt is extracted and ſent to the neighbouring provinces. It ſtands near the ſea, at the foot of a prodigious mountain, whoſe ſummit is generally hid in the clouds; but in clear weather, when the top appears, it is covered with ſnow. In ſome places in the vicinity are gold mines, and in others precious ſtones of great value.—*ib.*

SANTEE, a navigable river of S. Carolina, the largeſt and longeſt in that ſtate. It empties into the ocean by two mouths, a little ſouth of Georgetown, which laſt lies in lat. 33 27 N. and long. 79 24 W. About 120 miles in a direct line from its mouth, it branches into the Congaree and Wateree; the latter, or northern branch, paſſes the Catabaw nation of Indians, and bears the name of Catabaw river, from this ſettlement to its ſource.—*ib.*

SANTO ESPIRITU, a captainſhip of Brazil, bounded N. by the captainſhip of Seguro, and S. by that of Rio Janeiro, from which laſt the river Paraybo ſeparates it, and after a long courſe from W. to E. empties into the ocean, in lat. 21 30 S. This government is the moſt fertile, and beſt furniſhed with all ſorts of proviſions of any in Brazil; having alſo an incredible quantity of fiſh and game. Its low lands being interſected by a great number of rivers, are very fruitful; and the high grounds are covered with foreſts of large trees. Here it may be noticed that there are three rivers in Brazil, called Parayba, or Paraiba, viz. one which gives its name to a captainſhip already deſcribed; the ſecond is that above mentioned, and the third empties into the ocean between Cape St Vincent, and Rio de la Plata.—*ib.*

SANTO ESPIRITU, the capital of the above captainſhip, and indeed the only town in it, is ſituated on the ſouth ſide of a large bay on the eaſtern coaſt of Brazil, about 9 miles from the ſea. It has a caſtle in ruins, but no fortifications, and contains about 900 inhabitants. Here are two monaſteries and a college. The port is a ſmall bay, opening to the eaſt, interſected with many ſmall iſlands. On the top of a mountain, at ſome diſtance from the town, is a large white tower, called, by the Portugueſe, N ſtra Senhora de Pena, and near it a ſmall church, ſurrounded with a wall. At the foot of the mountain, are ſtill to be ſeen the melancholy remains of a place once called Villa Veja, or the Old City. S. lat. 20 36, W. long. 39 56.—*ib.*

SANTOS, a town in the captainſhip of St Vincent, in Brazil, ſeated on a river 9 miles from the ſea, which is there a mile broad, and five fathoms deep. It is defended by a rampart on the ſide next the river. It is alſo guarded by two caſtles, one on the ſouth ſide, and the other in the middle of the town, which contains 250 inhabitants. It has a pariſh church, a monaſtery, and a college. S. lat. 24 26, W. long. 42 30.—*ib.*

SAONA, or *Saone*, a ſmall iſland near the S. E. part of the iſland of St Domingo. It is about 8 leagues from E. to W. and 2 from N. to S. which becomes ſtill leſs in the narroweſt part. Its circumference is nearly 25 leagues. It lies eaſt of St Catherine Iſland; and it is not much above a league from Little Palm Tree Point, to that which advances from the north of the Saona. At each of its extremities, E. and W. is a mountain, and there is a third at a point about the middle of the ſouthern ſide. Theſe mountains at once ſhelter and water it, and temper the air. The Indians called this iſland *Adamanoy*, and had a particular cacique, who was ſovereign of the iſland, independent of thoſe of St Domingo. His ſubjects devoted themſelves to commerce with the Spaniards, to agriculture, to cultivation of grain and fruits. They furniſhed enough for the conſumption of the city of St Domingo, and for proviſioning ſeveral expeditions, going from that port. Some Caſtilians having cauſed the cacique to be eaten by a dog, this act of cruelty became the cauſe of a quarrel, and the Spaniards having exterminated the unfortunate inhabitants, formed ſettlements on their little iſland. It is ſurrounded with banks and breakers, except at the weſtern part; but there is a paſſage for ſmall barks, between its north ſide, and the main of the iſland of St Domingo. The iſland and its port are a ſhelter for the mariners ſailing in this part, who here find water, wood, and wild cattle, all which are in abundance. It is impoſſible to have an idea of the vaſt quantities of birds, and particularly of wood pigeons, that are ſeen here. The eaſtern point of the iſland lies in lat. 18 9 N. and long 71 11 W. of Paris.—*ib.*

SAP, or SAPP, in building, as to ſap a wall, &c. is to dig out the ground from beneath it, ſo as to bring it down all at once for want of ſupport.

SAPA, *St Michael de*, a village in the valley of Arica, in the province of Charcos, in Peru. It is a ſmall place, but famous for the quantity of Guinea pepper

pepper produced in its vicinity. It will not thrive in mountainous parts, but is cultivated in the vallies. The inhabitants of this village ſell annually no leſs than 80,000 crowns worth of it. S. lat. 17 30, W. long. 78 10.—*Morſe.*

SAPELO, a village of Georgia, in Liberty county, oppoſite to the ſound and iſland of that name, and about 6 miles ſouth of Sunbury.—*ib.*

SAPHAN, in zoology. See Mus, *Encycl.* p. 467.

SAPHIES, a kind of charms, conſiſting of ſome ſcrap of writing, which the credulous Negroes believe capable of protecting them from all evil. The writers of ſaphies are generally Moors, who ſell ſcraps of the Koran for this purpoſe to a people who believe not either in the Koran or the prophet. Accordingly, any piece of writing may be ſold as a ſaphie; and Mr Park found the Negroes diſpoſed to place greater confidence in the ſaphies of a Chriſtian than in thoſe of a Moor. The manner in which theſe charms are ſuppoſed to operate, will be learned from the following ſtory:

Mr Park being at Koolikorro, a conſiderable town near the Niger, and a great market of ſalt, his landlord, hearing that he was a Chriſtian, immediately thought of procuring a ſaphie. For this purpoſe he brought out his *walha*, or writing board, aſſuring me (ſays our author) that he would dreſs me a ſupper of rice if I would write him a ſaphie to protect him from wicked men. The propoſal was of too great conſequence to me to be refuſed; I therefore wrote the board full, from top to bottom, on both ſides; and my landlord, to be certain of having the whole force of the charm, waſhed the writing from the board into a calabaſh with a little water; and having ſaid a few prayers over it, drank this powerful draught; after which, leſt a ſingle word ſhould eſcape, he licked the board until it was quite dry. A ſaphie writer was a man of too great conſequence to be long concealed: the important information was carried to the Dooty, who ſent his ſon with half a ſheet of writing-paper, deſiring me to write him a *naphula ſaphie* (a charm to procure wealth). He brought me, as a preſent, ſome meal and milk; and when I had finiſhed the ſaphie, and read it to him with an audible voice, he ſeemed highly ſatisfied with his bargain, and promiſed to bring me in the morning ſome milk for my breakfaſt. Our author contrived to turn this abſurd ſuperſtition to his own advantage, by writing ſaphies for his ſubſiſtence when his money was exhauſted.

SAPONIES, Indians who inhabit on a north branch of Suſquehannah river. Warriors 30.—*Morſe.*

SARACOLETS, a Negro nation occupying the lands ſituated between the rivers of Senegal and Gambia. They are a laborious people, cultivate their lands with care, are plentifully ſupplied with all the neceſſaries of life, and inhabit handſome and well built villages; their houſes, of a circular form, are for the moſt part terraced; the others are covered with reeds as at Senegal; they are incloſed with a mud wall a foot thick, and the villages are ſurrounded with one of ſtone and earth of double that ſolidity. There are ſeveral gates, which are guarded at night for fear of a ſurpriſe. This nation is remarkably brave, and it is very uncommon to find a Saracolet ſlave. They always defend themſelves with advantage againſt their aſſailants. Such Saracolets as are expoſed to ſale may be ſafely purchaſed, for (excepting when they are at war with the Poules) none are to be met with but ſuch as have been condemned by the laws for ſome miſdemeanour; in ſuch caſe, theſe wretches could not eſcape ſlavery even by taking refuge in their own country; for they would be reſtored to their maſters, or would be put to death, if the convoy ſhould have failed. The religious principles of this people are nearly allied to Mahometaniſm, and ſtill more to natural religion. They acknowledge one God, and believe that thoſe who ſteal, or are guilty of any crime, are eternally puniſhed. They admit a plurality of wives, and believe their ſouls to be immortal like their own. They think lightly of adultery; for as they allow themſelves ſeveral wives, they are not ſo unjuſt as to puniſh women who diſtribute their favours among ſeveral gallants; a mutual exchange is then permitted, one woman may be bartered for another, unleſs ſhe be free, or a native of the country. In this laſt caſe, the French cuſtom prevails; it is winked at, although the laws are particularly ſevere againſt the violation of the moſt ſacred of all property. This nation lies near that of the Poules. (See that article, *Suppl.*) Its extent up the country is unknown; all that we know is, that it is governed by four powerful princes, all bearing the name of Fouquet. The leaſt conſiderable, according to the teſtimony of the Saracolets, is that of Tuago, who can aſſemble thirty thouſand horſe, and whoſe ſubjects occupy a territory two hundred leagues in extent, as well on the Senegal as on the track that reaches beyond the Felou; a rock which, according to the ſame report, forms cataracts, from whence proceed the Senegal and the river Gambia, equally conſiderable.

SARAMACHA, a river in the Dutch province of Surrinam.—*Morſe.*

SARANAC, a river of New-York, which paſſes through Plattſburg, and empties into Lake Champlain from the weſt. It has been explored nearly 30 miles, and there found equal in ſize to the mouth. It abounds with ſalmon, baſs, pike, pickerel, trout, &c. At the mouth of the river, ſalmon are found in ſuch plenty, that it is uſual to take 400 or 500 a day, with ſpears, and ſmall ſcoop-nets. They are caught from May till November.—*ib.*

SARATOGA, a county of the State of New-York, bounded E. and N. by Hudſon's river, which ſeparates it from Renſſelaer and Waſhington counties, and ſouth by Mohawk river. It has been eſtabliſhed ſince 1790, and is divided into 8 townſhips, viz. Greenfield, Ballſtown, Charlton, Half Moon, Milton, Saratoga, Galway, and Stillwater. In 1796, 3,270 of the inhabitants were qualified electors.—*ib.*

SARATOGA, or *Saraghtoga*, a townſhip of New-York, ſituated in Saratoga county, on the W. ſide of Hudſon's river, 36 miles N. of Albany. It contains few houſes in a compact ſtate. In 1790, when it belonged to Albany county, it contained 3,071 inhabitants; and there were here in 1796, 542 qualified electors. It will ever be diſtinguiſhed in hiſtory, for being the place at which Gen. Burgoyne was obliged to ſurrender his army, in 1777. This town is alſo famous for its medicinal waters, called the *Saratoga Springs*. They are 10 miles from Ballſtown, in a ſhallow vale or marſh, in ſeveral reſpects reſembling that of Ballſtown. Theſe waters appear to have received as ſtrong, if not ſtronger, impregnation of the ſame kind of ingredients that enter thoſe of Ballſtown, and may be a ſtream of the ſame fountain running through the ſame kind of calcareous earth. One of theſe ſprings is covered over by a natural cretaceous, or rather calcareous pyramid, about five or ſix feet high. This hollow pyramid, or cone, has a hole in the top about ſix inches over. If we look into this hole we ſee the mineral water boiling vehemently like a pot over the fire; the water is nevertheleſs intenſely cold, and is ſaid to be, in every reſpect, ſmarter than that at Ballſtown. The calcareous matter extends for ſeveral rods from the baſis of this pyramid. There are ſeveral idle ſtories related of this ſpring; one is, that it overflows at certain ſtages of the moon. This is not true. As this is found to be falſe, they tell you it overflows once a year; but this has as little foundation in truth as the other. People who live at theſe ſprings think they muſt relate ſomething marvellous by way of enhancing the value of the waters, and reconciling you to the great expenſe attending theſe viſits.—*ib.*

SARECTO, the chief town of Duplin county, N. Carolina, ſituated on the N. E. branch of Cape Fear river, which affords water for rafts to the town. It contains a court-houſe, gaol, and about 20 houſes. It is 130 miles above Wilmington, to the north.—*ib.*

SARENA, on the coaſt of Chili, in S. America, on the South Pacific Ocean. S. lat. 29 40, W. long. 71 15.—*ib.*

SARINHAYM, a river on the ſouth-eaſt coaſt of Brazil; and oppoſite to the iſland of Alexo, which is weſt of Cape St Auguſtine.—*ib.*

SARMIENTO *Iſlands, Pedro de,* in the South Pacific Ocean, are thought to be the ſame as the *Duke of York's Iſlands,* northward of the weſt end of the Straits of Magellan. They lie in about lat. 50 ſouth, and are about 80 in number.—*ib.*

SARONILLA, or *Serranella,* ſhoals off the iſland of Jamaica, 25 leagues weſt of Pedro Shoals, and 37 weſt of Portland Point. The middle of them lie in lat. 16 10 N. and long. 80 45 W.—*ib.*

SAROS, in chronology, a period of 223 lunar months. The etymology of the word is ſaid to be Chaldean, ſignifying reſtitution, or return of eclipſes; that is, conjunctions of the ſun and moon in nearly the ſame place of the ecliptic. The Saros was a cycle like to that of Meto.

SARRASIN, or SARRAZIN, in fortification, a kind of port-cullis, otherwiſe called a herſe, which is hung with ropes over the gate of a town or fortreſs, to be let fall in caſe of a ſurpriſe.

SASKACHAWAN, or *Siſkaſhawen,* a river of N. America, which runs eaſtward, and has communication, by ſhort portages, with Nelſon's river, which empties into Hudſon's Bay.—*Morſe.*

SASSAFRAS, a ſmall navigable river of Maryland, which riſes in Delaware State, and runs weſtward into Cheſapeak Bay. It ſeparates Kent county from that of Cecil, and has the towns of Fredericktown, Georgetown, and Saſſafras on its banks. The latter is 5 miles E. by N. of Georgetown, and about 3 ſouth of Warwick.—*ib.*

SATILLA, *Great* and *Little,* two rivers of Georgia, which fall into the ocean, in Camden county, between the Alatamaha and St Mary's rivers.—*ib.*

SAUCON, *Upper* and *Lower,* townſhips in Northampton county, Pennſylvania.—*ib.*

SAUKIES, or *Saikies,* an Indian tribe reſiding at Bay Puan, in the N. W. Territory, near the Minomanies.—*ib.*

SAUNDERS *Iſland,* in the S. Atlantic ocean, one of the ſmall iſlands which ſurround the two chief of the Falkland Iſles.—*ib.*

SAUNDERS *Iſland,* in South Georgia, and in the S. Atlantic ocean, is about 13 leagues north of Cape Montague. S. lat. 57 59, W. long. 26 54.—*ib.*

SAUNDERS *Iſland,* or *Sir Charles Saunders' Iſland,* called by the natives *Tapoamanao,* in the S. Pacific Ocean, is reckoned one of the Society Iſlands. When Port Royal Bay at Otaheite, is S. 70 45 E. diſtant 61 miles, this iſland bears S. S. W. S. lat. 17 28, W. long. 151 4. It is about two leagues long.—*ib.*

SAURA *Lower Town* is ſituated on the ſouth ſide of Dan river, in N. Carolina. It was formerly the chief town of the Saura Indians.—*ib.*

SAURA *Upper Town,* in the ſame State, an ancient and well peopled town of the Saura Indians; ſituated in Stokes county on the ſouth ſide of Dan river.—*ib.*

SAUTEURS, *le Morne des,* or *Leaper's Hill,* a precipice near the river Sauteurs, at the north end of the iſland of Grenada. After the year 1650 the French gradually exterminated the Charaibes; near this place they butchered 40 of them on the ſpot; and 40 others, who had eſcaped the ſword, threw themſelves headlong into the ſea from this precipice, and miſerably periſhed. A beautiful young girl, of 12 or 13 years of age, who was taken alive, became the object of diſpute between two of the French officers, each claiming her as a lawful prize, when a third of thoſe white ſavages put an end to the conteſt, by ſhooting the girl through the head.—*ib.*

SAVAGE, a ſmall river of Maryland, which runs ſouthward through Alleghany county, and empties into the Patowmac weſt of George's Creek. Its mouth is 21 miles ſouth-weſt of Fort Cumberland, and 48 ſouth-eaſt of the mouth of Cheat river. Boats carrying 10 tons can reach Alexandria in 4 or 5 days, but will take double the time to return.—*ib.*

SAVAGE *Creek,* a ſmall bay on the north-weſt coaſt of Newfoundland, near the weſtern entrance of the bay of Mouco, and 20 leagues N. E. of Cape Ferrol.—*ib.*

SAVAGE *Iſland,* in the S. Pacific Ocean, is about 33 miles in circuit, and is inhabited by ſavages. It is overrun with buſhes, and has no port. S. lat. 19 2, W. long. 169 30.—*ib.*

SAVAGE *Iſland, Great,* in Hudſon's Straits. N. lat. 62 25, W. long. 70. High water, at full and change, at 10 o'clock.—*ib.*

SAVAGE *Iſland, Lower,* in the ſame ſtraits, has high water at full and change at 9 o'clock. N. lat. 61 48, W. long. 66 20.—*ib.*

SAVAGE *Point, Upper,* on the north ſide of Hudſon's Straits, ſouth-eaſt of Cape Charles, and the north-weſt point of an inlet up into the land, ſo as to form the iſland of Good Fortune.—*ib.*

SAVAGE *Sound,* a paſſage in the north part of the Welcome Sea, in Hudſon's Bay, into Repulſe Bay. It is but little known.—*ib.*

SAVANNAH, a bay at the eaſt end of the iſland of Antigua, near the ſouth-eaſt part of Green Iſland, on the ſouth ſide, a little weſtward of Indian Creek. —*ib.*

Savannah *Channel*, towards the ſouth-eaſt point of the ſouth ſide of the iſland of Jamaica; a ſhort way weſt of Port Morant Harbour; between them is Fiſherman's river.—*ib.*

Savannah, a port of entry and poſt-town of Georgia, and formerly the metropolis of the State; ſituated in Chatham county, on the ſouth ſide of the river Savannah, on a high ſandy bluff, 17 miles from the ocean. The town is regularly built, in the form of a parallelogram, and, including its ſuburbs, contained, in 1787, about 2,300 inhabitants, of whom about 80 or 90 are Jews. More than two-thirds of this town was conſumed by fire in the fall of 1796. The exports for one year, ending the 30th of September 1794, amounted to the value of 263,830 dollars. This city was bravely defended by the Britiſh general Prevoſt, againſt a ſuperior force, headed by Count d'Eſtaing and Gen. Lincoln. The allies made a fatal and unſucceſsful attack on the 18th of October, 1779, when they were obliged to retreat, after having from 1000 to 1200 men killed and wounded. It is 129 miles N. by E. of St Mary's, 132 ſouth-weſt by ſouth from Auguſta, and 925 in a like direction from Philadelphia. N. lat. 32 3, W. long. 81 24.—*ib.*

Savannah *River* divides the State of Georgia from that of S. Carolina, and purſues a courſe nearly from north-weſt to ſouth-eaſt. It is formed chiefly of two branches, the Tugelo and Keowee, which ſpring from the mountains, and unite under the name of Savannah, 15 miles north-weſt of the northern boundary of Wilkes county. It is navigable for large veſſels 17 miles up to Savannah, and for boats of 100 feet keel to Auguſta. After riſing a fall juſt above this place, it is paſſable for boats to the mouth of Tugelo river. After it takes the name of Savannah, at the confluence of the Tugelo and Keowee, it receives a number of tributary ſtreams, from the Georgia ſide, the principal of which is Broad river. Tybee Bar, at the entrance of Savannah river, has 16 feet water at half tide. Tybee light-houſe lies in lat. 32 N. and long. 81 10 W. and from thence to Port Royal is 6 leagues N. E. ¼ E. The flood in this river was ſo great in Feb. 1796, that the water roſe 35 feet above its ordinary level. In Auguſta, the ſtreets were plied by boats which could carry 15 tons. —*ib.*

Savannah *River, Little*, falls into the gulf of Mexico, north-weſt of St Joſeph's Bay.—*ib.*

Savannah *la Mar*, at the eaſt end of the iſland of St Domingo, is a ſettlement on the ſouth ſide of the bay of Samana, oppoſite the city of Samana on the north ſide, and lies between the Bay of Pearls, (which is an excellent port) and the Point of Icaque. It has its governor and rector, and is ſituated at the end of a plain, which is more than 10 leagues from eaſt to weſt, and 4 wide from north to ſouth. The city of Samana and this town were both begun in 1756, and together do not contain more than 500 ſouls. The anchorage here is only fit for ſmall veſſels. Shallows and breakers render the navigation very dangerous between this and the point of Icaque, 4½ leagues diſtant.—*ib.*

Savannah *la Mar*, on the ſouth ſide of the Iſland of Jamaica, in Cornwallis county, has good anchorage for large veſſels. It was almoſt entirely deſtroyed by a dreadful hurricane and inundation of the ſea, in 1780. It is now partly rebuilt, and may contain from 60 to 70 houſes. It bears from Bluefield's Point W. by N. ½ N. about 3 leagues. N. lat. 18 12, W. long. 78 6.—*ib.*

SAVERIO, a cape or point on the N. coaſt of S. America, on that part called the Spaniſh Main. Between it and the Iſland Barbarata is the opening to the iſland of Bonaire.—*ib.*

SAVILLA, *St*, a ſmall town of Georgia, 64 miles ſouth of Savannah, and 65 north of St Mary's.—*ib.*

SAVILLE (Sir Henry), a very learned Engliſhman, the ſecond ſon of Henry Saville, Eſq; was born at Bradley, near Halifax, in Yorkſhire, November the 30th, 1549. He was entered of Merton College, Oxford, in 1561, where he took the degrees in arts, and was choſen fellow. When he proceeded maſter of arts in 1570, he read for that degree on the Almageſt of Ptolemy, which procured him the reputation of a man eminently ſkilled in mathematics and the Greek language; in the former of which he voluntarily read a public lecture in the univerſity for ſome time.

In 1578 he travelled into France and other countries; where, diligently improving himſelf in all uſeful learning, in languages, and the knowledge of the world, he became a moſt accompliſhed gentleman. At his return, he was made tutor in the Greek tongue to Queen Elizabeth, who had a great eſteem and liking for him.

In 1585 he was made warden of Merton College, which he governed ſix-and-thirty years with great honour, and improved it by all the means in his power.—In 1596 he was choſen provoſt of Eton College; which he filled with many learned men.—James the Firſt, upon his acceſſion to the crown of England, expreſſed a great regard for him, and would have preferred him either in church or ſtate; but Saville declined it, and only accepted the ceremony of knighthood from the king at Windſor in 1604. His only ſon Henry dying about that time, he thenceforth devoted his fortune to the promoting of learning. Among other things, in 1619, he founded, in the univerſity of Oxford, two lectures, or profeſſorſhips, one in geometry, the other in aſtronomy; which he endowed with a ſalary of 160l. a year each, beſides a legacy of 600l. to purchaſe more lands for the ſame uſe. He alſo furniſhed a library with mathematical books, near the mathematical ſchool, for the uſe of his profeſſors; and gave 100l. to the mathematical cheſt of his own appointing; adding afterwards a legacy of 40l. a year to the ſame cheſt, to the univerſity, and to his profeſſors jointly. He likewiſe gave 120l. towards the new building of the ſchools, beſide ſeveral rare manuſcripts and printed books to the Bodleian library; and a good quantity of Greek types to the printing-preſs at Oxford.

After a life thus ſpent in the encouragement and promotion of ſcience and literature in general, he died at Eton College the 19th of February 1622, in the 73d year of his age, and was buried in the chapel there. On this occaſion, the univerſity of Oxford paid him the greateſt honours, by having a public ſpeech and verſes made in his praiſe, which were publiſhed ſoon after in 4to, under the title of *Ultima Linea Savilii*.

As to the character of Saville, the higheſt encomiums are beſtowed on him by all the learned of his time; by Caſaubon, Mercerus, Meibomius, Joſeph Scaliger, and eſpecially the learned Biſhop Montague; who, in his *Diatribæ* upon Selden's Hiſtory of Tythes, ſtyles him, "that magazine of learning, whoſe memory ſhall be honourable amongſt not only the learned, but the righteous for ever."

Several noble inſtances of his munificence to the republic of letters have already been mentioned; in the account of his publications many more, and even greater will appear. Theſe are,

1. Four Books of the Hiſtories of Cornelius Tacitus, and the Life of Agricola; with Notes upon them, in folio, dedicated to Queen Elizabeth, 1581.—2. A View of certain Military Matters, or Commentaries concerning Roman Warfare, 1598.—3. *Rerum Anglicarum Scriptores poſt Bedam*, &c. 1596 This is a collection of the beſt writers of our Engliſh hiſtory; to which he added chronological tables at the end, from Julius Cæſar to William the Conqueror.—4. The Works of St Chryſoſtom, in Greek, in 8 vols folio, 1613. This is a very fine edition, and compoſed with great coſt and labour. In the preface he ſays, "that having himſelf viſited, about 12 years before, all the public and private libraries in Britain, and copied out thence whatever he thought uſeful to this deſign, he then ſent ſome learned men into France, Germany, Italy, and the Eaſt, to tranſcribe ſuch parts as he had not already, and to collate the others with the beſt manuſcripts." At the ſame time, he makes his acknowledgments to ſeveral eminent men for their aſſiſtance; as Thuanus, Velſerus, Schottus, Caſaubon, Ducæus, Gruter, Hoeſchelius, &c. In the 8th volume are inſerted Sir Henry Saville's own notes, with thoſe of other learned men. The whole charge of this edition, including the ſeveral ſums paid to learned men, at home and abroad, employed in finding out, tranſcribing, and collating the beſt manuſcripts, is ſaid to have amounted to no leſs than 8000l. Several editions of this work were afterwards publiſhed at Paris.—5. In 1618 he publiſhed a Latin work, written by Thomas Bradwardin, archbiſhop of Canterbury, againſt Pelagius, entitled, *De Cauſa Dei contra Pelagium, et de virtute cauſarum*; to which he prefixed the life of Bradwardin.—6. In 1621 he publiſhed a collection of his own Mathematical Lectures on Euclid's Elements, in 4to.—7. *Oratio coram Elizabetha Regina Oxoniæ habita*, anno 1592. Printed at Oxford in 1658, in 4to.—8. He tranſlated into Latin King James's Apology for the Oath of Allegiance. He alſo left ſeveral manuſcripts behind him, written by order of King James; all which are in the Bodleian library. He wrote notes likewiſe upon the margin of many books in his library, particularly Euſebius's Eccleſiaſtical Hiſtory; which were afterwards uſed by Valeſius, in his edition of that work in 1659.—Four of his letters to Camden are publiſhed by Smith, among Camden's Letters, 1691, 4to.

SAUSSURE (Horace Benedict de) was born at Geneva in 1740. His father, an intelligent farmer, to whom we are indebted for ſome memoirs relating to rural economy, reſided at Conches, a place ſituated on the banks of the Arve, at the diſtance of half a league from Geneva; and this country life, added to an active education, expanded no doubt in young De Sauſſure that phyſical ſtrength ſo neceſſary to the naturaliſt who devotes himſelf to travel. He repaired daily to town to enjoy the advantage of public inſtruction; and as he lived at the bottom of Saleve, a mountain which he has ſince rendered celebrated, he amuſed himſelf frequently with aſcending its ſteep and rugged ſides. Being thus ſurrounded by the phenomena of nature, and at the ſame time aided by ſtudy, he conceived a taſte for natural hiſtory, and avoided the error both of the learned, who form theories without having been out of their cloſets, and of thoſe farmers who, living too near to Nature, are incapable of admiring her beauties.

His earlieſt paſſion was botany: a variegated ſoil, abundant in plants of different kinds, invites the inhabitant of the banks of the Leman to cultivate that agreeable ſcience. This taſte produced an intimacy between De Sauſſure and the great Haller. He paid him a viſit in the year 1764, during his retreat to Bex; and he relates in his travels how much he admired that aſtoniſhing man, who excelled in every part of the natural ſciences. De Sauſſure was induced alſo to ſtudy the vegetable kingdom, by his connection with Ch. Bonnet, who had married his aunt, and who ſoon ſet a juſt value on the riſing talents of his nephew. Bonnet (See his life in this *Suppl.*) was then employed on the leaves of plants. De Sauſſure ſtudied theſe organs of vegetables alſo, and he publiſhed the reſult of his reſearches, under the title of Obſervations on the Bark of Leaves. This ſmall work, which appeared ſoon after the year 1760, contains new obſervations on the epidermis of leaves, and in particular on the miliary glands by which they are covered.

About that period, the place of profeſſor of philoſophy falling vacant, it was conferred upon De Sauſſure, who was then only twenty-one years of age. Experience proves, that if premature rewards extinguiſh the zeal of thoſe who labour merely for themſelves, they, on the contrary, ſtrengthen it in thoſe who labour only for truth. At that time the two profeſſors of philoſophy at Geneva taught phyſics and logic alternately. De Sauſſure diſcharged this double taſk with equal ſucceſs. He gave to his courſe of logic a practical, and, as one may ſay, experimental turn; and his method of teaching, which began by ſtudying the ſenſes to arrive at the general laws of the underſtanding, announced already an able obſerver of nature.

Phyſics, however, were the part for which he had the greateſt taſte, and which conducted him to the ſtudy of chemiſtry and mineralogy. He then began his travels through the mountains; not now to examine their vegetable productions, but to ſtudy the mountains themſelves, either in the ſtones of which they are compoſed, or the diſpoſition of their maſſes. Geology, a ſcience which was then ſcarcely in exiſtence, added charms to his numerous excurſions through the Alps; and it was then that the talents of the great philoſopher were really diſplayed. During the firſt fifteen or twenty years of his profeſſorſhip, he employed himſelf by turns in diſcharging the duties of his office, and in traverſing the different mountains in the neighbourhood of Geneva. He even extended his excurſions on one ſide as far as the banks of the Rhine, and on the other to Piedmont. At the ſame time he undertook a journey to Auvergne to examine there the extinguiſhed volcanoes, and another to Paris, England, and Holland. After that he viſited Italy, and even Sicily. Theſe

were

were not mere journeys for the purpoſe of reaching any particular place ; he undertook them only with a view of ſtudying nature ; never travelled but ſurrounded by every inſtrument that could be of uſe to him, and never ſet out until he had drawn up a plan of the experiments and obſervations he intended to make. He often ſays in his works that he had found this method exceedingly uſeful.

In the year 1779 he publiſhed the firſt volume of his Travels through the Alps ; which contains a minute deſcription of the environs of Geneva, and an excurſion as far as Chamouni, a village at the bottom of Mont Blanc. Philoſophers will read there with pleaſure the deſcription of his Magnetometer. The more he examined mountains, the more was he ſenſible of the importance of mineralogy. To ſtudy it with advantage, he learned the German language ; and it may be ſeen, in the laſt volumes of his Travels, how much new mineralogical knowledge he had acquired.

Amidſt his numerous excurſions through the Alps, and at the time of the political troubles of Geneva in 1782, he found means to make his beautiful experiments on hygrometry, which he publiſhed in 1783, under the title of *Eſſays on Hygrometry*. This work, the beſt that ever came from his pen, eſtabliſhed fully his reputation as a philoſopher. We are indebted to him alſo for the invention of a new hygrometer. Deluc had already invented his whalebone hygrometer ; and on that account there aroſe between him and De Sauſſure a ſort of conteſt, which degenerated into a pretty violent diſpute.

In the year 1786 De Sauſſure reſigned the profeſſor's chair, which he had filled for about twenty-five years, to his pupil and fellow-labourer Pictet, who diſcharged with reputation the duties of an office rendered more difficult by ſucceeding ſo eminent a philoſopher.

When De Sauſſure was invited by the ſtate to take a ſhare in the public education, he made it one of the ſubjects of his meditations, and preſented the plan of a reform in the education of Geneva ; the tendency of which was, to make young people early acquainted with the natural ſciences and mathematics. He even wiſhed that their phyſical education ſhould not be neglected, and with that view propoſed gymnaſtic exerciſes. This plan, which excited much attention in a city where every one is convinced of the importance of education, found admirers and partiſans ; but the poverty of its pecuniary reſources was an obſtacle to every important innovation. It was beſides feared that, by altering eſtabliſhed forms, they might loſe the ſubſtance, and that things might be changed for the worſe. The Geneveſe were attached to their old ſyſtem of education ; and they had reaſon to be ſo, becauſe it had not only proved the means of diffuſing knowledge generally amongſt them, but had called forth the talents of ſeveral eminent mathematicians (A) and philoſophers (B).

But De Sauſſure's attention was not confined to public education alone. He ſuperintended himſelf the education of his two ſons and a daughter, who have ſhewn themſelves worthy of ſuch an inſtructor. His daughter to the charms of her ſex unites an extenſive knowledge of the natural ſciences ; and his eldeſt ſon has already made himſelf known by his phyſical and chemical labours.

The ſecond volume of his Travels was publiſhed in 1786. It contains a deſcription of the Alps around Mont Blanc, which the author conſiders as a mineralogiſt, a geologiſt, and a philoſopher. He gives alſo ſome intereſting experiments on electricity, and a deſcription of his electrometer, one of the moſt perfect that we have. We are indebted to him alſo for ſeveral inſtruments of meaſurement, ſuch as his *cyanometer*, deſtined to meaſure the degree of the blueneſs of the heavens, which varies according to the elevation of the obſerver ; his *diaphanometer* (See PHOTOMETER, in this *Suppl.*), and his *anemometer*, which, by means of a kind of balance, meaſures the force of the wind.

Some years after the publication of the ſecond volume of his Travels, De Sauſſure was admitted as a foreign aſſociate of the Academy of Sciences of Paris ; and Geneva could then boaſt of having two of its citizens in that claſs, which conſiſted only of ſeven members. De Sauſſure not only did honour to his country ; he loved and ſerved it. He was the founder of the Society of Arts, to which Geneva is indebted for the high ſtate of proſperity it has attained within the laſt thirty years. He preſided over that ſociety till the laſt moment of his life; and one of his fondeſt wiſhes was the preſervation of this uſeful eſtabliſhment.

In conſequence of M. de Sauſſure's fatiguing labours in the Council of Two Hundred, of which he was a member, and afterwards in the National Aſſembly, his health began to be deranged, and in 1794 he was almoſt deprived of the total uſe of his limbs by a ſtroke of the palſy. However painful his condition then might be, his mind ſtill preſerved its activity ; and after that accident he reviſed the two laſt volumes of his Travels, which appeared in 1796. They contain an account of his excurſions to the mountains of Piedmont and Swiſſerland, and in particular of his journey to the ſummit of Mont Blanc. Theſe volumes, inſtead of exhibiting any marks of his malady, preſent an enormous maſs of new facts and obſervations of the utmoſt importance to phyſics.

He rendered alſo an important ſervice to that ſcience by publiſhing the *Agenda*, which terminate his fourth volume, and in which that great man, ſurviving himſelf, conducts the young naturaliſt through the middle of mountains, and teaches him the method of obſerving them with advantage. Theſe *Agenda* are a proof of his genius, and of the ſtrength of mind which he retained amidſt his ſufferings. It was alſo during his illneſs that he directed the experiments made on the height of the bed of the Arve, and that he publiſhed Obſervations on the Fuſibility of Stones by the Blow-pipe, which were inſerted in the *Journal de Phyſique*.

Having gone for the ſake of his health to the baths of Plombiers, he ſtill obſerved the mountains at a diſtance, and cauſed to be brought to him ſpecimens of the ſtrata which he perceived in the ſteepeſt rocks. He had announced that he would conclude his travels with

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(A) Abauzit, Cramer, Lhuilier, J. Trembley, &c.

(B) Jalabert, A. Trembley, Bonnet, Leſage, Deluc, Senebier, Prévoſt, Pictet, and De Sauſſure himſelf.

ſome ideas on the primitive ſtate of the earth; but the more he acquired new facts, and the more he meditated on the ſubject, the more uncertain did his opinions become in regard to thoſe grand revolutions which preceded the preſent epoch. In general he was a Neptunian; that is to ſay, aſcribed all the revolutions of our globe to water. He admitted the poſſibility of the mountains having been thrown up by elaſtic fluids diſengaged from the cavities of the earth.

Though the ſtate of his health began gradually to become worſe, he ſtill entertained hopes of recovery; and the French government having appointed him profeſſor of philoſophy at the Special School of Paris, he did not deſpair of being one day able to fill that office: but his ſtrength was exhauſted, a general langour ſucceeded the vigour he had always enjoyed, his ſlow and embarraſſed pronunciation no longer correſponded with the vivacity of his mind, and formed a melancholy contraſt with the pleaſantneſs by which he had been formerly diſtinguiſhed. It was a painful ſpectacle to ſee this great man reduced thus to imbecility at an age when meditation is beneficial, and when he might have enjoyed the fruits of his reputation and labours.

In vain did he try, for the re-eſtabliſhment of his health, all the remedies which medicine, enlightened by the phyſical ſciences, could afford—all aſſiſtance was uſeleſs. The vital power quitted him with ſlow and painful ſteps. Towards the beginning of autumn 1798 his decay became more viſible, his mind loſt all its activity, and on the 22d of March 1799 he terminated his brilliant career, at the age of 59, lamented by a family to whom he was dear—by a country to which he had done honour—and by Europe, the knowledge of which he had extended.

SAVOY, a new townſhip, in Berkſhire county, Maſſachuſetts, incorporated in 1797.—*Morse.*

SAWYER's *Ferry*, a ſmall poſt-town of N. Carolina, 14 miles from Nixonton, 10 from Indiantown, and 482 from Philadelphia.—*ib.*

SAWYER's, or *Aſſeradores, Iſland*, on the weſt coaſt of Mexico; is of ſmall ſize, and has on its ſouth-eaſt ſide a ſmall creek of its name, which boats can only enter at high water. It is 12 miles from the Bar of Realejo.—*ib.*

SAXAPAHAW, the upper part of the north-weſt branch of Cape Fear river, in N. Carolina. It is formed by Aramanche and Deep rivers, and it is ſaid may be made navigable for boats about 50 miles.—*ib.*

SAXEGOTHA, a village or ſettlement in S. Carolina, on the ſouthern bank of Congaree river; about 48 miles north-weſterly of Auguſta, in Georgia.—*ib.*

SAXTON's *River*, in Vermont, empties into the Connecticut at Weſtminſter.—*ib.*

SAYBROOK, a poſt-town of Connecticut, Middleſex county, on the weſt ſide of Connecticut river, acroſs which is a ferry, on the road leading to New-London. It is 36 miles eaſt of New-Haven, 18 weſt of New-London, and 219 north-eaſt of Philadelphia. This is the moſt ancient town in the State, having been ſettled by Mr Fenwick in 1634, who gave it its preſent name in honour of Lord Say and Seal and Lord Brook.—*ib.*

SCALE, in architecture and geography, a line divided into equal parts, placed at the bottom of a map or draught to ſerve as a common meaſure to all the parts of the building, or all the diſtances and places of the map.

SCALES, in mathematics, ſee SCALES (*Encycl.*), and likewiſe *LOGARITHMIC Lines*, under which title are mentioned ſome improvements by Mr Nicholſon on Gunter's ſcale. Theſe improvements are valuable; and the reader will find a fuller account of them in the firſt volume of the author's *Philoſophical Journal*.

SCANTLING, a meaſure, ſize, or ſtandard, by which the dimenſions, &c. of things are to be determined. The term is particularly applied to the dimenſions of any piece of timber, with regard to its breadth and thickneſs.

SCAPEMENT, in clock-work, a general term for the manner of communicating the impulſe of the wheels to the pendulum. The ordinary ſcapements conſiſt of the ſwing-wheel and pallets only; but modern improvements have added other levers or detents, chiefly for the purpoſes of diminiſhing friction, or for detaching the pendulum from the preſſure of the wheels during part of the time of its vibration. See *WATCH Making*, in this *Suppl.*

SCARBOROUGH, a townſhip of the Diſtrict of Maine, ſituated in Cumberland county, on the ſea coaſt, between Pepperelborough and Cape Elizabeth. It was incorporated in 1658; contains 2,235 inhabitants; and lies 113 miles northerly of Boſton.—*Morse.*

SCARBOROUGH *Cove*, in the harbour of Chebucto, on the ſouthern coaſt of Nova-Scotia, is on the middle of the weſt ſide of Cornwallis Iſland. It is 5 or 6 furlongs broad, and nearly the ſame in depth.—*ib.*

SCARBOROUGH, a town and fort in the iſland of Tobago, in the W. Indies.—*ib.*

SCARFING, a term in carpentry; by which is meant the joining of two beams of wood together to increaſe the length: the beams in the joint are indented into one another, as in figures 19, 24, and 25, Plate X. *Supplement.*

SCARLET, a beautiful bright red colour given to cloth, either by a preparation of kermes (See that article in *Suppl.*), or more completely by the American cochineal. Profeſſor Beckmann, in the ſecond volume of his Hiſtory of Inventions, ſeems to have eſtabliſhed the following concluſions:

1ſt, Scarlet, or the kermes-dye, was known in the Eaſt in the earlieſt ages, before Moſes, and was a diſcovery of the Phœnicians in Paleſtine, but certainly not of the ſmall wandering Hebrew tribes. *2d*, *Tola* was the ancient Phœnician name uſed by the Hebrews, and even by the Syrians; for it is employed by the Syrian tranſlator, Iſaiah, chap. 1. ver. 18. Among the Jews, after their captivity, the Aramæan word *zehori* was more common. *3d*, This dye was known alſo to the Egyptians in the time of Moſes; for the Iſraelites muſt have carried it along with them from Egypt. *4th*, The Arabs received the name kermes, with the dye, from Armenia and Perſia, where it was indigenous, and had been long known; and that name baniſhed the old name in the Eaſt, as the name ſcarlet has in the Weſt. For the firſt part of this aſſertion we muſt believe the Arabs. *5th*, Kermes were perhaps not known in Arabia; at leaſt they were not indigenous, as the Arabs appear to have had no name for them. *6th*, Kermes ſignifies always *red dye*; and when pronounced ſhort, it becomes *deep red*.

Concerning the origin of the name ſcarlet, which was in uſe ſo early as the 11th century, our author has many conjectures, which we need not tranſcribe, as he ſeems

ſeems not quite ſatisfied with any of them himſelf. The following reflections upon the comparative excellence of the ancient and modern ſcarlet, together with the progreſs of the art of dying that colour, are worthy of notice :

“Of the preparation and goodneſs of the ancient ſcarlet we certainly know nothing : but as we find in many old pieces of tapeſtry of the 11th century, and perhaps earlier, a red which has continued remarkably beautiful even to the preſent time, it cannot at any rate be denied, that our anceſtors extolled their ſcarlet not without reaſon. We can, however, venture to aſſert, that the ſcarlet prepared at preſent is far ſuperior, owing principally to the effects of a ſolution of tin. —This invention may be reckoned amongſt the moſt important improvements of the art of dyeing, and deſerves a particular relation.

“The tincture of cochineal alone yields a purple colour, not very pleaſant, which may be heightened to the moſt beautiful ſcarlet by a ſolution of tin in aqua-regia (nitro muriatic acid). This diſcovery was made as follows: Cornelius Drebbel, who was born at Alkmaar, and died at London in 1634, having placed in his window an extract of cochineal, made with boiling water, for the purpoſe of filling a thermometer, ſome aqua-regia dropped into it from a phial, broken by accident, which ſtood above it, and converted the purple dye into a moſt beautiful dark red. After ſome conjectures and experiments, he diſcovered that the tin by which the window-frame was divided into ſquares had been diſſolved by the aqua regia, and was the cauſe of this change. He communicated his obſervations to Kuffelar, that excellent dyer at Leyden, who was afterwards his ſon-in-law. The latter brought the diſcovery to perfection, and employed it ſome years alone in his dye houſe, which gave riſe to the name of Kuffelar's colour. In the courſe of time the ſecret became known to an inhabitant of Menin, called Gulich, and alſo to another perſon of the name of Van der Vecht, who taught it to the brothers Gobelins in France. Giles Gobelin, a dyer at Paris, in the time of Francis I. had found out an improvement of the then uſual ſcarlet dye ; and as he had remarked that the water of the rivulet Bievre, in the ſuburbs St Marceau, was excellent for his art, he erected on it a large dye houſe ; which, out of ridicule, was called *Folie Gobelins*, Gobelin's Folly. About this period, a Flemiſh painter, whom ſome name Peter Koek, and others Kloek, and who had travelled a long time in the Eaſt, eſtabliſhed, and continued to his death in 1650, a manufactory for dyeing ſcarlet cloth by an improved method. Through the means of Colbert, one of the Gobelins learned the proceſs uſed for preparing the German ſcarlet dye from one Gluck, whom ſome conſider as the above-mentioned Gulich, and others as Kloek; and the Pariſian ſcarlet dye ſoon roſe into ſo great repute, that the populace imagined that Gobelin had acquired his art from the devil. It is well known that Louis XIV. by the advice of Colbert, purchaſed Gobelin's building from his ſucceſſors in the year 1667, and tranſformed it into a palace, to which he gave the name of *Hôtel royal des Gobelins*, and which he aſſigned for the uſe of firſt-rate artiſts, particularly painters, jewellers, weavers of tapeſtry, and others. After that time the rivulet was no longer called Bievre, but Gobelins. About the year 1643, a Fleming, named Kepler, eſtabliſhed the firſt dye-houſe for ſcarlet in England, at the village of Bow, not far from London ; and on that account the colour was called, at firſt, by the Engliſh, the *Bow dye*. In the year 1667, another Fleming, named Brewer, invited to England by King Charles II. with the promiſe of a large ſalary, brought this art there to great perfection.”

SCARSDALE, a townſhip in Weſt-Cheſter county, New-York, bounded weſterly by Bronx river, and ſoutherly by the town of Eaſt-Cheſter. It contains 281 inhabitants, of whom 33 are electors.—*Morſe*.

SCATARI, a ſmall uninhabited iſland on the eaſtern coaſt of Cape Breton Iſland. It is about 6 miles long and 2 broad. It ſerves as a ſhelter to a bay from the eaſt and ſouth which lies ſouthward of Miray Bay, called Menadou, or Panadou Bay. N. lat. 46 3, W. long. 59 35. It was formerly called Little Cape Breton.—*ib*.

SCAUYACE, a river of New-York, which iſſues from the north-eaſt corner of Seneca Lake, and ſeparating the townſhip of Romulus from that of Junius, on the north, empties into Cayuga Lake.—*ib*.

SCHACTEKOKE, or *Scaghtikoke*, a townſhip of New-York, in Renſſelaer county, lies north of the townſhip of Renſſelaerwick, on Hudſon's river. In 1796, 275 of the inhabitants were electors.—*ib*.

SCHACADERO, a ſmall village on the Iſthmus of Darien ; on the eaſt ſide of the mouth of the river of Santa Maria, on a riſing ground, open to the gulph of St Michael. It has a fine rivulet of freſh water, and ſerves as a place of refreſhment to the miners. The freſh breezes from the ſea render it very healthy. N. lat. 7 50, W. long. 82 5.—*ib*.

SCHEME, a draught or repreſentation of any geometrical or aſtronomical figure, or problem, by lines ſenſible to the eye ; or of the celeſtial bodies in their proper places for any moment ; otherwiſe called a diagram.

SCHLOSSER *Fort* or *Sluſher*, in the ſtate of New-York, is ſituated on the eaſtern ſide of Niagara river, near the celebrated falls, on the north bank of a bend of the river, and oppoſite to the north-weſt end of Navy Iſland.—*Morſe*.

SCHODACK, or *Shudack*, a townſhip in Renſſelaer county, New-York, taken from Renſſelaerwick townſhip, and incorporated in 1795. It is 14 miles E. of Albany ; and, in 1796, there were 377 of its inhabitants electors.—*ib*.

SCHOEN-BRUNN, or the *Beautiful Spring*, one of the eaſternmoſt ſettlements of the Moravians on Muſkingum river. This ſettlement of Chriſtian Indians was eſtabliſhed in 1772, on a tract of land granted by the Delaware tribe. In 1775, the chapel, which could contain 500 people was found too ſmall for the hearers, who came in great numbers. It was ſituated about 30 miles from Gekelmuckpechuenk, 70 from Lake Erie, and 75 weſt from Friedenſtadt. It had a good ſpring ; a ſmall lake ; good planting grounds ; much game ; and every other convenience for the ſupport of an Indian colony. It appears that a large fortified Indian town formerly ſtood here ; ſome ramparts and the ruins of three Indian forts being ſtill viſible. The Delawares granted to the Chriſtian Indians all the tract from the entrance of Gekelmuckpechuenk Creek into the

the Muſkingum, to Tuſcarawi. This thriving ſettlement was deſtroyed in 1782, when the Huron Indians carried the inhabitants to Sanduſky; and when theſe peaceable Indians were permitted to return to reap their harveſt, they were cruelly butchered by the American ſettlers, while praiſing God and forgiving their enemies. Congreſs granted 4,000 acres of land here to the ſociety of the United Brethren for the purpoſe of propagating the goſpel, on Sept. 3, 1788.—*ib.*

SCHOHARIE, a county of New-York, taken from thoſe of Albany and Otſego, and incorporated in 1795. The land is variegated with hills; is in general fertile and well watered by Schoharie, Cobus Kill, and ſeveral other ſtreams. The county is bounded north by Montgomery, ſouth by Ulſter, eaſt by Albany, and weſt by Otſego. By a law paſſed 17th March, 1797, this county was divided into the ſix following towns, viz. Schoharie, Middleberg, Blenheim, Briſtol, Cobleſkill, and Sharon.—*ib.*

SCHOHARIE, the principal town in the above county, is on Schoharie Creek or river, and is one of the wealthieſt inland farming towns in the State. The inhabitants are Dutch, and, before its diviſion in 1797 were 2,073 in number. It is between 30 and 40 miles eaſtward of Albany.—*ib.*

SCHOHARIE *River* runs a northerly courſe of about 80 miles from the Kaats Kill Mountains, and empties into Mohawk river at Fort-Hunter. The weſtern branch of this river is called Cobus Kill. On the E. ſide of Cobus is the ſettlement of its name. The towns and ſettlements on Schoharie were, in 1796, as you proceed from S. to N. Batavia, Fountain's-Town, Schoharie, Smith's-Town, and Fox-Town.—*ib.*

SCHUYLER, *Fort, New*, in the townſhip of Rome, ſtands on the weſt ſide of a bend of Mohawk river, about 7 miles weſtward of Whiteſtown.—*ib.*

SCHUYLER, *Fort, Old*, is on the ſouth ſide of Mohawk river, 4 miles E. N. E. of the compact part of Whiteſtown, and 20 above the German Flats. Here were, in 1796, 35 compact houſes, ſituated partly in each of the townſhips of Whiteſtown and Frankfort. In 1790, there were but 3 ſmall huts here.—*ib.*

SCHUYLER, a townſhip of New-York, Herkemer county, between Mohawk river and Canada Creek, 20 miles above the town of German Flats. In 1796, according to the State cenſus, it contained 1,219 inhabitants, of whom 222 were electors. It was incorporated in 1792. This town was divided by act of the legiſlature in 1797.—*ib.*

SCHUYLER'S *Lake*, in New-York State, is 10 miles weſt of Lake Otſego. It is 9 miles long and 4 or 5 broad.—*ib.*

SCHUYLKILL, a river of Pennſylvania, which riſes north-weſt of the Kittatinny Mountains, through which it paſſes into a fine champaign country, and runs, from its ſource, upwards of 120 miles in a ſouth-eaſt direction, and paſſing through the limits of the city of Philadelphia, falls into the Delaware, oppoſite Mud Iſland, 6 or 7 miles below the city. It will be navigable from above Reading, 85 or 90 miles to its mouth, when the canal begun at Norriſtown is completed. This will paſs by the falls, and alſo form a communication with the Delaware above the city. There are 4 floating bridges thrown acroſs it, made of logs faſtened together, and lying upon the water, in the vicinity of Philadelphia. *Little Schuylkill River* falls into this river from the north, at Reading. On the head-waters of Schuylkill are quantities of coal.—*ib.*

SCIAGRAPHY, or SCIOGRAPHY, the profile or vertical ſection of a building; uſed to ſhew the inſide of it.

SCIAGRAPHY, in aſtronomy, &c. is a term uſed by ſome authors for the art of finding the hour of the day or night, by the ſhadow of the ſun, moon, ſtars, &c.

SCIOPTIC, or *Scioptric Ball*, a ſphere or globe of wood, with a circular hole or perforation, where a lens is placed. It is ſo fitted, that, like the eye of an animal, it may be turned round every way, to be uſed in making experiments of the darkened room.

SCIOTA *River*, which falls into the Ohio in the territory of the United States N. W. of the Ohio, is larger than either the Muſkingum or Hockhocking, and opens a more extenſive navigation. It is paſſable for large barges for 200 miles, with a portage of only 4 miles to the Sanduſky, a boatable water which falls into Lake Erie. Through the Sanduſky and Sciota lies the moſt common paſs from Canada to the Ohio and Miſſiſſippi; one of the moſt extenſive and uſeful communications that are to be found in any country. Prodigious extenſions of territory are here connected; and, from the rapidity with which the weſtern parts of Canada, Lake Erie, and the Kentucky countries are ſettling, we may anticipate an immenſe intercourſe between them. The flour, corn, flax and hemp, raiſed for exportation in that great country between the Lakes Huron and Ontario, will find an outlet through Lake Erie and theſe rivers, or down the Miſſiſſippi. The Ohio merchant can give a higher price than thoſe of Quebec for theſe commodities; as they may be tranſported from the former to Florida and the Weſt-India iſlands, with leſs expenſe, riſk and inſurance, than from the latter; while the expenſe from the place of growth to the Ohio will not be ¼ of what it would be to Quebec, and much leſs than even to the Oneida Lake. The ſtream of the Sciota is gentle, no where broken by falls. At ſome places, in the ſpring of the year, it overflows its banks, providing for large natural rice plantations. Salt ſprings, coal mines, white and blue clay, and freeſtone, abound in the country adjoining this river. Its mouth is in N. lat. 38 40 W. long. 83 36; about 300 miles below Pittſburg, and is navigable to its ſource in canoes.—*Morse.*

SCIPIO, a poſt-town of New York, Onondago county, on the E. ſide of Cayuga Lake, 14 miles ſouth-eaſt of Geneva, 39 S. W. by W. of Onondago, and 461 N. W. by N. of Philadelphia. This townſhip was incorporated in 1794, and comprehends in its juriſdiction the townſhip of Sempronius, together with that part of the lands reſerved to the Cayuga nation of Indians, on the eaſt ſide of the Cayuga Lake; ſouth of a weſt line drawn from the ſouth-weſterly corner of the townſhip of Aurelius, in the eaſt bounds of the ſaid reſervation to the ſaid Cayuga Lake. The county courts of Onondago county, are held at Manlius and Scipio alternately. The lands are very fertile. The courts are at preſent held in the pleaſant village of *Aurora*, on the bank of Cayuga Lake.—*ib.*

SCITUATE, a townſhip of Maſſachuſetts, on the bay of that name, in Plymouth county, 28 miles ſouth-eaſt of Boſton. It was incorporated in 1637, and contains 2,856 inhabitants. Scituate harbour is north-weſt of

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of Marſhfield Point, and S. S. E. of Haddock Rock, and about 16 miles northward of Plymouth, in the direction of the land. A millpond in this town being ſuddenly drawn off by a breach in the dam, in the winter ſeaſon, ſome years ago, exhibited a matter of ſpeculation to many of the inhabitants. The ſwine of the neighbourhood rooted up houſe ſwallows in great quantities, from the ſpot which the water had left, which they ate greedily. Swallows have been found in ſeveral other places; at Egg Harbour, in New-Jerſey, in a marſhy place, a large cedar being blown down, a vaſt number of ſwallows were found in the mud of the root.—*ib.*

Scituate, a townſhip of Rhode-Iſland, Providence county, between Foſter and Johnſton. It contains 2,315 inhabitants. It is 27 miles N. W. of Newport, and 11 S. W. by W. of Providence. On the line which ſeparates the town from Kent county on the ſouth, is the foundery for cannon and bells, called the Hope Furnace.—*ib.*

SCOLYMUS (ſee that article *Encycl.*) is, by Pliny and Theophraſtus, reckoned to belong to the genus of the thiſtles. The former ſays, that, like moſt others of the ſame kind, the ſeeds were covered by a ſort of wool (*pappus*). It had a high ſtem, ſurrounded with leaves, which were prickly, but which ceaſed to ſting when the plant withered. It flowered the whole ſummer through, and had often flowers and ripe ſeed at the ſame time; which is the caſe alſo with our artichoke plants. The calyx of the *ſcolymus* was not prickly; the root was thick, black, and ſweet, and contained a milky juice. It was eaten both raw and cooked; and Theophraſtus obſerves, as ſomething very remarkable, that when the plant was in flower, or as others explain the words, when it had finiſhed blowing, it was moſt palatable. What renders this circumſtance ſingular is, that moſt milky roots uſed for food loſe their milk, and become unfit to be eaten as ſoon as they have blown. This is the caſe with the goat's beard, which is eatable only the firſt year.

Profeſſor Beckman has, with much labour and erudition, endeavoured to aſcertain what is really the plant, which was known to the ancients by the name of *ſcolymus*. He ſeems to have proved ſufficiently, that it was not the *cactus*, the *carduus*, or the *cinara*; but he has not been able to come to any other concluſion. "Were I appointed or condemned (ſays he) to form a new Latin dictionary, I ſhould explain the article *ſcolymus* in the following manner: *Planta compoſita, capitata. Caulis longus, obſitus foliis ſpinoſis. Radix carnoſa, lacteſcens, nigra, dulcis, edulis. Calix ſquamis inermibus, diſco carnoſo, ante efflorescentiam eduli. Semina pappoſa. Turiones edules.* This deſcription, ſhort as it is, contains every thing that the ancients have ſaid in order to characteriſe that plant."

SCONCES, ſmall forts, built for the defence of ſome paſs, river, or other place. Some ſconces are made regular, of four, five or ſix baſtions; others are of ſmaller dimenſions, fit for paſſes or rivers; and others for the field.

SCOODICK, or *Schudick*, a river of Waſhington county, Diſtrict of Maine. It is properly an arm of the inner bay of Paſſamaquoddy. De Mons and Champlaine called it Etchemins. Its main ſource is near Penobſcot river, to which the Indians have a communication; the carrying-place acroſs is but 3 miles. Scoodick lakes lie in a chain between Scoodick and Penobſcot rivers.—*Morſe.*

Scotales.

SCOTALES, were meetings held formerly in England for the purpoſe of drinking ale, of which the expence was defrayed by joint contribution. Thus the tenants of South Malling in Suſſex, which belonged to the Archbiſhop of Canterbury, were, at the keeping of a court, to entertain the Lord or his bailiff with a drinking, or an *ale*; and the ſtated quotas towards the charge were, that a man ſhould pay three pence halfpenny for himſelf and his wife, and a widow and a cottager three halfpence. In the manor of Ferring, in the ſame county, and under the ſame juriſdiction, it was the cuſtom for the tenants named to make a *ſcotale* of ſixteen pence halfpenny, and to allow out of each ſixpence three halfpence for the bailiff.

Common ſcotales in taverns, at which the clergy were not to be preſent, are noticed in ſeveral eccleſiaſtical canons. They were not to be publiſhed in the church by the clergy or the laity; and a meeting of more than ten perſons of the ſame pariſh or vicinage was a ſcotale that was generally prohibited. There were alſo common drinkings, which were denominated *leet-ale, bride ale, clerk-ale,* and *church-ale*. To a *leet ale* probably all the reſidents in a manorial diſtrict were contributors; and the expence of a *bride-ale* was defrayed by the relations and friends of a happy pair, who were not in circumſtances to bear the charges of a wedding dinner. This cuſtom prevails occaſionally in ſome diſtricts of Scotland even at this day, under the denomination of a *penny bride-ale*, and was very common fifty or ſixty years ago. The *clerk's* ale was in the Eaſter holidays, and was the method taken to enable clerks of pariſhes to collect more readily their dues.

Mr Warton, in his Hiſtory of Engliſh Poetry, has inſerted the following extract from an old indenture, which ſhews clearly the deſign of a *church*-ale. "The pariſhioners of Elveſton and Okebrook, in Derbyſhire, agree jointly to brew four ales, and every ale of one quarter of malt, betwixt this and the feaſt of St John the Baptiſt next coming; and that every inhabitant of the ſaid town of Okebrook ſhall be at the ſeveral ales. And every huſband and his wife ſhall pay two pence, every cottager one penny; and all the inhabitants of Elveſton ſhall have and receive all the profits and advantages coming of the ſaid ales, to *the uſe and behoof of the ſaid church of Elveſton.*"

The *give-ales* were the legacies of individuals; and from that circumſtance entirely gratuitous. They ſeem to have been very numerous, and were generally left to the poor; though, from the largeneſs of the quantity of ale enjoined to be brewed, it muſt have been ſometimes intended that others were to partake of them. Theſe bequeſts were likewiſe, not unfrequently, made to the light or altar of a ſaint, with directions for ſinging maſſes at the obit, trenthal, or anniverſary of the teſtator. Hence, though ſcotales were generally kept in houſes of public reſort, the give-ales were ſometimes diſpenſed in the church, and often in the churchyard; by which means "Godde's houſe (as Summer ſays in his Treatiſe on Gavelkind) was made a tavern of gluttons." Such certainly would be Chalk church, if in it was kept the give-ale of William May of that pariſh; for he ordered his wife to "make in bread ſix buſhels

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of wheat, and in drink ten buſhels of mault, and in cheeſe, twenty-pence, to give to poor people for the health of his ſoull; and he ordered that, after the deceaſe of his wife, his executors and feoffees ſhould continue the cuſtom for evermore."

SCOTCH *Plains*, a village in Eſſex county, New-Jerſey, on a N. E. branch of Rariton river, between Weſtfield and Turky; 11 miles weſt of Elizabeth-Town, and as far northward of New-Brunſwick.—*Morſe*.

SCOTLAND *Neck*, a village of N. Carolina, where is a poſt office, 396 miles from Philadelphia.—*ib.*

Scotland *River*, in the iſland of Barbadoes, is ſcarcely deſerving notice, otherwiſe than being almoſt the only rivulet in the iſland, except St Joſeph's river, another ſmall brook. It riſes in St Andrew's pariſh, and falls into Long Bay on the eaſtern ſide of the iſland, 2½ miles north-weſt of St Joſeph's river.—*ib.*

SCOTS *Bay*, on the ſouth-weſt coaſt of the iſland of Dominica, towards the ſouthern extremity of the iſland. It lies in St Martin's pariſh, having Scots Head on the ſouth, and Vaughan's Point on the north.—*ib.*

Scots *Cove*, on the ſouth-weſt part of the iſland of Jamaica.—*ib.*

SCOWHEGAN *Falls*, in Kennebeck river, in the Diſtrict of Maine, are near the town of Canaan. Boats cannot paſs this fall.—*ib.*

SCOWRING of stuffs, is an art much more generally practiſed than underſtood. It ſuppoſes, ſays Chaptal, 1ſt, a knowledge of the different ſubſtances capable of ſtaining any kind of cloth; 2d, of the ſubſtances to which recourſe muſt be had, in order to make thoſe depoſited on the ſtuff to diſappear; 3d, a knowledge of the effects produced on colours by thoſe re-agents, which it may be neceſſary to employ to deſtroy ſtains; 4th, a knowledge of the manner in which the cloth is affected by thoſe re-agents; 5th, of the art of reſtoring a colour changed or faded. Of thoſe bodies which occaſion ſpots on different kinds of cloth, ſome are eaſily diſtinguiſhed by their appearance, ſuch as greaſy ſubſtances; but others have more complex effects, ſuch as acids, alkalies, perſpired matter, fruits, urine, &c. Acids redden black, fawn, violet, and puce-colour, and every ſhade communicated with orchilla-weed, iron, aſtringents, and every blue except indigo and pruſſian blue. They render the yellows paler, except that of arnatto, which they change into orange.

Alkalies change to violet the reds produced by Brazil-wood, logwood, and cochineal. They render the greens on woollen cloth yellowiſh, make yellow browniſh, and change the yellow produced by arnatto to aurora. Perſpired matter produces the ſame effects as alkalies.

When the ſpots are produced by ſimple bodies on ſtuffs, it is eaſy to remove them by the means already known. Greaſy ſubſtances are removed by alkalies, ſoaps, the yolk of eggs, fat earths; oxyds of iron, by the nitric and oxalic acids; acids by alkalies, and reciprocally. Stains of fruit on white ſtuffs may be removed by the ſulphureous acid, and ſtill better by the oxygenated muriatic acid. But when the ſpots are of a complex kind, it will be neceſſary to employ ſeveral means in ſucceſſion. Thus, to deſtroy the ſtain of coom from carriage wheels, after the greaſe has been diſſolved, the oxyd of iron may be removed by the oxalic acid.

As colours are often changed by re-agents, it will be neceſſary, in order to reſtore them, that the ſcowrer ſhould poſſeſs a thorough knowledge of the art of dyeing, and how to modify the means according to circumſtances. This becomes the more difficult, when it is neceſſary to reproduce a colour ſimilar to that of the reſt of the ſtuff, to apply that colour only in one place, and often to reſtore the mordant by which it was fixed, and which has been deſtroyed, or even the firſt tint which gave the colour its intenſity. It may be readily conceived, that the means to be employed muſt depend on the nature of the colour and the ingredients by which it was produced; for it is known that the ſame colour may be obtained from very different bodies. Thus, after an alkali has been employed to deſtroy an acid ſpot on browns, violets, blues, poppies, &c. the yellow ſpot which remains may be made to diſappear by a ſolution of tin; a ſolution of ſulphat of iron reſtores the colour to brown ſtuffs which have been galled; acids reſtore to their former ſplendour yellows which have been rendered duſky or brown by alkalies; blacks produced by logwood become red by acids; alkalies change theſe red ſpots to yellow, and a little of the aſtringent principle makes them again become black. A ſolution of one part of indigo in four parts of ſulphuric acid, diluted with a ſufficient quantity of water, may be employed with ſucceſs to revive the blue colour of cotton or wool which has been changed. Scarlet may be revived by means of cochineal and a ſolution of the muriat of tin, &c.

The choice of re-agents is not a matter of indifference. Vegetable acids are preferable; the ſulphureous acid, however, may be employed for ſtains occaſioned by fruit; it does not change the blue of ſilk nor colours produced by aſtringents; it does not degrade the yellow of cotton. Ammonia ſucceeds better than fixed alkalies in removing ſpots produced by acids. It is employed in vapour; its action is ſpeedy, and ſeldom alters the colour.

The means of removing greaſy ſpots are well known. This effect is produced by alkalies, fullers earth, volatile oils diſſolved in alcohol, a heat proper for volatilizing greaſe, &c. Spots occaſioned by ink, ruſt, or iron-mould of any kind, and all thoſe produced by the yellow oxyd of iron, are removed by the oxalic acid: the colour may be reſtored by alkalies, or a ſolution of the muriat of tin. Theſe ſpots may be removed alſo by the oxygenated muriatic acid, when they are on white ſtuffs or paper.

The action of alkalies, and that of perſpired matter, are the ſame; their ſpots may be effaced by acids, or even by a weak ſolution of the muriat of tin. When theſe ſpots ariſe from ſeveral unknown cauſes, in order to deſtroy them, recourſe muſt be had to polychreſt compoſitions. The following may be conſidered as one of the moſt efficacious: Diſſolve white ſoap in alcohol, and mix this ſolution with the yolks of from four to ſix eggs; add gradually eſſence of turpentine; and incorporate with the whole ſome fullers earth, in ſuch a manner as to form balls of a ſuitable conſiſtence. Moiſten the ſpot; and having rubbed it with theſe balls, the ſpot will be removed by waſhing the ſtuff. All ſpots, except iron-mould and ink, may be removed in this manner.

Waſhing deſtroys the luſtre, and leaves a tarniſhed place diſagreeable to the eye; but the luſtre may be reſtored by drawing over the waſhed place, and in the direction of the pile, a bruſh moiſtened in water, impregnated with a little gum. You may then apply a ſheet of paper, or a piece of cloth, and a conſiderable weight, under which the cloth muſt be left to dry.

SCRIVAN, a good harbour on the eaſt ſide of the Iſthmus of Darien, but ſo full of rocks at the entrance, that none can paſs it with ſafety, but ſuch as are acquainted there. It is 3 leagues weſt of Sanballet Point, and 17 eaſt of Porto Bello. N. lat. 9 40, W. long. 78 49.—*Morſe.*

SCRIVEN, a new county in the lower diſtrict of Georgia.—*ib.*

SCROON *Lake*, in the State of New-York, lies weſt of Lake George, and is a dilatation of the eaſtern branch of Hudſon's river. In ſome maps it is called *Scaron.* A ſmall but rapid ſtream enters into it, which, in Montgomery county, runs under a hill, the baſe of which is 60 or 70 yards diameter, forming a moſt curious and beautiful arch in the rock, as white as ſnow. The fury of the water and the roughneſs of the bottom, added to the terrific noiſe within, has hitherto prevented any perſon from paſſing through the chaſm.—*ib.*

SCRUB *Iſland*, one of the ſmaller Virgin Iſlands, ſituated to the weſt of Virgin Gorda, and eaſt of the north end of Tortula, on which it depends. N. lat. 18 25, weſt long. 62 57.—*ib.*

SCYLLA. Under this title we gave, in the *Encyclopædia*, an account of Scylla and Charybdis, which, though taken from a work which we thought good authority, appears to be far from correct. Theſe places, ſo famous in the poems of Homer and Virgil, were examined with minute attention by that accurate obſerver of nature the Abbé Spallanzani; who thus deſcribes Scylla.

"It is a lofty rock, diſtant twelve miles from Meſſina, which riſes almoſt perpendicularly from the ſea on the ſhore of Calabria, and beyond which is the ſmall city of the ſame name. Though there was ſcarcely any wind, I began to hear, two miles before I came to the rock, a murmur and noiſe like a confuſed barking of dogs, and on a nearer approach readily diſcovered the cauſe. This rock, in its lower parts, contains a number of caverns, one of the largeſt of which is called by the people there *Dragara.* The waves, when in the leaſt agitated, ruſhing into theſe caverns, break, daſh, throw up frothy bubbles, and thus occaſion theſe various and multiplied ſounds. I then perceived with how much truth and reſemblance of nature Homer and Virgil, in their perſonifications of Scylla, had pourtrayed this ſcene, by deſcribing the monſter they drew as lurking in the darkneſs of a vaſt cavern, ſurrounded by ravenous barking maſtiffs, together with wolves, to increaſe the horror.

"Such is the ſituation and appearance of Scylla: let us now conſider the danger it occaſions to mariners. Though the tide is almoſt imperceptible in the open parts of the Mediterranean, it is very ſtrong in the ſtrait of Meſſina, in conſequence of the narrowneſs of the channel, and is regulated, as in other places, by the periodical elevations and depreſſion of the water. Where the flow or current is accompanied by a wind blowing the ſame way, veſſels have nothing to fear, ſince they either do not enter the ſtrait, both the wind and the ſtream oppoſing them, but caſt anchor at the entrance; or, if both are favourable, enter on full ſail, and paſs through with ſuch rapidity that they ſeem to fly over the water. But when the current runs from ſouth to north, and the north wind blows hard at the ſame time, the ſhip which expected eaſily to paſs the ſtrait with the wind in its ſtern, on its entering the channel is reſiſted by the oppoſite current, and, impelled by two forces in contrary directions, is at length daſhed on the rock of Scylla, or driven on the neighbouring ſands; unleſs the pilot ſhall apply for the ſuccour neceſſary for his preſervation. For, to give aſſiſtance in caſe of ſuch accidents, 24 of the ſtrongeſt, boldeſt, and moſt experienced ſailors, well acquainted with the place, are ſtationed night and day along the ſhore of Meſſina; who, at the report of guns fired as ſignals of diſtreſs from any veſſel, haſten to its aſſiſtance, and tow it with one of their light boats. The current, where it is ſtrongeſt, does not extend over the whole ſtrait, but winds thro' it in intricate meanders, with the courſe of which theſe men are perfectly acquainted, and are thus able to guide the ſhip in ſuch a manner as to avoid it. Should the pilot, however, confiding in his own ſkill, contemn or neglect this aſſiſtance, however great his ability or experience, he would run the moſt imminent riſk of being ſhipwrecked. In this agitation and conflict of the waters, forced one way by the current, and driven in a contrary direction by the wind, it is uſeleſs to throw the line to diſcover the depth of the bottom, the violence of the current frequently carrying the lead almoſt on the ſurface of the water. The ſtrongeſt cables, though ſome feet in circumference, break like ſmall cords. Should two or three anchors be thrown out, the bottom is ſo rocky that they either take no hold; or, if they ſhould, are ſoon looſened by the violence of the waves. Every expedient afforded by the art of navigation, though it might ſucceed in ſaving a ſhip in other parts of the Mediterranean, or even the tremendous ocean, is uſeleſs here. The only means of avoiding being daſhed againſt the rocks, or driven upon the ſands in the midſt of this furious conteſt of the winds and waves, is to have recourſe to the ſkill and courage of theſe Meſſineſe ſeamen.

Scylla.

Charybdis is ſituated within the ſtrait, in that part of the ſea which lies between a projection of land named *Punta Secca*, and another projection on which ſtands the tower called *Lanterna*, or the light-houſe, a light being placed at its top to guide veſſels which may enter the harbour by night. Every writer, who has hitherto deſcribed Charybdis, has ſuppoſed it to be a whirlpool; but this is a miſtake, as Spallanzani has completely proved, by aſcertaining what it really is.

"Charybdis is diſtant from the ſhore of Meſſina about 750 feet, and is called by the people of the country *Calofaro*, not from the agitation of the waves, as ſome have ſuppoſed, but from καλος and φαρος; that is, *the beautiful tower*, from the light-houſe erected near it for the guidance of veſſels. The phenomenon of the Calofaro is obſervable when the current is deſcending; for when the current ſets in from the north, the pilots call it the *deſcending rema*, or current; and when it runs from

from the ſouth, the *aſcending rema*. The current aſcends or deſcends at the riſing or ſetting of the moon, and continues for ſix hours. In the interval between each aſcent or deſcent, there is a calm which laſts at leaſt a quarter of an hour, but not longer than an hour. Afterwards, at the riſing or ſetting of the moon, the current enters from the north, making various angles of incidence with the ſhore, and at length reaches the Calofaro. This delay ſometimes continues two hours; ſometimes it immediately falls into the Calofaro; and then experience has taught that it is a certain token of bad weather."

When our author obſerved Charybdis from the ſhore, it appeared like a group of tumultuous waters; which group, as he approached, became more extenſive and more agitated. He was carried to the edge, where he ſtopped ſome time to make the requiſite obſervations; and was then convinced, beyond the ſhadow of a doubt, that what he ſaw was by no means a vortex or whirlpool.

Hydrologiſts teach us, that by a whirlpool in a running water we are to underſtand that circular courſe which it takes in certain circumſtances; and that this courſe or revolution generates in the middle a hollow inverted cone, of a greater or leſs depth, the internal ſides of which have a ſpiral motion. But Spallanzani perceived nothing of this kind in the Calofaro. Its revolving motion was circumſcribed to a circle of at moſt 100 feet in diameter; within which limits there was no incurvation of any kind, nor vertiginous motion, but an inceſſant undulation of agitated waters, which roſe, fell, beat, and daſhed on each other. Yet theſe irregular motions were ſo far placid, that nothing was to be feared in paſſing over the ſpot, which he did; though their little bark rocked very much from the continual agitation, ſo that they were obliged conſtantly to make uſe of their oars to prevent its being driven out of the Calofaro. Our author threw ſubſtances of different kinds into the ſtream. Such as were ſpecifically heavier than the water ſunk, and appeared no more; thoſe which were lighter remained on the ſurface, but were ſoon driven out of the revolving circle by the agitation of the water.

Though from theſe obſervations he was convinced that there was no gulph under the Calofaro, as otherwiſe there would have been a whirlpool, which would have carried down into it the floating ſubſtances; he determined to ſound the bottom with the plummet, and found its greateſt depth did not exceed 500 feet. He was likewiſe informed, to his no ſmall ſurpriſe, that beyond the Calofaro, towards the middle of the ſtrait, the depth was double.

When the current and the wind are contrary to each other, and both in their greateſt violence, eſpecially when the ſcilocco, or ſouth wind, blows, the ſwelling and daſhing of the waves within the Calofaro is much ſtronger, more impetuous, and more extenſive. It then contains three or four ſmall whirlpools, or even more, according to the greatneſs of its extent and violence. If at this time ſmall veſſels are driven into the Calofaro by the current or the wind, they are ſeen to whirl round, rock, and plunge, but are never drawn down into the vortex. They only ſink when filled with water, by the waves beating over them. When veſſels of a larger ſize are forced into it, whatever wind they have they cannot extricate themſelves; their ſails are uſeleſs; and after having been for ſome time toſſed about by the waves, if they are not aſſiſted by the pilots of the country, who know how to bring them out of the courſe of the current, they are furiouſly driven upon the neighbouring ſhore of the Lanterna, where they are wrecked, and the greater part of their crews periſh in the waves.

From theſe facts, the claſſical reader will perceive, that the ancient deſcriptions of Charybdis are by no means ſo accurate as thoſe of Scylla. The ſaying, however, which became proverbial among the ancients, viz. that "he who endeavours to avoid Charybdis, daſhes upon Scylla," is, in a great meaſure, true. If a ſhip be extricated from the fury of Charybdis, and carried by a ſtrong ſoutherly wind along the ſtrait towards the northern entrance, it will indeed paſs out ſafely; but ſhould it meet with a wind in a nearly oppoſite direction, it would become the ſport of both theſe winds, and, unable to advance or recede, be driven in a middle courſe between their two directions, that is to ſay, full upon the rock of Scylla, if it be not immediately aſſiſted by the pilots. It is likewiſe obſerved, that in theſe hurricanes a land wind frequently riſes, which deſcends from a narrow paſs in Calabria, and increaſes the force with which the ſhip is impelled towards the rock.

SEABROOK, a townſhip of New-Hampſhire, in Rockingham county, on the road from Portſmouth to Newbury-Port; about 16 miles ſoutherly of the former, and 6 northerly of the latter. It was formerly part of Hampton; was incorporated in 1768, and contains 715 inhabitants.—*Morſe.*

SEAKONNET *Point* and *Rocks*, the S. extremity of the eaſtern ſhore which forms the entrance of Narraganſet Bay, in the State of Rhode-Iſland; about 6 miles eaſt ſouth-eaſt of Newport.—*ib.*

SEAL *Iſland, Machias*, on the coaſt of the Diſtrict of Maine. From thence to Grand Manan Iſland the courſe is eaſt-north-eaſt 2 leagues; and to Matinicus Iſland weſt-ſouth-weſt 26 leagues. N. lat. 44 27, weſt long. 66 52.—*ib.*

SEAL *River*, in New North Wales, runs eaſt to Hudſon's Bay, into which it empties eaſtward of Mooſe river.—*ib.*

SEA OTTER *Sound*, on the north-weſt coaſt of N. America, lies ſouth-eaſterly of the Hazy Iſlands. N. lat. 55 18, weſt long. 133 47 30.—*ib.*

SEARSBURGH, a townſhip of Vermont, Bennington county, 12 miles eaſt of Bennington.—*ib.*

SEA SICKNESS is a diſorder which has been but little treated of, notwithſtanding the frequency of its occurrence, and the irkſomeneſs and diſtreſs to which the patient is ſubjected during its continuance. It has been found to be very beneficial in ſeveral diſeaſes, among which the principal are aſthmatic and pulmonary complaints; and there are very few inſtances of its being attended with fatal conſequences. The ſea-ſickneſs ſeems to be a ſpaſmodic affection of the ſtomach, produced by the alternate preſſure and receſs of the contents of that viſcus againſt its lower internal ſurface, according as the riſe and fall of the ſhip oppoſes or recedes from the action of gravity.

The ſeas in which this diſorder attacks the paſſenger with the greateſt violence, are thoſe where the waves have long uninterrupted freedom of action; of courſe, bays,

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bays, gulphs and channels, may be navigated with leſs inconvenience, as the waves, meeting with more frequent reſiſtance, and the repercuſſion being conſiderably ſtronger, the veſſel does not experience that gentle uniform vacillation which ſickens the ſtomach, and renders the head giddy. By the ſame argument, a perſon feels leſs inconvenience from the diſorder on the wide ocean in a ſmall veſſel, on which the ſlighteſt motion of the waves makes a ſtrong impreſſion. He is likewiſe leſs expoſed to it in a very large veſſel, as in a ſhip of the line, or a large merchantman deeply laden; as the waves, in this caſe, ſcarcely affect the veſſel. It is in ſhips of the middling ſize, and which carry but a light cargo, that the paſſenger ſuffers moſt from the ſea ſickneſs. It has been obſerved, that this diſorder affects people in years leſs than young perſons; thoſe of a dark leſs than thoſe of a fair complection, and that it ſeldom attacks infants. The duration is not limited to any fixed period of time; with ſome it laſts only a few days, with others weeks, months, and even during the whole courſe of the voyage. The ſooner it takes place after embarkation, the greater probability is there of its continuance. It does not always ceaſe immediately on landing, but has been known, in ſome caſes, to continue for a conſiderable time. Even the oldeſt and moſt ſkilful ſeamen have experienced a relapſe, eſpecially if they have quitted the ſea ſervice for a long term of years.

There have been many modes recommended for mitigating, if not entirely preventing, this diſorder; among which the following ſeem the moſt efficacious:

1. Not to go on board immediately after eating; and, when on board, not to eat in any great quantity at any one meal.

2. To take ſtrong exerciſe, with as little intermiſſion as conveniently can be done; for inſtance, to aſſiſt at the pumps, or any other active employment, as indolent and ſlothful paſſengers always ſuffer moſt from the diſorder.

3. To keep much upon deck, even in ſtormy and rainy weather, as the ſea breeze is leſs liable to affect the ſtomach than the ſtagnated air of the cabin, which is frequently rendered infectious for want of ſufficient circulation.

4. Not to watch the motion of the waves, eſpecially when ſtrongly agitated with tempeſt.

5. To avoid carefully all employments which haraſs the mind, as reading, ſtudy, meditation, and gaming; and on the other hand, to ſeek every opportunity of mirth and mental relaxation.

6. To drink occaſionally carbonic acids, as the froth of ſtrong fermented beer, or wine mixed with Seltzer water, and fermented with pounded ſugar, or a glaſs of Champaign.

7. It will be found of great ſervice to take the acid of ſulphur dulcified, dropped upon lump ſugar, or in peppermint-water; or ten drops of ſulphureous ether.

With regard to eating, it is adviſable to be very ſparing, at leaſt not to eat much at one meal. The proper diet is bread and freſh meat, which ſhould be eaten cold with pepper. All ſweet ſavoured food ſhould be carefully avoided; and the paſſenger ſhould refrain from fat, but eſpecially from all meat that is in the leaſt degree tainted. Even the odour of flowers is very pernicious; for which reaſon, it is not expedient to examine marine productions, as theſe generally have a nauſeating ſmell. The fumes of vinegar may be inhaled with great benefit. The drink ſhould conſiſt of tart wines, lemonade, or Seltzer water, but never of common water. The paſſenger would do well to drink little and often. As experience has proved, that an accidental diarrhœa has frequently relieved the patient from the ſea-ſickneſs, it will be prudent to follow the clue of nature, and take a gentle laxative, or, if circumſtances will permit, a clyſter of ſalt-water and Venice ſoap, which is the more neceſſary, as ſea-faring people are liable to obſtructions. It will further be found uſeful to apply to the pit of the ſtomach a tonic anodyne antiſpaſmodic emplaſtrum, ſpread upon leather, and covered with linen.

Where the above preventives have not been employed, or have not ſucceeded in ſecuring the paſſenger from the ſea-ſickneſs, he may, however, experience conſiderable relief from the following remedies:

If ſymptoms of vomiting appear, they may frequently be remedied by the patient proſtrating himſelf in a horizontal poſition, upon the back or belly, and lying perfectly ſtill. We would recommend likewiſe a gentle compreſſion of the abdomen. But if the fits of vomiting are too violent to be repreſſed, in that caſe, it is beſt to promote them by a ſtrong doſe of ſalt-water; an expedient, however, which muſt not be too often repeated, as it tends ſtill more to weaken the ſtomach. When the emetic takes effect, let the patient bend his body, advancing his knees towards his breaſt, and ſupport his head againſt a firm and ſolid reſting-place. He muſt be particularly careful to untie his garters and cravat, as this precaution will ſecure him from the riſk of a rupture, and from the ill effects of the blood ruſhing violently towards the head and breaſt.

After the vomiting has ſubſided, its return may be guarded againſt by preſerving a ſtate of repoſe, and even keeping the eyes ſhut for a conſiderable time. Let the patient chooſe a cool, ventilated place, remembering to keep himſelf warm and well clothed, as perſpiration is highly ſalutary. But he muſt not indulge in too long ſleep during the day-time, as this induces torpidneſs. In the morning he ſhould conſtantly take a gargle of ſugar diſſolved in vinegar. Let him eat often, but ſparingly: and if he can content himſelf with a diſh of chocolate, coffee, or ſtrong tea, he will reap ſtill greater benefit. He ſhould never drink water in its pure elementary ſtate, but mix it with brandy, vinegar, or wine. In the morning, inſtead of brandy, he may take a glaſs of wine, with an infuſion of orange peel, gentian root, or peruvian bark (*quinquina*). A glaſs of punch taken occaſionally will prove of very eſſential ſervice, as it promotes perſpiration.

Perſons in the habit of ſmoking, will find a pleaſant and ſalutary companion in the pipe; but thoſe who are not accuſtomed to it will be ſufferers by taking to the practice.

In concluſion, it is proper to add, that warm clothing, flannel ſhirts, trowſers, caps, &c. are efficacious remedies againſt exceſſive expectoration, and all other ſymptoms of this terrible diſorder.

SEBACO, an iſland on the weſt coaſt of Mexico, 12 miles north of Point Mariat, and 45 north-eaſt of Quicara.—*Morſe.*

SEBACOOK, or *Sebago*, a pond or lake of the

Diſtrict of Maine, 18 miles N. W. of Portland, is equal in extent to two large townſhips, and is connected with Long Pond on the north-weſt by Sungo, or Songo river. The whole extent of theſe waters is nearly 30 miles north-weſt and ſouth-eaſt.—*ib.*

SEBARIMA, one of the principal mouths of Oronoco river that is navigable for ſhips.—*ib.*

SEBASTACOOK, a river of the Diſtrict of Maine, that riſes in lakes nearly N. from its mouth; and in its windings receives brooks and ſmall ſtreams for the ſpace of 150 miles, and joins the Kennebeck at Taconnet Fall, where Fort Halifax was erected in 1754. The fall is 18 miles from Fort Weſtern, which was built in 1752. Its numerous ſtreams abound with ſmall fiſh, as alewives, &c.—*ib.*

SEBASTIAN, *Cape St*, the eaſtern point of the Gulf of Darien, on the coaſt of the Spaniſh Main, is 10 leagues from the weſtern point of Cape Tiburon. Here was formerly a city, which was abandoned on account of its unwholeſome ſituation.—*ib.*

SEBASTIAN, *Cape St*, on the coaſt of California. N. lat. 43, W. long. 126.—*ib.*

SEBASTIAN, *St*, a town of Terra Firma, on the eaſtern ſide of the Gulf of Darien.—*ib.*

SEBASTIAN *Iſland, St*, on the coaſt of Brazil, is S. W. by W. from the bay of Angra dos Reys; to the eaſtward of which are ſeveral other iſlands of leſs note. The city of Sebaſtian is large and handſome, and the capital of the province of Rio Janeiro, being ſeated at the mouth of the river of that name. S. lat. 22 54, W. long. 43 11.—*ib.*

SEBASTIAN *River, St*, or *Spaniſh Admiral's Creek*, on the E. coaſt of Eaſt Florida, has communication with Indian river. Oppoſite this river the admiral of the Plate Fleet periſhed in 1715. The reſt of the fleet, 14 in number, were loſt between this and the Beach yard.—*ib.*

SEBASTIAN *de la Plata*, a ſmall place in the juriſdiction of Popayan, in the province of Quito, 6 miles N. E. of Popayan. It ſtands on a large plain on the bank of the river Galli, and is ſubject to earthquakes. There are ſilver mines in its vicinity. N. lat. 3 44, W. long. 74 1 —*ib.*

SEBOU, or *Sibou*, ſmall iſlands on the coaſt of Cape Breton iſland, off the ſouth point of Port Dauphin.—*ib.*

SECAS ISLANDS, or *Dry Iſlands*, on the W. coaſt of New-Mexico, are within Bahia Honda, or Deep Bay, and 12 miles from Point Chiriqui, the limit of the bay.—*ib.*

SECHURA, a town of Peru, 10 leagues ſouth of Piura, ſituated on the bank of a river of its own name, a league from the ocean. It contains about 400 families, all Indians; chiefly employed in fiſhing or driving of mules. They are remarkably ingenious, and generally ſucceed in whatever they apply themſelves to. The Deſert of Sechura is a frightful waſte of ſand, extending 30 leagues to the town of *Morope*. S. lat. 5 32 33, W. long. 79 42.—*ib.*

SECKLONG, a town of New-Spain, on the Moſquito ſhore, on the north-weſtern ſide of Golden river; about 100 miles from Cape Gracias a Dios, at the mouth of the river.—*ib.*

SECTOR OF A SPHERE, is the ſolid generated by the revolution of the ſector of a circle about one of its radii; the other radius deſcribing the ſurface of a cone, and the circular arc a circular portion of the ſurface of the ſphere of the ſame radius. So that the ſpherical ſector conſiſts of a right cone, and of a ſegment of the ſphere having the ſame common baſe with the cone. And hence the ſolid content of it will be found by multiplying the baſe or ſpherical ſurface by the radius of the ſphere, and taking a third part of the product.

SECTOR *of an ellipſe*, or *of an hyperbola*, &c. is a part reſembling the circular ſector, being contained by three lines, two of which are radii, or lines drawn from the centre of the figure to the curve, and the intercepted arc or part of that curve.

SED, *Cape*, a promontory on the N. ſide of the iſland of Cuba, and 18 leagues from the Havannah.—*Morſe.*

SEDGWICK, a townſhip of the Diſtrict of Maine, Hancock county, on Naſkeag Point, which bounds Penobſcot on the north-eaſt. It extends up to the town of Penobſcot, and is 315 miles north-eaſt of Boſton.—*ib.*

SEEDS, PRESERVATION OF, in a ſtate fit for vegetation, is a matter of great and general importance, becauſe, if it can be accompliſhed, it will enable us to rear many uſeful plants in one country which are there unknown, being indigenous only in others at a great diſtance from it. There is a letter on this ſubject in the 16th volume of the *Tranſactions of the Society of Arts*, &c. from which we ſhall extract what is fit for our purpoſe.

"Many years ago (ſays the author), having obſerved ſome ſeeds which had got accidentally amongſt raiſins, and that they were ſuch as are generally attended with difficulty to raiſe in England after coming in the uſual way from abroad, I ſowed them in pots, within a framing; and as all of them grew, I commiſſioned my ſons, who were then abroad, to pack up all ſorts of ſeeds they could procure in abſorbent paper, and ſend ſome of them ſurrounded by raiſins, and others by brown moiſt ſugar; concluding that the former ſeeds had been preſerved by a peculiarly favourable ſtate of moiſture thus afforded them. It occurred, likewiſe, that as many of our common ſeeds, ſuch as clover, charlock, &c. would lie dormant for ages within the earth, well preſerved for vegetation whenever they might happen to be thrown to the ſurface, and expoſed to the atmoſphere, ſo theſe foreign ſeeds might be equally preſerved, for many months at leaſt, by the kindly covering and genial moiſture that either raiſins or ſugar afforded them: and this conjecture was really fulfilled, as not one in twenty of them failed to vegetate, when thoſe of the ſame kinds, that I ordered to be ſent lapped in common parcels, and forwarded with them, would not grow at all. I obſerved, upon examining them all before they were committed to the earth, that there was a prevailing dryneſs in the latter, and that the former looked freſh and healthy, and were not in the leaſt infeſted by inſects, as was the caſe with the others. It has been tried repeatedly to convey ſeeds (of many plants difficult to raiſe) cloſed up in bottles, but without ſucceſs; ſome greater proportion of air, as well as a proper ſtate of moiſture, perhaps, being neceſſary. I ſhould alſo obſerve, that no difference was made in the package of the ſeeds, reſpecting their being kept in huſks, pods, &c. ſo as to give thoſe in raiſins or ſugar any advantage over the others,

others, all being ſent equally guarded by their natural teguments."

SEEKHONK *River* is the name of that part of Pawtucket river below Pawtucket bridge and falls; from which to its mouth at Fox Point, in the town of Providence, is a little more than 4 miles. Over it are two bridges, connecting Providence in Rhode-Iſland, with the State of Maſſachuſetts, viz *India* bridge, and three-fourths of a mile above that *Central* bridge. —*Morſe.*

SEEWEE *Bay*, or *Bull's Harbour*, on the coaſt of S. Carolina, lies nearly at an equal diſtance ſouth-weſt of Cape Roman, and north eaſt of Charleſton Entrance, having ſeveral iſles which form the bay.—*ib.*

SEGALIEN, the name given by Europeans to a large iſland ſeparated by a narrow channel from the coaſt of Chineſe Tartary, and called by the natives *Tchoka*, and by the Chineſe *Oku-Jeſſo*. It lies between the 46th and 54th degrees of north latitude, but its breadth from eaſt to weſt is not known. Indeed hardly any thing about it was known till the year 1787, that M. La Perouſe penetrated almoſt to the bottom of the channel which ſeparates it from the continent, and which grew ſo very ſhallow as he advanced northward that, in all probability, the iſland will ſoon become a peninſula. The French frigates came to anchor in different bays on the coaſt of Segalien; and the fineſt of theſe bays, to which the Commodore gave the name of *Baie d'Eſtaing*, is ſituated in 48° 59′ N. Lat. and 140° 32′ Lon. Eaſt from Paris.

La Perouſe and M. Rollin, the ſurgeon of his ſhip, both deſcribe the natives of this iſland as a worthy and intelligent people. Of the preſents which were made to them, they ſeemed to ſet a value only on ſuch as were uſeful. Iron and ſtuffs prevailed over every thing; they underſtood metals as well as their gueſts, and for ornament preferred ſilver to copper, and copper to iron. They make uſe of looms, which, though ſmall, are very complete inſtruments; and by means of ſpindles they prepare thread of the hair of animals, of the bark of the willow, and the great nettle, from which they make their ſtuffs. They are of a moderate ſize, ſquat, and ſtrong built, with the muſcles of their bodies very exactly defined: their common height is five feet, and the greateſt does not exceed five feet four inches; but men of this ſize are very uncommon among them. They have all a large head, and a broader and more rounded face than Europeans; their countenance is animated and agreeable, though, upon the whole, it is deſtitute of that regularity and grace which we eſteem ſo eſſential to beauty: they have large cheeks, a ſhort noſe rounded at its extremity, with very broad noſtrils: their eyes are lively, of a moderate ſize, for the moſt part black, though ſome have blue ones among them: their eyebrows are buſhy, their mouth of the common ſize, their voice is ſtrong, their lips are rather thick, and of a dull red: M. Rollin remarked, that in ſeveral the upper lip was tattoed, and tinged of a blue colour: theſe, as well as their eyes, are capable of every variety of expreſſion: their teeth are white, even, and of the uſual number; their chin is rounded and a little advancing; their ears are ſmall: they bore and wear in them glaſs ornaments or ſilver rings.

The women are not ſo large as the men, and are of a more rounded and delicate figure, though there is but little difference between the features of their faces. Their upper lip is tattoed all over of a blue colour, and they wear their hair long and flowing: their dreſs hardly differs from that of the men; the colour of the ſkin in both ſexes is tawny, and that of their nails, which they ſuffer to grow to a great length, is a ſhade darker than that of Europeans. Theſe iſlanders are very hairy, and have long beards, which gives, eſpecially to the old men, a grave and venerable air: theſe laſt appear to be held in much reſpect by the younger part of the inhabitants. The hair of their head is black, ſmooth, and moderately ſtrong; in ſome it is of a cheſnut colour: they all wear it round, about ſix inches long behind, and cut into a bruſh on the top of their head and over the temples.

Their cloathing conſiſts of a kind of ſurtout which wraps over before, where it is faſtened by little buttons, ſtrings, and a girdle placed above the haunches. This ſurtout is made of ſkin or quilted nankeen, a kind of ſtuff that they make of willow bark: it generally reaches to the calf of the leg, and ſometimes even lower, which for the moſt part renders the uſe of drawers unneceſſary: ſome of them wear ſeal ſkin boots, the feet of which, in form and workmanſhip, reſemble the Chineſe ſhoe; but the greater number of them go bare-footed and bare-headed: a few indeed wear a bandage of bear-ſkin round the head; but this is rather as an ornament than a defence againſt the weather.

Like the lower claſſes of the Chineſe, they all wear a girdle, to which they hang their knife as a defence againſt the bears, and ſeveral little pockets, into which they put their flint and ſteel, their pipe, and their box of tobacco; for they make a general practice of ſmoking.

Their huts are ſufficient to defend them againſt the rain and other inclemencies of the air, but are very ſmall in proportion to the number of the inhabitants which they contain. The roof is formed of two inclined planes, which are from ten to twelve feet high at their junction, and three or four on the ſides: the breadth of the roof is about fifteen feet, and its length eighteen: theſe cabins are conſtructed of frame work, ſtrongly put together, the ſides being filled up with the bark of trees, and the top thatched with dry graſs in the ſame manner as our cottages are.

On the inſide of theſe houſes is a ſquare of earth raiſed about ſix inches above the ground, and ſupported on the ſides by ſtrong planking; on this they make the fire: along the ſides of the apartment are benches twelve or fifteen inches high, which they cover with mats, on which they ſleep.

The utenſils that they employ in cooking their food conſiſt of an iron pot, ſhells, veſſels made of wood and birch bark, of various ſhapes and workmanſhip; and, like the Chineſe, they take up their food with little ſticks: they have generally two meals in the day, one at noon, and the other in the evening.

The habitations in the ſouth part of the iſland are much better built and furniſhed, having for the moſt part planked floors: our author ſaw in them ſome veſſels of Japan porcelain, on which the owners appeared to ſet great value, probably becauſe they are not to be procured but with great trouble and at conſiderable expenſe. They cultivate no kind of vegetable, living only on dried and ſmoked fiſh, and what little game they take by hunting.

Each family has its own canoe, and implements for fiſhing and hunting. Their arms are bows, javelins, and a kind of ſpontoon, which they uſe principally in bear-hunting. By the ſide of their houſes are the magazines, in which they lay up the proviſion which they have prepared and collected during ſummer for their winter ſubſiſtence. It conſiſts of dried fiſh, and a conſiderable quantity of garlic and wild celery, angelica, a bulbous root which they call *aſé*, better known under the name of the yellow lily of Kamtſchatka, and fiſh oil, which they preſerve in the ſtomachs of bears, and other large animals. Theſe magazines are made of planks, ſtrongly and cloſely put together, raiſed above the ground on ſtakes about four feet high.

Dogs are the only domeſtic animals belonging to the natives of Tchoka; they are of a middling ſize, with ſhaggy hair, pricked ears, and a ſharp long muzzle; their cry is loud and not ſavage.

Theſe people, who are of a very mild and unſuſpecting diſpoſition, appear to have commercial intercourſe with the Chineſe by means of the Mantchou Tartars, with the Ruſſians to the north of their iſland, and the Japaneſe to the ſouth: but the articles of trade are of no great conſequence, conſiſting only of a few furs and whale oil. This fiſh is caught only on the ſouthern coaſt of the iſland. Their mode of extracting the oil is by no means economical; they drag the whale on ſhore on a ſloping ground, and ſuffering it to putrefy, receive in a trench, at the foot of the ſlope, the oil, which ſeparates ſpontaneouſly.

The iſland is well wooded, and mountainous towards the centre, but is flat and level along the coaſt, the ſoil of which appears admirably adapted to agriculture: vegetation is extremely vigorous here; foreſts of pine, willow, oak, and birch, cover nearly the whole ſurface. The ſea abounds with fiſh, as well as the rivers and brooks, which ſwarm with ſalmon and trout of an excellent quality. The weather is, in general, foggy and mild. All the inhabitants have an air of health and ſtrength, which they retain even to extreme old age; nor did our author obſerve among them any inſtance of defective organization, or the leaſt trace of contagious or eruptive diſorders.

SEGMENTS, line of, are two particular lines, ſo called on Gunter's ſector. They lie between the lines of ſines and ſuperfices, and are numbered with 5, 6, 7, 8, 9, 10. They repreſent the diameter of a circle, ſo divided into 100 parts, as that a right line drawn through theſe parts, and perpendicular to the diameter, ſhall cut the circle into two ſegments, the greater of which ſhall have the ſame proportion to the whole circle, as the parts cut off have to 100.

SEGO, the capital of the kingdom of Bambarra in Africa, is ſituated on the banks of the Niger, in 14° 4′ N. Lat. and 2° 1′ Weſt Long. It conſiſts, properly ſpeaking, of four diſtinct towns; two on the northern bank of the Niger, called Sego Korro, and Sego Boo; and two on the ſouthern bank, called Sego Soo Korro, and Sego See Korro. They are all ſurrounded with high mud-walls; the houſes are built of clay, of a ſquare form, with flat roofs; ſome of them have two ſtories, and many of them are whitewaſhed. Beſides theſe buildings, Mooriſh moſques are ſeen in every quarter; and the ſtreets, though narrow, are broad enough for every uſeful purpoſe in a country where wheel-carriages are entirely unknown. Mr Park informs us, that from the beſt inquiries that he could make, he has reaſon to believe that Sego contains altogether about thirty thouſand inhabitants. The King of Bambarra conſtantly reſides at Sego See Korro; he employs a great many ſlaves in conveying people over the river, and the money they receive (though the fare is only ten kowrie ſhells for each individual) furniſhes a conſiderable revenue to the king in the courſe of a year. The canoes are of a ſingular conſtruction, each of them being formed of the trunks of two large trees, rendered concave, and joined together, not ſide by ſide, but endwiſe; the junction being exactly acroſs the middle of the canoe; they are therefore very long and diſproportionably narrow, and have neither decks nor maſts; they are, however, very roomy; for our author obſerved in one of them four horſes, and ſeveral people, croſſing over the river. The vew of this extenſive city; the numerous canoes upon the river; the crowded population, and the cultivated ſtate of the ſurrounding country, formed altogether a proſpect of civilization and magnificence which he little expected to find in the boſom of Africa.

He met not, however, in Sego with that hoſpitality which he had experienced in ſome other African towns. The Moors, who abound in it, and whoſe bigotry renders them the implacable enemies of every white man ſuſpected of being a Chriſtian, contrived to perſuade the king that it was for no good purpoſe he had come into the territories of Bambarra. He was therefore ordered to take up his reſidence at a village a little diſtant, without being admitted into the royal preſence. Even there, ſo ſtrong was the prejudice that had been excited againſt him, no perſon would admit him into his houſe. About ſunſet, however, as he was preparing to paſs the night in the top of a tree, that he might not be in danger of being torn to pieces by wild beaſts, a poor Negro woman conducted him to her hut, dreſſed a fine fiſh for his ſupper, and furniſhed him with a mat to ſleep on. She then called to the female part of her family, who had ſtood gazing on him all the while with fixed aſtoniſhment, to reſume their taſk of ſpinning cotton; in which they continued to employ themſelves great part of the night. They lightened their labour by ſongs; one of which was compoſed extempore, for our author was himſelf the ſubject of it. It was ſung by one of the young women, the reſt joining in a ſort of chorus. The air was ſweet and plaintive, and the words, literally tranſlated, were theſe—"The winds roared, and the rains fell.—The poor white man, faint and weary, came and ſat under our tree.—He has no mother to bring him milk; no wife to grind his corn. *Chorus.* Let us pity the white man; no mother has he", &c. &c. "Trifling (ſays Mr Park) as this recital may appear to the reader, to a perſon in my ſituation the circumſtance was affecting in the higheſt degree."

Having remained three days in this village, he was diſmiſſed on the fourth, after receiving from the king 5000 kowries, to enable him to purchaſe proviſions in the courſe of his journey. Though this ſum amounted only to one pound ſterling, ſo cheap are the neceſſaries of life in Bambarra, that it was ſufficient to purchaſe proviſions for himſelf, and corn for his horſe, for fifty days.

SEGOVIA, *New*, a ſmall city in the juriſdiction of Guatimala, in New Spain, 30 miles north of New Granada,

Granada. It has ſeveral gold mines in its neighbourhond, though the city is ſmall and thinly inhabited. N. lat. 12 42, W. long. 87 31.—*Morſe*.

SEGUINE *Iſland*, or *Segum*, on the coaſt of the Diſtrict of Maine, is one of the ſouthernmoſt iſlands in Caſco Bay; between Cape Small Point and Georgetown. There is a light-houſe on this iſland which contains a repeating light, ſo conſtructed as to diſappear once every minute and a half, which diſtinguiſhes it from Portland light. N. lat. 43 56, W. long. 69 20.—*ib*.

SEGURA *de la Frontera*, a large town in the province of Tlaſcala, and kingdom of Mexico, 70 miles weſt of Xalappa, and in the road from Vera Cruz to Mexico. The ſurrounding country has a temperate air, and is remarkably fruitful, producing large quantities of corn and fruits, particularly grapes. N. lat. 19 28, W. long. 100 10.—*ib*.

SELL, in building, is of two kinds, viz. *Ground Sell*, which denotes the loweſt piece of timber in a wooden building, and that upon which the whole ſuperſtructure is raiſed; and *Sell of a Window*, or *of a Door*, which is the bottom piece in the frame of them, upon which they reſt.

SEMINOLES, a diviſion of the Creek nation of Indians. They inhabit the flat, level country on the rivers Apalachicola and Flint.—*Morſe*.

SEMPRONIUS, a townſhip of New-York, nearly in the centre of the county of Onondago, is 20 miles ſouth-eaſt from the ferry on Cayuga Lake. It is within the juriſdiction of the townſhip of Scipio.—*ib*.

SENECA, a town of New-York, Onondago county, lately laid off into ſtreets and ſquares, on the north ſide of Seneca Falls. The enterpriſing proprietors are erecting flour and ſaw mills, of the beſt kind, on this never failing ſtream; and from its central ſituation, both by land and water, between the eaſtern and weſtern countries, being at the carrying place, it promiſes a rapid increaſe. The proprietors have expended large ſums of money, not only in erecting mills, but in building a convenient bridge acroſs Seneca river, and are now co-operating with the enterpriſing Gen. Williamſon in making a good waggon-road to Geneva.—*ib*.

SENECA *Creek*, in Maryland, has two branches; one of which is called Little Seneca. It empties into Patowmac river, about 19 miles N. W. of the mouth of Rock Creek, which ſeparates Georgetown from Waſhington city.—*ib*.

SENECA *River*, in the State of New-York, riſes in the Seneca country; runs eaſtwardly, and in its paſſage receives the waters of Seneca and Cayuga lakes, (which lie north and ſouth 10 or 12 miles apart; each is between 30 and 40 miles in length, and a mile in breadth) and empties into the Onondago river, 14 miles below the falls, at a place called the Three Rivers. The river is boatable from the lakes downwards. Within half a mile of the river is the famous Salt Lake.—*ib*.

SENECAS, a tribe of Indians, one of the *Six Nations*. They inhabit on Geneſſee river, at the Geneſſee Caſtle. The tribe conſiſts of about 1780 ſouls. They have two towns of 60 or 70 ſouls each, on French Creek in Pennſylvania, and another town on Buffaloe Creek, and two ſmall towns on Alleghany river.—*ib*.

SENN, a kind of itinerant cowkeeper in Switzerland, particularly in the canton of Appenzell. Theſe men do not grow ſo much hay themſelves as they require for their cattle during the winter ſeaſon, and ſome of them have no graſs lands at all. To ſupply this deficiency, they employ agents throughout the canton, who are to inform them where good hay may be obtained, which farmers made it in favourable weather, &c. and then the Senn, or the great cowkeeper, who is in want of fodder, makes his agreements for the winter with the wealthier farmers, to whom he ſucceſſively drives his cattle as ſoon as they return from graſs. Thus the itinerant Senn, with his cows, often viſits five different places during the winter ſeaſon. He who ſells the hay furniſhes the Senn not only with ſtabling for his beaſts, but boards and lodges him as well as his whole family. In return, the Senn, beſides paying the ſtipulated price for the hay, allows to his hoſt as much milk, whey, and *zieger* (a kind of lean cheeſe) as may be uſed in the houſe, and leaves him alſo the manure of his cows. In the middle of April, when Nature revives, the Senn again iſſues forth with his herd to the meadows and fertile Alps, which he rents for the ſummer. Thus the life of theſe men is a conſtant migration, affording the moſt pleaſing variety, and bleſſing them with health, content, and cheerfulneſs; but they had not been then curſed with French fraternity.

Fine cattle are the pride of the cowkeeper who inhabits the Alps:—but, not ſatisfied with their natural beauty, he will likewiſe pleaſe his vanity. He adorns his beſt cows with large bells ſuſpended from broad thongs; and the expenſe in ſuch bells is carried even to a luxurious exceſs. Every Senn has an harmonious ſet of at leaſt two or three bells, chiming in with the famous *ranz des vaches* (A). The inhabitants of the Tyrol bring a number of ſuch bells, of all ſizes, to every fair kept in the canton of Appenzell. They are fixed to a broad ſtrap, neatly pinked, cut out, and embroidered; which is faſtened round the cow's neck by means of a large buckle. A bell of the largeſt ſize meaſures upwards of a foot in diameter, is of an uniform width at top, ſwells out in the middle, and tapers towards the end. It coſts from forty to fifty gilders: and the whole peal of bells, including the thongs, will ſometimes be worth between 140 and 150 gilders, while the whole apparel of the Senn himſelf, when beſt attired, does not amount to the price of twenty gilders. The fineſt black cow is adorned with the largeſt bell, and thoſe next in appearance have two ſmaller. Theſe ornaments, however, are not worn on every day, but only on ſolemn occaſions, viz. when, in the ſpring, they are driven up the Alps, or removed from one paſture to another; or when they deſcend in the autumn, or travel

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(A) This famous paſtoral ſong is never ſung by the cowherds with words to it: all the tones of it are ſimple, and moſtly formed within the throat. Hence the tune produces very little or no motion of the jawbones, and its ſounds do not reſemble thoſe which commonly iſſue from the human throat, but rather ſeem to be the tones of ſome wind inſtrument; particularly as ſcarcely any breathing is perceived, and as the cowherds ſometimes ſing for minutes together without fetching breath.

travel in the winter to the different farms, where their owner has contracted for hay. On ſuch days, the Senn, even in the depth of winter, appears dreſſed in a fine white ſhirt, of which the ſleeves are rolled up above the elbow; neatly embroidered red braces keep up his yellow linen trowſers, which reach down to the ſhoes; a ſmall leather cap, or hat, covers his head; and a new milk bowl, of wood ſkilfully carved, hangs acroſs the left ſhoulder. Thus arrayed, the Senn precedes ſinging the *ranz des vaches*, and followed by three or four fine goats; next comes the handſomeſt cow with the great bell; then the two other cows with ſmaller bells; and theſe are ſucceeded by the reſt of the cattle walking one after another, and having in their rear the bull with a one-legged milking ſtool hanging on his horns; the proceſſion is cloſed by a *traineau*, or ſledge, on which are placed the implements for the dairy. It is ſurpriſing to ſee how proud and pleaſed the cows ſtalk forth when ornamented with their bells. Who would imagine that even theſe animals are ſenſible of their rank, nay, touched with vanity and jealouſy! If the leading cow, who hitherto bore the largeſt bell, be deprived of her honours, ſhe very plainly manifeſts her grief at the diſgrace, by lowing inceſſantly, abſtaining from food, and growing lean. The happy rival, on whom the diſtinguiſhing badge of ſuperiority has devolved, experiences her marked vengeance, and is butted, wounded, and perſecuted by her in the moſt furious manner; until the former either recovers her bell, or is entirely removed from the herd. However ſingular this phenomenon may appear, it is placed beyond all doubt by the concurring teſtimony of centuries.

The cows, when diſperſed on the Alps, are brought together by the voice of the Senn, who is then ſaid to *allure* them (*locken*). How well the cattle diſtinguiſh the note of their keeper appears from the circumſtance of their haſtening to him, though at a great diſtance, whenever he begins to hum the *ranz des vaches*. He furniſhes that cow which is wont to ſtray fartheſt with a ſmall bell, and knows by her arrival that all the reſt are aſſembled.

SENTER *Harbour*, in the north-weſt part of Lake Winnipiſeogee.—*Morſe*.

SEPARATION *Bay*, in the Straits of Magellan, is 3 leagues within Cape Pillar, at the weſt end of the Straits, and lies weſt of Tueſday Bay.—*ib*.

SEREGIPPE, a captainſhip of Brazil, ſo named from a river of the ſame name, running through the middle of it, and falling into the Atlantic Ocean in lat. 11 12 ſouth. It is bounded north by the river St Francis, and ſouth by that of Todos los Santós. It produces ſugar and tobacco in conſiderable quantities.—*ib*.

SEREGIPPE, the capital of the above captainſhip, with a harbour on the S. Atlantic Ocean, 40 leagues N. E. of St Salvadore. It is ſituated on a riſing ground on the north ſide of Vazabaris river, 33 miles from the ſea. It is very inconſiderable; but has ſome ſilver mines in its neighbourhood. S. lat. 11 20, W. long. 31 2.—*ib*.

SERRANA, an iſle between Jamaica and the coaſt of Nicaragua, which took its name from one *Serrana*, who parted with the fleet from Spain, in the time of Charles V. and was ſhipwrecked on the rocks of this iſland; but having gained the ſhore by ſwimming, he found there neither herbs, trees, nor water, and went over all the iſland, which is about 6 miles in circuit, without finding any thing to quench thirſt or ſatisfy hunger. Preſſed at laſt with extreme hunger, he caught ſome crabs on the ſhore, which were his food for ſome days; and then ſeeing large turtles which came aſhore, he caught ſome of them. Having lived for three years in this manner, on crabs and turtles, and drank nothing but rain-water which he gathered in turtle-ſhells, he diſcovered another companion in misfortune, who had alſo been ſhipwrecked. This companion was ſome comfort to him, and they lived four years together; at the end of which time, a veſſel coming near the iſland, carried them both to Spain. The laſt of theſe died on the way thither; but *Serrana* was carried to Germany, and preſented to Charles V. as a kind of prodigy, for all his body was overgrown with hair like a bear, and his beard came down to his waiſt. The emperor beſtowed on him 4,800 ducats to be paid in Peru; but he died on his way to Panama, as he was going to receive them.—*ib*.

SERRISHTEHDAR, in Bengal, keeper of records or accounts.

SESEME *Quian*, a river of the N. W. Territory, which empties through the weſtern bank of Illinois river, about 180 miles from the Miſſiſſippi. Its mouth is 40 yards wide; and the land bordering on it is very good. It is boatable 60 miles.—*Morſe*.

SEVEN *Brothers*, ſmall iſlands on the north coaſt of the iſland of St Domingo. They lie oppoſite the mouth of Monte Chriſt river, or Grand Yaqui. They have occaſioned ſeveral wrecks, and prove a ſhelter to privateers.—*ib*.

SEVEN *Iſlands Bay*, on the north ſide of the river St Lawrence; 25 leagues from the weſt end of the iſland of Anticoſti, and in lat. 50 20 N. It was one of the French poſts for trading with the Indians, and has a very ſecure harbour for ſhips in any wind.—*ib*.

SEVEN STARS, a common denomination given to the cluſter of ſtars in the neck of the ſign Taurus, the bull, properly called the *Pleiades*. They are ſo called from their number Seven which appear to the naked eye, though ſome eyes can diſcover only ſix of them; but by the help of teleſcopes there appears to be a great multitude of them.

SEVERN, a ſmall river of Maryland, of ſhort courſe, which runs ſouth-eaſt to Cheſapeak Bay. It paſſes by Annapolis city on the N. and empties into the bay about two miles below the city.—*Morſe*.

SEVERN, a river of New South Wales, which purſues a north-eaſterly courſe, and enters Hudſon's Bay at Severn Houſe, which is 160 miles eaſt of York Fort.—*ib*.

SEVIER, a county of Tenneſſee, Hamilton diſtrict. In 1795, it contained, according to the State cenſus, 3,578 inhabitants, including 129 ſlaves.—*ib*.

SEVILLA *Nueva*, a town which was founded by the famous Eſquivel, on the north ſide of the iſland of Jamaica; a little to the weſtward of Mammee Bay, and the ſpot which had been honoured by the reſidence of Columbus, after his ſhipwreck in 1503. It is now called Seville Plantation; and the ruins of the ancient town are ſtill viſible in ſome of the cane-fields.—*ib*.

SEWEE *Bay*, or *Bull's Harbour*, on the coaſt of S. Carolina, is ſouth-weſt of Cape Carteret. The long and narrow iſland called Racoon Keys is between Cape Carteret Iſland and the entrance to this harbour, which is at the N. E. end of Bull's Iſland.—*ib.*

SEYBO, or *Seyvo*, a ſettlement in the ſouth-eaſt part of the iſland of St Domingo, on the upper road from Higuey to St Domingo city; 18 leagues weſt by north of the former, and 24 N. E. of the latter. It is alſo 12 leagues north of the little iſland of St Catherine, on the ſouth coaſt of the main iſland. It is not that founded in 1502, by John of Eſquivel, but a ſettlement formed in the ſame canton about 60 years ago by ſeveral graziers, and has a place of worſhip. Towards the year 1780 it had augmented, but is now falling to decay. The pariſh contains more than 4,000 perſons; the greateſt part of whom are graziers or herdſmen, free negroes or people of colour.—*ib.*

SEZAWUL, in Bengal, an officer deputed occaſionally to enforce the due payment of the revenue.

SHADOWS (COLOURED), a curious optical phenomenon, which was obſerved, a conſiderable number of years ago, by Profeſſor Scherffer of Vienna, and more lately by Count Rumford. The Count made the diſcovery when proſecuting his experiments upon light; of which the reader will find ſome account under the titles LAMP and PHOTOMETER in this *Suppl.* "Deſirous (ſays he) of comparing the intenſity of the light of a clear blue ſky by day with that of a common wax-candle, I darkened my room, and letting the day-light from the north, coming thro' a hole near the top of the window-ſhutter, fall at an angle of about 70° upon a ſheet of very fine white paper, I placed a burning wax-candle in ſuch a poſition that its rays fell upon the ſame paper, and, as near as I could gueſs, in the line of reflection of the rays of day-light from without; when, interpoſing a cylinder of wood, about half an inch in diameter, before the centre of the paper, and at the diſtance of about two inches from its ſurface, I was much ſurpriſed to find that the two ſhadows projected by the cylinder upon the paper, inſtead of being merely ſhades without colour, as I expected; the one of them, that which, correſponding with the beam of day-light, was illuminated by the candle, was yellow; while the other, correſponding to the light of the candle, and conſequently illuminated by the light of the heavens, was of the moſt beautiful blue that it is poſſible to imagine. This appearance, which was not only unexpected, but was really in itſelf in the higheſt degree ſtriking and beautiful, I found upon repeated trials, and after varying the experiment in every way I could think of, to be ſo perfectly permanent, that it is abſolutely impoſſible to produce two ſhadows at the ſame time, from the ſame body, the one anſwering to a beam of day-light, and the other to the light of a candle or lamp, without theſe ſhadows being coloured, the one yellow, and the other blue.

"If the candle be brought nearer to the paper, the blue ſhadow will become of a deeper hue, and the yellow ſhadow will gradually grow fainter; but if it be removed farther off, the yellow ſhadow will become of a deeper colour, and the blue ſhadow will become fainter; and the candle remaining ſtationary in the ſame place, the ſame varieties in the ſtrength of the tints of the coloured ſhadows may be produced merely by opening the window-ſhutter a little more or leſs, and rendering the illumination of the paper, by the light from without, ſtronger or weaker. By either of theſe means, the coloured ſhadows may be made to paſs through all the gradations of ſhade, from the deepeſt to the lighteſt, and *vice verſa*; and it is not a little amuſing to ſee ſhadows thus glowing with all the brilliancy of the pureſt and moſt intenſe priſmatic colours, then paſſing ſuddenly through all the varieties of ſhade, preſerving in all the moſt perfect purity of tint, growing ſtronger and fainter, and vaniſhing and returning, at command."

With reſpect to the cauſes of the colours of theſe ſhadows, there is no doubt (ſays the Count) but they ariſe from the different qualities of the light by which they are illuminated; but how they are produced, does not appear to him ſo evident. With the utmoſt deference to this amiable and very ingenious philoſopher, we think all the phenomena of coloured ſhadows which he enumerates,[*] have been, or may be accounted for by Profeſſor Scherffer's theory, of which the reader will find, we hope, a perſpicuous view under *Accidental* COLOURS, in this *Supplement*.

SHAFTSBURY, a conſiderable and flouriſhing townſhip of Vermont. It has Arlington on the north and Bennington on the ſouth, and contains 1999 inhabitants.—*Morse.*

SHAG *Iſland*, near the entrance into Chriſtmas Sound, on the ſouth coaſt of the iſland of Terra del Fuego. The entrance to Port Clerke in this ſound is juſt to the north of ſome low rocks which lie off a point of Shag Iſland.—*ib.*

SHAGREEN, or CHAGRIN, in commerce, a kind of grained leather; of the proceſs of preparing which, we gave the beſt account that we could then find in the *Encyclopædia*. That account, however, as we learn from Profeſſor Pallas, is very defective. He ſays, indeed, that no accurate account of it has ever been publiſhed in Europe previous to his own; of which we ſhall now lay an abridgement before our readers.

"All kinds of horſes or aſſes ſkin, which have been dreſſed in ſuch a manner as to appear grained, are, by the Tartars, called *ſauwer*, by the Perſians *ſogre*, and by the Turks *ſagri*, from which the Europeans have made *ſhagreen* or *chagrin*. The Tartars who reſide at Aſtracan, with a few of the Armenians of that city, are the only people in the Ruſſian empire acquainted with the art of making ſhagreen. Thoſe who follow this occupation not only gain conſiderable profit by the ſale of their production to the Tartars of Cuban, Aſtracan, and Caſan, who ornament with it their Turkey leather boots, ſlippers, and other articles made of leather, but they derive conſiderable advantage from the great ſale of horſes hides, which have undergone no other proceſs than that of being ſcraped clean, and of which ſeveral thouſands are annually exported, at the rate of from 75 to 85 roubles per hundred, to Perſia, where there is a ſcarcity of ſuch hides, and from which the greater part of the ſhagreen manufactured in that country is prepared. The hind part only of the hide, however, which is cut out in the form of a creſcent about a Ruſſian ell and a half in length acroſs the loins, and a ſhort ell in breadth along the back, can properly be employed for ſhagreen. The remaining part, as is proved by experience, is improper for that purpoſe, and is therefore rejected.

"The preparation of the ſkins, after being cut into the above form, is as follows:—They are depoſited in

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[*] *Phil. Tranſ.* 1794, p. 107.

a tub filled with pure water, and ſuffered to remain there for ſeveral days, till they are thoroughly ſoaked, and the hair has dropped off. They are then taken from the tub, one by one, extended on boards placed in an oblique direction againſt a wall, the corners of them, which reach beyond the edges of the board, being made faſt, and the hair with the epidermis is then ſcraped off with a blunt iron ſcraper called *urak*. The ſkins thus cleaned are again put in pure water to ſoak. When all the ſkins have undergone this part of the proceſs, they are taken from the water a ſecond time, ſpread out one after the other as before, and the fleſh ſide is ſcraped with the ſame kind of inſtrument. They are carefully cleaned alſo on the hair ſide, ſo that nothing remains but the pure fibrous tiſſue, which ſerves for making parchment, conſiſting of coats of white medullary fibres, and which has a reſemblance to a ſwine's bladder ſoftened in water.

" After this preparation, the workmen take a certain kind of frames called *pälzi*, made of a ſtraight and a ſemicircular piece of wood, having nearly the ſame form as the ſkins. On theſe the ſkins are extended in as ſmooth and even a manner as poſſible by means of cords; and during the operation of extending them, they are ſeveral times beſprinkled with water, that no part of them may be dry, and occaſion an unequal tenſion. After they have been all extended on the frames, they are again moiſtened, and carried into the houſe, where the frames are depoſited cloſe to each other on the floor with the fleſh ſide of the ſkin next the ground. The upper ſide is then thickly beſtrewed with the black exceedingly ſmooth and hard ſeeds of a kind of gooſe foot (*chenopodium album*), which the Tartars call *alabuta*, and which grows in abundance, to about the height of a man, near the gardens and farms on the ſouth ſide of the Volga; and that they may make a ſtrong impreſſion on the ſkins, a piece of felt is ſpread over them, and the ſeeds are trod down with the feet, by which means they are deeply imprinted into the ſoft ſkins. The frames, without ſhaking the ſeeds, are then carried out into the open air, and placed in a reclining poſition againſt a wall to dry, the ſide covered with the ſeeds being next the wall, in order that it may be ſheltered from the ſun. In this ſtate the ſkins muſt be left ſeveral days to dry in the ſun, until no appearance of moiſture is obſerved in them, when they are fit to be taken from the frames. When the impreſſed ſeeds are beat off from the hair ſide, it appears full of indentations or inequalities, and has acquired that impreſſion which is to produce the grain of the ſhagreen, after the ſkins have been ſubjected to the laſt ſmoothing or ſcraping, and have been dipped in a ley, which will be mentioned hereafter, before they receive the dye.

" The operation of ſmoothing is performed on an inclined bench or board, which is furniſhed with an iron hook, and is covered with thick felt of ſheep's wool, on which the dry ſkin may gently reſt. The ſkin is ſuſpended in the middle of the bench or board to its iron hook, by means of one of the holes made in the edge of the ſkin for extending it in its frame as before mentioned; and a cord, having at its extremity a ſtone or a weight, is attached to each end of the ſkin, to keep it in its poſition while under the hands of the workman. It is then ſubjected to the operation of ſmoothing and ſcraping by means of two different inſtruments. The firſt uſed for this purpoſe, called by the Tartars *tokar*, is a piece of ſharp iron bent like a hook, with which the ſurface of the ſhagreen is pretty cloſely ſcraped to remove all the projecting inequalities. This operation, on account of the corneous hardneſs of the dry ſkin, is attended with ſome difficulty; and great caution is at the ſame time required that too much of the impreſſion of the *alabuta* ſeed be not deſtroyed, which might be the caſe if the iron were kept too ſharp. As the iron, however, is pretty blunt, which occaſions inequalities on the ſhagreen, this inconvenience muſt afterwards be remedied by means of a ſharp ſcraping iron or *urak*, by which the ſurface acquires a perfect uniformity, and only faint impreſſions of the *alabuta* ſeed then remain, and ſuch as the workman wiſhes. After all theſe operations, the ſhagreen is again put into water, partly to make it pliable, and partly to raiſe the grain. As the ſeeds occaſion indentations in the ſurface of the ſkin, the intermediate ſpaces, by the operations of ſmoothing and ſcraping, loſe ſome part of their projecting ſubſtance; but the points which have been depreſſed, and which have loſt none of their ſubſtance, now ſwell up above the ſcraped parts, and thus form the grain of the ſhagreen. To produce this effect, the ſkins are left to ſoak in water for 24 hours after which they are immerſed ſeveral times in a ſtrong warm ley, obtained, by boiling, from a ſtrong alkaline earth named *ſchora*, which is found in great abundance in the neighbourhood of Aſtracan. When the ſkins have been taken from this ley, they are piled up, while warm, on each other, and ſuffered to remain in that ſtate ſeveral hours; by which means they ſwell, and become ſoft. They are then left 24 hours in a moderately ſtrong pickle of common ſalt, which renders them exceedingly white and beautiful, and fit for receiving any colour. The colour moſt uſual for theſe ſkins is a ſea-green; but old experienced workmen can dye them blue, red, or black, and even make white ſhagreen.

" For the green colour nothing is neceſſary but filings of copper and ſal ammoniac. Sal ammoniac is diſſolved in water till the water is completely ſaturated; and the ſhagreen ſkins, ſtill moiſt, after being taken from the pickle, are waſhed over with the ſolution on the ungrained fleſh ſide, and when well moiſtened a thick layer of copper filings is ſtrewed over them: the ſkins are then folded double, ſo that the ſide covered with the filings is innermoſt. Each ſkin is then rolled up in a piece of felt; the rolls are all ranged together in proper order, and they are preſſed down in an uniform manner by ſome heavy bodies placed over them, under which they remain 24 hours. During that period, the ſolution of ſal ammoniac diſſolves a quantity of the cupreous particles ſufficient to penetrate the ſkin and to give it a ſea-green colour. If the firſt application be not ſufficient, the proceſs is repeated in the ſame manner; after which the ſkins are ſpread out and dried.

" For the blue dye, indigo is uſed. About two pounds of it, reduced to a fine powder, are put into a kettle; cold water is poured over it, and the mixture is ſtirred round till the colour begins to be diſſolved. Five pounds of pounded *alakar*, which is a kind of barilla or crude ſoda, prepared by the Armenians and Calmucs, is then diſſolved in it, with two pounds of lime and a pound of pure honey, and the whole is kept ſeveral days in the ſun, and during that time frequently ſtirred round. The ſkins intended to be dyed blue muſt be moiſtened only in the natrous ley *ſchora*, but not in the ſalt brine. When ſtill moiſt, they are folded up and ſewed together at the edge, the fleſh ſide being innermoſt, and the ſhagreened hair ſide outwards; after which they are dipped three times in the remains of an exhauſted kettle of the ſame dye, the ſuperfluous dye being each time expreſſed; and after this proceſs they are dipped in the freſh dye prepared as above, which muſt not be expreſſed. The ſkins are then hung up in the ſhade to dry; after which they are cleaned and pared at the edges.

"For black ſhagreen, gall nuts and vitriol are employed in the following manner:—The ſkins, moiſt from the pickle, are thickly beſtrewed with finely pulveriſed gall nuts. They are then folded together, and laid over each other for 24 hours. A new ley, of bitter ſaline earth or *ſchora*, is in the mean time prepared, and poured hot into ſmall troughs. In this ley each ſkin is ſeveral times dipped; after which they are again beſtrewed with pounded gall-nuts, and placed in heaps for a certain period, that the galls may thoroughly penetrate them, and they are dried and beat, to free them from the duſt of the galls. When this is done, they are rubbed over, on the ſhagreen ſide, with melted ſheep's tallow, and expoſed a little in the ſun, that they may imbibe the greaſe. The ſhagreen-makers are accuſtomed alſo to roll up each ſkin ſeparately, and to preſs or ſqueeze it with their hands againſt ſome hard ſubſtance, in order to promote the abſorption of the tallow. The ſuperfluous particles are removed by means of a blunt wooden ſcraper *(urac)*; and when this proceſs is finiſhed, and the ſkins have lain ſome time, a ſufficient quantity of vitriol of iron is diſſolved in water, with which the ſhagreen is moiſtened on both ſides, and by this operation it acquires a beautiful black dye. It is then dreſſed at the edges, and in other places where there are any blemiſhes.

"To obtain white ſhagreen, the ſkins muſt firſt be moiſtened on the ſhagreen ſide with a ſtrong ſolution of alum. When the ſkin has imbibed this liquor, it is daubed over on both ſides with a paſte made of flour, which is ſuffered to dry. The paſte is then waſhed off with alum-water, and the ſkin is placed in the ſun till it is completely dry. As ſoon as it is dry, it is gently beſmeared with pure melted ſheep's tallow, which it is ſuffered to imbibe in the ſun; and to promote the effect, it is preſſed and worked with the hands. The ſkins are then faſtened in ſucceſſion to the before mentioned bench, where warm water is poured over them, and the ſuperfluous fat is ſcraped off with a blunt wooden inſtrument. In the laſt operation the warm water is of great ſervice. In this manner ſhagreen perfectly white is obtained, and nothing remains but to pare the edges and dreſs it.

"But this white ſhagreen is not intended ſo much for remaining in that ſtate, as for receiving a dark red dye; becauſe, by the above previous proceſs, the colour becomes much more perfect. The ſkins deſtined for a red colour muſt not be immerſed firſt in ley of bitter ſalt earth *(ſchora)*, and then in pickle, but after they have been whitened, muſt be left to ſoak in the pickle for 24 hours. The dye is prepared from cochineal, which the Tartars call *kirmitz*. About a pound of the dried herb *tſchagann*, which grows in great abundance in the neighbourhood of Aſtracan, and is a kind of ſoda plant or kali *(ſalſola ericoides* (A), is boiled a full hour in a kettle containing about four common pailfuls of water; by which means the water acquires a greeniſh colour. The herb is then taken out, and about half a pound of pounded cochineal is put into the kettle, and the liquor is left to boil a full hour, care being taken to ſtir it that it may not run over. About 15 or 20 drams of a ſubſtance which the dyers call *lüter* (orchilla) is added, and when the liquor has been boiled for ſome time longer, the kettle is removed from the fire. The ſkins taken from the pickle are then placed over each other in troughs, and the dye-liquor is poured over them four different times, and rubbed into them with the hands, that the colour may be equally imbibed and diffuſed. The liquor each time is expreſſed; after which they are fit for being dried. Skins prepared in this manner are ſold at a much dearer rate than any of the other kinds."

SHALLOW *Ford*, is that part of Tenneſſee river which is 1200 yards broad; 12 miles above the *Whirl*. It lies between Chatanuga and Chickaugo rivers which fall in from the ſouth-eaſt.—*Morſe*.

SHALLOW *Water, Point*, on the N. W. coaſt of N. America, lies in lat. 63 N. Between this point and Shoal Neſs, which is 3 degrees of lat. to the ſouthward, Capt. Cook did not explore the coaſt, on account of the ſhallow water he met with.—*ib.*

SHAMBE, a ſmall river of Weſt-Florida, which empties into Penſacola Bay. It admits ſhallops ſome miles up, and boats upwards of 50 miles.—*ib.*

SHAMOKIN, a former Moravian ſettlement, a little below the town of Sunbury, in Pennſylvania.—*ib.*

SHAPLEIGH, a townſhip of the Diſtrict of Maine, on the weſt line of York county, at the head of Mouſom river. It was incorporated in 1785, contains 1329 inhabitants, and lies 108 miles N. of Boſton.—*ib.*

SHARON, a townſhip of Vermont, Windſor county, eaſtward of Royalton, and weſtward of Norwich on White river. It contains 569 inhabitants.—*ib.*

SHARON, a townſhip of Maſſachuſetts, Norfolk county, 10 miles ſouth-weſterly of Boſton. It was taken from Stoughton, and incorporated in 1765. It contains 1,994 inhabitants.—*ib.*

SHARON, a townſhip of Connecticut, in Litchfield county, bounded eaſt by Cornwall, from which it is ſeparated by Houſatonic river, and weſt by the eaſt line of New-York State. It is about 12 miles north-weſt of Litchfield.—*ib.*

SHARON, a village in Georgia, about 5 miles from Savannah. In this place, juſt at the cloſe of the war, Gen. Wayne was attacked in a furious manner by a body of Cherokee Indians, headed by a Britiſh officer.

(A) The beautiful red Turkey leather is dyed with cochineal prepared in the ſame manner. Profeſſor Gmelin junior, in the ſecond part of his Travels through Ruſſia, explains the herb *tſchagann* by *artemiſia annua*, having doubtleſs been deceived by the appearance the plant acquires after it has been dried. Beſides, this *artemiſia* is found only in the middle of Siberia, and never on the weſt ſide of the Irtiſch.

They fought hand to hand manfully, and took 2 pieces of artillery. But Gen. Wayne, at the hazard of his own life, gained the victory.—*ib.*

Sharon, a new town in Schoharie county, New-York, incorporated in 1797.—*ib.*

SHARKSTOWN, in Queen Ann's county, Maryland.—*ib*

SHARP (Abraham), an eminent mathematician, mechaniſt, and aſtronomer, was deſcended from an ancient family at Little-Horton, near Bradford, in the Weſt Riding of Yorkſhire, where he was born about the year 1651. At a proper age he was put apprentice to a merchant at Mancheſter; but his genius led him ſo ſtrongly to the ſtudy of mathematics, both theoretical and practical, that he ſoon became uneaſy in that ſituation of life. By the mutual conſent, therefore, of his maſter and himſelf, though not altogether with that of his father, he quitted the buſineſs of a merchant. Upon this he removed to Liverpool, where he gave himſelf up wholly to the ſtudy of mathematics, aſtronomy, &c.; and where, for a ſubſiſtence, he opened a ſchool, and taught writing and accounts, &c.

He had not been long at Liverpool when he accidentally fell in company with a merchant or tradeſman viſiting that town from London, in whoſe houſe it ſeems the aſtronomer Mr Flamſteed then lodged. With the view therefore of becoming acquainted with this eminent man, Mr Sharp engaged himſelf with the merchant as a book-keeper. In conſequence he ſoon contracted an intimate acquaintance and friendſhip with Mr Flamſteed, by whoſe intereſt and recommendation he obtained a more profitable employment in the dock-yard at Chatham; where he continued till his friend and patron, knowing his great merit in aſtronomy and mechanics, called him to his aſſiſtance, in contriving, adapting, and fitting up the aſtronomical apparatus in the Royal Obſervatory at Greenwich, which had been lately built, namely, about the year 1676. He was principally employed in the conſtruction of the mural arch; which in the compaſs of 14 months he finiſhed ſo greatly to the ſatisfaction of Mr Flamſteed, that he ſpeaks of him in terms of the higheſt praiſe. According to Mr Smeaton, this was the firſt good and valid inſtrument of the kind; and Mr Sharp the firſt artiſt who cut accurate and delicate diviſions upon aſtronomical inſtruments. At the time this inſtrument was conſtructed, Mr Flamſteed was 30 and Mr Sharp 25 years of age.

Theſe two friends continued together for ſome time, making obſervations on the meridional zenith diſtances of the fixed ſtars, ſun, moon, and planets, with the times of their tranſits over the meridian; alſo the diameters of the ſun and moon, and their eclipſes, with thoſe of Jupiter's ſatellites, the variation of the compaſs, &c.

Mr Sharp aſſiſted Mr Flamſteed alſo in making a catalogue of near 3000 fixed ſtars, with their longitudes and magnitudes, their right aſcenſions and polar diſtances, with the variations of the ſame while they change their longitude by one degree.

But from the fatigue of continually obſerving the ſtars at night, in a cold thin air, joined to a weakly conſtitution, he was reduced to a bad ſtate of health; for the recovery of which he deſired leave to retire to his houſe at Horton; where, as ſoon as he found himſelf on the recovery, he began to fit up an obſervatory of his own; having firſt made an elegant and curious engine for turning all kinds of work in wood or braſs, with a maundril for turning irregular figures, as ovals, roſes, wreathed pillars, &c. Beſide theſe, he made himſelf moſt of the tools uſed by joiners, clockmakers, opticians, mathematical inſtrument makers, &c. The limbs or arcs of his large equatorial inſtrument, ſextant, quadrant, &c. he graduated with the niceſt accuracy, by diagonal diviſions into degrees and minutes. The teleſcopes he made uſe of were all of his own making, and the lenſes ground, figured, and adjuſted with his own hands.

It was at this time that he aſſiſted Mr Flamſteed in calculating moſt of the tables in the ſecond volume of his *Hiſtoria Cœleſtis*, as appears by their letters, to be ſeen in the hands of Mr Sharp's friends at Horton. Likewiſe the curious drawings of the charts of all the conſtellations viſible in our hemiſphere, with the ſtill more excellent drawings of the planiſpheres both of the northern and ſouthern conſtellations. And though theſe drawings of the conſtellations were ſent to be engraved at Amſterdam by a maſterly hand, yet the originals far exceeded the engravings in point of beauty and elegance: theſe were publiſhed by Mr Flamſteed, and both copies may be ſeen at Horton.

The mathematician, ſays Dr Hutton, meets with ſomething extraordinary in Sharp's elaborate treatiſe of *Geometry Improved* (in 4to, 1717, ſigned A. S. Philomath): 1ſt, by a large and accurate table of ſegments of circles, its conſtruction and various uſes in the ſolution of ſeveral difficult problems, with compendious tables for finding a true proportional part; and their uſe in theſe or any other tables exemplified in making logarithms, or their natural numbers, to 60 places of figures; there being a table of them for all primes to 1100, true to 61 figures. 2d, His conciſe treatiſe of Polyedra, or ſolid bodies of many baſes, both the regular ones and others: to which are added twelve new ones, with various methods of forming them, and their exact dimenſions in ſurds, or ſpecies, and in numbers; illuſtrated with a variety of copperplates, neatly engraved by his own hands. Alſo the models of theſe polyedra he cut out in boxwood with amazing neatneſs and accuracy. Indeed few or none of the mathematical inſtrument makers could exceed him in exactly graduating or neatly engraving any mathematical or aſtronomical inſtrument, as may be ſeen in the equatorial inſtrument above mentioned, or in his ſextant, quadrants, and dials of various ſorts; alſo in a curious armillary ſphere, which, beſide the common properties, has moveable circles, &c. for exhibiting and reſolving all ſpherical triangles; alſo his double ſector, with many other inſtruments, all contrived, graduated, and finiſhed, in a moſt elegant manner, by himſelf. In ſhort, he poſſeſſed at once a remarkably clear head for contriving, and an extraordinary hand for executing, any thing, not only in mechanics, but likewiſe in drawing, writing, and making the moſt exact and beautiful ſchemes or figures in all his calculations and geometrical conſtructions.

The quadrature of the circle was undertaken by him for his own private amuſement in the year 1699, deduced from two different ſeries, by which the truth of it it was proved to 72 places of figures; as may be ſeen in the introduction to Sherwin's Tables of Logarithms; that is, if the diameter of a circle be 1, the circumference will be found equal to 3·14159265358979323846264338327950288419716939937510582097494459 2307816405, &c. In the ſame book of Sherwin's may alſo be ſeen his ingenious improvements on the making of logarithms, and the conſtructing of the natural ſines, tangents and ſecants.

He alſo calculated the natural and logarithmic ſines, tangents, and ſecants, to every ſecond in the firſt minute of the quadrant; the laborious inveſtigation of which may probably be ſeen in the archives of the Royal Society, as they were preſented to Mr Patrick Murdoch for that purpoſe; exhibiting his very neat and accurate manner of writing and arranging his figures, not to be equalled perhaps by the beſt penman now living.

Mr Sharp kept up a correſpondence by letters with moſt of the eminent mathematicians and aſtronomers of his time, as Mr Flamſteed, Sir Iſaac Newton, Dr Halley, Dr Wallis, Mr Hodgſon, Mr Sherwin, &c. the anſwers to which letters are all written upon the backs, or empty ſpaces, of the letters he received, in a ſhort-hand of his own contrivance. From a great variety of letters (of which a large cheſtful remain with his friends) from theſe and many other celebrated mathematicians, it is evident that Mr Sharp ſpared neither pains nor time to promote real ſcience. Indeed, being one of the moſt accurate and indefatigable computers that ever exiſted, he was for many years the common reſource for Mr Flamſteed, Sir Jonas Moore, Dr Halley, and others, in all ſorts of troubleſome and delicate calculations.

Mr Sharp continued all his life a bachelor, and ſpent his time as recluſe as a hermit. He was of a middle ſtature, but very thin, being of a weakly conſtitution. He was remarkably feeble the laſt three or four years before he died, which was on the 18th of July 1742, in the 91ſt year of his age.

In his retirement at Little Horton, he employed four or five rooms or apartments in his houſe for different purpoſes, into which none of his family could poſſibly enter at any time without his permiſſion. He was ſeldom viſited by any perſons, except two gentlemen of Bradford, the one a mathematician, and the other an ingenious apothecary; theſe were admitted, when he choſe to be ſeen by them, by the ſignal of rubbing a ſtone againſt a certain part of the outſide wall of the houſe. He duly attended the diſſenting chapel at Bradford, of which he was a member, every Sunday; at which time he took care to be provided with plenty of halfpence, which he very charitably ſuffered to be taken ſingly out of his hand, held behind him during his walk to the chapel, by a number of poor people who followed him, without his ever looking back, or aſking a ſingle queſtion.

Mr Sharp was very irregular as to his meals, and remarkably ſparing in his diet; which he frequently took in the following manner. A little ſquare hole, ſomething like a window, made a communication between the room where he was uſually employed in calculations, and another chamber or room in the houſe where a ſervant could enter; and before this hole he had contrived a ſliding board: the ſervant always placed his victuals in this hole, without ſpeaking or making any the leaſt noiſe; and when he had a little leiſure, he viſited his cupboard to ſee what it afforded to ſatisfy his hunger or thirſt. But it often happened, that the breakfaſt, dinner, and ſupper, have remained untouched by him when the ſervant has gone to remove what was left—ſo deeply engaged had he been in calculations.

SHARPS in flour, the finer part of what we have denominated POLLARDS. See that article, *Suppl.*

SHARPSBURG, a poſt-town of Maryland, Waſhington county, about 2 miles from Patowmack river, and nearly oppoſite to Shepherdſtown, in Virginia, at the mouth of Shenandoah river. It contains a church, and about 250 houſes. It is 9 miles N. N. W. of Williams port, 69 W. by N. of Baltimore, and 181 W. S. W. of Philadelphia.—*Morse.*

SHASTAH, the ſame as SHASTER; which ſee, *Encycl.*

SHAWANEE, and *Shavanon;* the former the Indian, and the latter the French name of Cumberland river, in the State of Tenneſſee. It is alſo called *Shawanoe.*—*Morse.*

SHAWANESE, or *Shawanoes*, an Indian nation, great numbers of whom have joined the Creek confederacy. They have 4 towns on the Tallapooſee river, containing 300 warriors; and more are expected to remove thither. By the treaty of peace, Aug. 3, 1795, The United States agreed to pay to this tribe a ſum in hand, and 1000 dollars a year forever, in goods. They inhabit alſo on Scioto river, and a branch of the Muſkingum, and have their hunting-grounds between Ohio river and Lake Erie. They are generally of a ſmall ſize, rather handſome in their features, and are a very cheerful and crafty people. Counſelling among their old people, and dancing among their young men and women, take up a great part of their time.—*ib.*

SHAWANGUNK, a townſhip in Ulſter county, New-York; bounded eaſterly by Newburgh and Marlborough, and ſoutherly by Montgomery and the Platte Kill. It contains 2,128 inhabitants; of whom 323 are electors, and 350 ſlaves. It is 20 miles from Goſhen, and 12 from New Paltz.—*ib.*

SHAWSHEEN, a conſiderable ſtream of Maſſachuſetts, which riſes in Bedford, in Middleſex county, and, paſſing through Billerica, Tewkſbury and Andover, diſcharges itſelf into Merrimack river.—*ib.*

SHEA, the name of a tree, from the fruit of which the Negroes, in the interior parts of Africa between the tropics, prepare a kind of vegetable butter. Theſe trees are not planted by the natives, but are found growing naturally in the woods; and in clearing wood land for cultivation, every tree is cut down but the Shea. The tree itſelf very much reſembles the American oak; and the fruit, from the kernel of which being firſt dried in the ſun the butter is prepared, by boiling the kernel in water, has ſomewhat the appearance of a Spaniſh olive. The kernel is enveloped in a ſweet pulp, under a thin green rind; and the butter produced from it, beſides the advantage of its keeping the whole year without ſalt, is whiter, firmer, and, Mr Park ſays, to his palate, of a richer flavour than the beſt butter which he ever taſted made from cows milk. The growth and preparation of this commodity, ſeem to be among the firſt objects of African induſtry in this and the neighbouring ſtates; and it conſtitutes a main article of their inland commerce. In ſome places they

Sheave. || Shebbeare.

they dry the fruit in kilns, containing each about half a cart load of fruit, under which is kept up a clear wood fire. Our author, who ſaw the fruit in one of theſe kilns, was informed, that in three days the fruit would be ready for pounding and boiling; and that the butter thus manufactured, is preferable to that which is prepared from fruit dried in the ſun; eſpecially in the rainy ſeaſon, when the proceſs by inſolation is always tedious, and oftentimes ineffectual. Might it not be worth while, if practicable, to cultivate Shea-trees in ſome of our Weſt India iſlands?

SHEAVE, in mechanics, a ſolid cylindrical wheel, fixed in a channel, and moveable about an axis, as being uſed to raiſe or increaſe the mechanical powers applied to remove any body.

SHEBBEARE (John) was born at Bideford, a conſiderable ſea-port and corporation town in Devonſhire, in the year 1709. His father was an attorney; but having ſmall practice and little fortune, he carried on alſo the buſineſs of a corn-factor. He had four children, two ſons and two daughters. Of the ſons, John, the ſubject of our preſent memoir, was the eldeſt. The other ſon was called Richard, and entirely the reverſe of his brother in diſpoſition; he was bred to the ſea, and died young.

John received the rudiments of his education at the free grammar ſchool of Exeter, then conducted by the learned Mr Zachary Mudge (author of an Eſſay for a new Verſion of the Pſalms, and a volume of excellent Sermons), afterwards Rector of St Andrew in Plymouth. It has oftentimes been remarked, that the future life of a man may be nearly gueſſed at from his puerile character. Thus Shebbeare, while a ſchoolboy, gave the ſtrongeſt indications of his future eminence in miſanthropy and literature, by the remarkable tenaciouſneſs of his memory, and the readineſs of his wit, and no leſs ſo by the malignity of his diſpoſition; being univerſally conſidered as a lad of ſurpriſing genius, while at the ſame time he was as generally deſpiſed for his malicious and ungrateful temper. This may eaſily be believed, when it is ſaid, that he formed not one connection, either at ſchool or afterwards, with any perſon in the way of friendſhip, except with a young barber of an abandoned character, but whoſe ſoul was perfectly congenial to that of Shebbeare's.

Such is the account of Shebbeare's boyiſh years which we have in the 14th volume of the *European Magazine*. It is probably much exaggerated; for Shebbeare continued through life a ſtaunch Tory, if not a Jacobite; and it is well known that many of our journaliſts conſider themſelves as at liberty to give what character they pleaſe of ſuch men.

In the fifteenth or ſixteenth year of his age, young Shebbeare was bound apprentice to a very eminent and worthy ſurgeon in his native town; in which ſituation he acquired a conſiderable ſhare of medical knowledge. His genius for lampoon appeared at this early period, and he could not forbear from exerciſing it on his maſter. No one indeed could give him the ſlighteſt offence with impunity; for which reaſon almoſt every perſon avoided his acquaintance, as we would avoid the careſſing of an adder. The chief marks, however, of the arrows of his wit were the gentlemen of the corporation: one or other, and ſometimes all of them, were almoſt conſtantly expoſed in a libel upon the public poſts and corners of the ſtreets. But though the wiſer part of them only laughed at theſe harmleſs trifles, yet ſome were more irritable, and many a proſecution was commenced againſt, but not one could fix itſelf upon him, ſo artfully had he contrived to conceal himſelf. He was alſo ſeveral times ſummoned to appear at the ſeſſions, for daring to ſpeak and write irreverently of the worſhipful magiſtrates; but the laugh was always on the ſide of Shebbeare, nor could they ever come at his back, ſo cloſely had he fitted on his armour, with the whip of authority.

Shebbe

When he was out of his time he ſet up trade for himſelf, and then ſhewed a taſte for chemiſtry; and ſoon after he married a very agreeable and amiable young woman, of no fortune, but of a genteel family. Whether his inſuperable propenſity to ſatire deprived him of friends and of buſineſs, or that he ſpent too much in chemical experiments, we know not; but failing at Bideford, he removed, about the year 1736, to Briſtol, where he entered into partnerſhip with a chemiſt, and never afterwards ſet his foot in his native town.

In the year 1739 he attracted the attention of the public, by an epitaph to the memory of Thomas Coſter, Eſq; member for Briſtol; in which, it has been truly obſerved, that he has contrived to raiſe emotions of pity, grief, and indignation, to a very high degree. The next year he publiſhed a pamphlet on the Briſtol waters; from which period there is a chaſm in our author's life we are unable to fill up. In this interval may probably be placed his failure in buſineſs, and his effort to obtain a higher ſituation in his profeſſion. It is certain that in the year 1752 he was at Paris, and there he obtained the degree, if he obtained it at all, which gave him the addition to his name which accompanied him during the reſt of his life, that of Doctor. Until this time he appears to have lived in obſcurity; but at an age when vigorous exertion uſually ſubſides, he ſeems to have reſolved to place himſelf in a conſpicuous ſituation, whatever hazard might attend it, and commenced a public writer with a degree of celerity and virulence for which it would be difficult to find a parallel even in the moſt intemperate times. To read over his works now, when the paſſions they then raiſed have ſubſided, we feel ſurpriſe at the effect they produced; and it is within the memory of many yet living, that their influence was very conſiderable. In the year 1754, he began his career with The Marriage Act, a political novel; in which he treated the legiſlature with ſuch freedom, that it occaſioned his being taken into cuſtody, from whence, however, he was ſoon releaſed.

The performances, however, moſt celebrated, were a ſeries of Letters to the People of England, which were written in a ſtyle vigorous and energetic, though ſlovenly and careleſs, well calculated to make an impreſſion on common readers; and were accordingly read with avidity, and circulated with diligence. They had a very conſiderable effect on the minds of the people, and galled the miniſtry, who ſeem to have been at firſt too eager to puniſh the author. On the publication of the Third Letter, we find warrants, dated 4th and 8th of March, 1756, iſſued by Lord Holderneſſe, to take up both Scott the publiſher and the author. This proſecution, however, ſeems to have been dropt, and the culprit proceeded for ſome time unmoleſted, "having declared (ſays one of his anſwer-ers) that he would write himſelf into a poſt or into the pillory; in the laſt of which he at length ſucceeded." On the 12th of January 1758, a general warrant was ſigned by Lord Holderneſſe, to ſearch for the author, printer, and publiſhers of a wicked, audacious and treaſonable libel, entitled, "A Sixth Letter to the People of England, on the progreſs of national ruin; in which is ſhewn that the preſent grandeur of France and calamities of this nation are owing to the influence of Hanover on the councils of England;" and them having found, to ſeize and apprehend, together with their books and papers.

At this juncture government ſeem to have been effectually rouſed; for having received information that a ſeventh letter was printing, by virtue of another warrant, dated January 23, all the copies were ſeized and entirely ſuppreſſed. In Eaſter Term an information was filed againſt him by Mr Pratt, then attorney general, afterwards Lord Camden; in which it is now worthy of remark, that the crown officer, in his application to the court, in expreſs terms admitted a point, ſince much diſputed, that of the jury's right to determine both the law and the fact in matters of libel. "What I urge (ſays the advocate) to the court, is only to ſhew there is reaſonable ground for conſidering this publication as a libel, and for putting it in a way of trial, and therefore it is I pray to have the rule made abſolute; for I admit, and your lordſhip well knows, that the jury in matter of libel are judges of the law as well as the fact, and have an undoubted right to conſider whether, upon the whole, the pamphlet in queſtion be, or be not, a falſe, malicious, and ſcandalous libel." On the 17th of June, the information was tried, when our author was found guilty; and on the 28th November, he received ſentence, by which he was fined five pounds, ordered to ſtand in the pillory December 5, at Charing Croſs, to be confined three years, and to give ſecurity for his good behaviour for ſeven years, himſelf in 500l. and two others in 250l. each.

On the day appointed, that part of the ſentence which doomed him to the pillory was put in execution, amidſt a prodigious concourſe of people aſſembled on the occaſion. The under ſheriff, at that time, happened to be Mr Beardmore, who had ſometimes been aſſiſted by the Doctor in writing the Monitor, a paper in its principles of the ſame tendency with the writings of the culprit, who conſequently might expect every indulgence from the officer to whom the execution of his ſentence was committed. The manner in which it was conducted may be learned from the affidavits on which afterwards the under ſheriff's conduct became the ſubject of animadverſion in the court of King's Bench, and which aſſert, "that the defendant only ſtood upon the platform of the pillory, unconfined, and at his eaſe, attended by a ſervant in livery (which ſervant and livery were hired for the occaſion only) holding an umbrella over head all the time: but his head, hands, neck, and arms, were not at all confined, or put into the holes of the pillory; only that he ſometimes put his hands upon the holes of the pillory in order to reſt himſelf." For this neglect of duty, Beardmore was fined 50l. and ſuffered two months impriſonment.

Some time before he was tried for the obnoxious publication already mentioned, the Dutcheſs of Queensbury, as heir of Lord Clarendon, obtained an injunction in the Court of Chancery to ſtop the publication of the continuation of that nobleman's hiſtory; a copy of which had got into the hands of Francis Gwyn, Eſq; between whom and the Doctor there had been an agreement to publiſh it and equally divide the profits. The care and expences attending the uſhering this work into the world were to be wholly Dr Shebbeare's, who performed his part of the agreement, and cauſed it to be handſomely printed in quarto, with a Tory preface, containing frequent reflections on, and alluſions to recent events, and to living characters, which gave it the appearance rather of a temporary pamphlet than of a work calculated for poſterity. On the injunction being obtained, Dr Shebbeare was under the neceſſity of applying to the aid of law to recover the money expended by him in printing, amounting to more than 500l. Of that ſum more than half had been waſted on his ſide in the courts of law and equity. And ſome years afterwards, ſpeaking of the ſituation of his affairs, he ſays, "It may be eaſily imagined, that my circumſtances were not improved by three years impriſonment. I had no club of partizans to maintain me during that time, to diſcharge my debts, nor even the fine, which I was obliged to pay after a three years confinement for a ſingle offence. Notwithſtanding the difficulties which inevitably aroſe from theſe particulars, and although an inſolvent act was paſſed ſoon after his Majeſty's acceſſion to the throne, and my circumſtances might have apologiſed for my taking that opportunity which it offered; I nevertheleſs declined from availing myſelf of that occaſion to evade the payment of my debts. I preferred the labour of endeavouring to pay them, and the riſk of being again impriſoned if I did not ſucceed. But, thank Heaven, I am in no danger of a ſecond impriſonment on that account." During his confinement, he declares he never received as preſents more than twenty guineas from all the world.

While he was confined in the King's Bench, he ſolicited ſubſcriptions for the firſt volume of a Hiſtory of England, from the Revolution to the then preſent time. But at the perſuaſion of his friends he was induced to alter his deſign, and receipts were iſſued for a firſt volume of the Hiſtory of England and of the Conſtitution thereof from its origin. That volume he wrote, and had tranſcribed. "But as it was impracticable (to uſe his own words), whilſt I was in confinement, to procure that variety of books, or to apply to manuſcript authorities, for all that was requiſite to the completing of this firſt volume, I found on being releaſed from my impriſonment, and on application to the former only, that the volume which I had written was incorrect, inſufficient, and erroneous, in too many particulars, to admit of its being publiſhed, without injuſtice to my ſubſcribers, and reprehenſions on myſelf. Into this diſpleaſing ſituation I had been miſled by relying on the authorities of modern hiſtorians, who pretend to cite the authors from whence their materials are taken, many of whom appear never to have ſeen them, but implicitly to have copied one another, and all of them manifeſtly defective; not only in the authorities they ſhould have ſought, but in their omiſſions and miſrepreſentations of thoſe whom they had conſulted: more eſpecially reſpecting thoſe parts of the old German codes, on which our conſtitution is erected, and without which it cannot be properly explained or underſtood. Such being the real ſituation of things, I perceived that more time than I could expect to live would be neceſſarily required for ſo extenſive a work as the whole hiſtory I had propoſed; and that a ſingle volume, or even a few volumes of an hiſtory incomplete, would by no means anſwer either the intention of my ſubſcribers, or my own: I determined therefore to change my plan, and to include in one volume that which might require no others to complete this new deſign.

"In conſequence of this alteration, I reſolved to exert my beſt abilities, not only to trace the conſtitution of England from its origin in the woods of Germany, as M. de Monteſquieu expreſſes it, but from the firſt principles of human nature, from which the formation of all kinds of government is derived. With this view, I have attempted an analyzation of the mental and corporeal faculties, in order to ſhew in what manner they reciprocally influence each other in the various actions of man, not only as an individual, but as a gregarious being, impelled by nature to aſſociate in communities. From hence I have attempted to delineate in what manner legiſlature ſprang and proceeded from its ſource, through that variety of meanders which it hath formed in its current, both before and ſince the introduction of one common ſign, whereby to expreſs the intrinſic value, not only of all the productions of nature and of art, but even of the human faculties, as they are now eſtimated; to compare the conſtitutions of thoſe different ſtates which have been, and are the moſt celebrated in ancient and modern hiſtory, with each other, and with that of England; and then to derive ſome reaſonable grounds for the determination of that which ſeems to be the moſt conſentaneous with the primogenial inſtitutes of nature, and the happineſs of human kind. In conſequence of this intent, the manners that ſucceſſively aroſe and prevailed in ſuch ſtates, the benefits and miſchiefs which enſued from them, are delineated, in order to explain on what foundation the welfare of national communities may moſt probably be eſtabliſhed."

This plan, thus delineated, he at times employed himſelf in filling up; but on being rudely attacked for not performing his promiſe with his ſubſcribers, he, in 1774, obſerved—"From the inevitable obligations, not only of ſupporting my own family, but thoſe alſo whom as ſon and brother it was my duty to ſuſtain for forty years, and which, reſpecting the claims of the latter, ſtill continues; it will be eaſily diſcerned that many an avocation muſt have proceeded from theſe circumſtances, as well as from a ſenſe of gratitude to his majeſty, in defence of whoſe government I have thought it my duty occaſionally to exert my beſt abilities." He adds, however, that he did not intend to die until what he had propoſed was finiſhed; a promiſe which the event has ſhewn he was unable to perform.

In priſon he was detained during the whole time of the ſentence, and with ſome degree of rigour; for when his life was in danger from an ill ſtate of health, and he applied to the court of King's Bench for permiſſion to be carried into the rules a few hours in a day, though Lord Manſfield acceded to the petition, yet the prayer of it was denied and defeated by Judge Foſter. At the expiration of the time of his ſentence, a new reign had commenced; and ſhortly afterwards, during the adminiſtration of Mr Grenville, a penſion was granted him by the crown. This he obtained by the perſonal application of Sir John Philips to the King, who, on that occaſion, was pleaſed to ſpeak of him in very favourable terms, which he promiſed undeviatingly to endeavour to deſerve by allegiance and gratitude.

From the time of that event we find Dr Shebbeare a uniform defender of the meaſures of Government, and the mark againſt whom every oppoſer of adminiſtration conſidered himſelf at liberty to throw out the groſſeſt abuſe. Even the friends of power were often adverſe to him. Dr Smollet introduced him in no very reſpectful light, under the name of Ferret, in the novel of Sir Launcelot Greaves, and Mr Hogarth made him one of the group in the third election print.

Scarce a periodical publication was without ſome abuſe of him, which he ſeems to have in general had the good ſenſe to neglect. In the year 1774, however, he departed from his general practice, and defended himſelf from ſome attacks at that time made upon him. In this pamphlet he repreſented the conduct and character of King William in ſuch a light as to excite the indignation of every Whig in the kingdom: he treated him in print with as great ſeverity as Johnſon uſed to do in converſation.

Early in life he appears to have written a comedy, which in 1766 he made an effort to get repreſented at Covent Garden. In 1768 he wrote the Review of Books in the Political Regiſter for three months, and was often engaged to write for particular perſons, with whom he frequently quarrelled when he came to be paid. This was the caſe with Sir Robert Fletcher, and we think of others. His pen ſeems to have been conſtantly employed, and he wrote with great rapidity, what certainly can now be read with little ſatisfaction, and muſt ſoon be forgotten. Though penſioned by government, he can ſcarce be ſaid to have renounced his opinions; for in the pamphlet already mentioned, his abuſe of the Revolution is as groſs as in that for which he ſuffered the pillory. His violence defeated his own purpoſe, and made thoſe who agreed in party with him revolt from the virulence with which he treated his adverſaries. During the latter years of his life he ſeems to have written but little. He was a ſtrenuous ſupporter of the miniſtry during the American war, having publiſhed, in 1775, An Anſwer to the printed Speech of Edmund Burke, Eſq; ſpoken in the Houſe of Commons, April 19, 1774. In which his knowledge in polity, legiſlature, human kind, hiſtory, commerce, and finance, is candidly examined; his arguments are fairly refuted; the conduct of adminiſtration is fully defended; and his oratoric talents are clearly expoſed to view.—And An Eſſay on the Origin, Progreſs, and Eſtabliſhment of National Society; in which the principles of Government, the definitions of phyſical, moral, civil, and religious Liberty contained in Dr Price's Obſervations, &c. are fairly examined, and fully refuted; together with a juſtification of the Legiſlature in reducing America to obedience by force. To which is added, an Appendix on the Excellent and Admirable in Mr Burk's ſecond printed Speech of the 22d of March 1775, both 8vo.

His publications, ſatirical, political, and medical, amount to thirty-four, beſides a novel, entitled Lydia, or or Filial Piety; in which religious hypocriſy and bluſtering courage are very properly chaſtiſed. He died on the 1ſt of Auguſt 1788, leaving, among thoſe who knew him beſt, the character of a benevolent man; a character which, from the manner in which he ſpeaks of his connections, he probably deſerved.

SHECATICA, a bay of very irregular ſhape and breadth, on the coaſt of Labrador, N. America; having an iſland of its name at its mouth. It is ſituated between lat. 51 14 and 51 28 N. and between long. 58 16 and 58 22 W.—*Morſe.*

SHECHARY, a lake of New North Wales, formed like a bow. It receives Churchill river from the ſouth-weſt and at its N. E. end has communication with Berbazon Lake, which lies due N. and ſouth. At the ſouth end of the latter, the waters of both lakes run eaſt under the name of Seal river, which empties into Hudſon's Bay at Churchill Fort, between Button's Bay on the N. and Cape Churchill on the ſouth-eaſt. Both lakes are long and narrow.—*ib.*

SHEDIAC, a harbour on the eaſtern coaſt of New-Brunſwick, and on the weſt ſide of the Gulf of St Lawrence; 53 miles ſouth-eaſt of Miramichi Bay.—*ib.*

SHEEPSCOT, or *Sheepſcut*, a ſmall river of the Diſtrict of Maine, which empties into the ocean to the eaſt of Kennebeck, and is navigable 20 or 30 miles. On the weſt ſide of this river is the excellent port called Wiſcaſſet, in the townſhip of Pownalborough. Newcaſtle townſhip is at the head of navigation on this river, and extends from Sheepſcot to Damariſcotta river. The compact part, which is a poſt-town, is 10 miles north-eaſt of Wiſcaſſet. Sheepſcot harbour has high water, at full and change, 45 minutes after 10 o'clock; depth, 9 fathoms.—*ib.*

SHEEP's *Cove*, on the eaſt coaſt of Newfoundland, lies between Bay Robert and Port Grave.—*ib.*

SHEERS, aboard a ſhip, an engine uſed to hoiſt or diſplace the lower maſts of a ſhip.

SHEFFIELD, a townſhip in the northern part of Caledonia county, Vermont.—*Morſe.*

Sheffield, a poſt-town of Maſſachuſetts, Berkſhire county, 30 miles ſouth-eaſt of Hudſon in the State of New-York, 145 weſt-ſouth-weſt of Boſton, and 257 north-eaſt of Philadelphia. It was incorporated in 1733, and contains 1,899 inhabitants. Houſatonic river, which is nine rods in breadth, paſſes through it from north to ſouth, which with its branches ſupply water for ſeveral mills and iron-works. South Mountain extends the whole length of the town, along the eaſt ſide of the river.—*ib.*

SHEIBON, a diſtrict in Africa, lying to the ſouth-eaſt of the kingdom of Dar-Fur (See Soudan in this volume), where much gold is found both in duſt and in ſmall pieces. The natives, who are idolaters and ſavages, collect the duſt in quills of the oſtrich and vulture, and in that condition ſell it to the merchants. They have a ceremony on diſcovering a large piece of gold, of killing a ſheep on it before they remove it. The people, who are all black, have ſome form of marriage, *i. e.* of an agreement between man and woman to cohabit. Women of full age wear a piece of platted graſs on their parts. The younger and unmarried are quite naked. The ſlaves, which are brought in great numbers from this quarter, are ſome priſoners of war among themſelves (for their wars are frequent), and ſome ſeduced by treachery, and ſold. But it is ſaid to be a common practice for a father in time of ſcarcity to ſell his children.

At Sheibon are ſome Mohammedans, who live among the idolaters, and wear clothing: it is not ſaid whether Arabs or not. Mr Browne, from whoſe travels we have taken this account of Sheibon, does not give its latitude or longitude.

SHELBURNE, a townſhip of Vermont, Chittenden county, on the eaſt ſide of Lake Champlain. It has Burlington on the north, and Charlotte on the ſouth, and contains 389 inhabitants.—*Morſe.*

Shelburne, an interior townſhip in Grafton county, New-Hampſhire. It was incorporated in 1769, and contains 35 inhabitants.—*ib.*

Shelburne, a townſhip in Hampſhire county, Maſſachuſetts, adjoining Greenfield.—*ib.*

Shelburne, a town of Nova-Scotia, at the head of a bay which runs up from Port Roſeway, at the ſouth-weſt part of the province. In 1783, it contained 600 families, but is now leſs populous. It is 18 miles north eaſt of Barrington, and 88 ſouth weſt by ſouth of Halifax.—*ib.*

SHELBY, a new county of Kentucky.—*ib.*

SHELTER *Iſland*, at the eaſt end of Long Iſland, in Suffolk county, New-York, lies 3 leagues weſt of Gardener's Iſland. It is about 5 miles from eaſt to weſt, and 7 from north to ſouth. It is a fruitful ſpot, containing about 8000 acres; was incorporated in 1788, and contains 201 inhabitants, of whom 34 are electors. Conſiderable numbers of cattle, ſheep and poultry are raiſed here. When you leave Shelter Iſland on your larboard hand, and run weſt by north about 5 or 6 miles, you will open a large bay where 100 ſail of veſſels may lie ſafe and anchor in 3 or 4 fathoms.—*ib.*

SHENANDOAH, a county of Virginia, bounded north by Frederick, and ſouth by Rockingham. It contains 10,510 inhabitants, including 512 ſlaves. Chief town, Woodſtock.—*ib.*

Shenandoah, a river of Virginia, which riſes in Auguſta county, and after running a north-eaſt courſe of about 200 miles, it joins the Patowmack in about lat. 38 4, juſt before the latter burſts through the Blue Ridge. It is navigable about 100 miles; and may be rendered ſo nearly its whole courſe at a ſmall expenſe. When this is done, it will bear the produce of the richeſt part of the ſtate.—*ib.*

Shenandoah *Valley*, extends from Wincheſter, in Virginia, to Carliſle and the Suſquehannah, in Pennſylvania, and is chiefly inhabited by Germans and Dutch.—*ib.*

SHEPHERDSFIELD, a plantation of the Diſtrict of Maine, in Cumberland county, containing 330 inhabitants.—*ib.*

SHEPHERDSTOWN, or *Shepherdſburg*, a poſt-town of Virginia, ſituated in Berkley county, on the ſouth ſide of Patowmack river. Its ſituation is healthy and agreeable, and the neighbouring country is fertile and well cultivated. It contains about 2000 inhabitants, moſtly of German extraction. It lies at the mouth of Shenandoah river, oppoſite to Sharpſburg; 10 miles eaſt by ſouth of Martinſburg, and 178 ſouth-weſt by weſt of Philadelphia.—*ib.*

SHERBURNE, a townſhip of New-York, Herkemer county. By the ſtate cenſus of 1796, it contains 483 inhabitants, of whom 79 are electors.—*ib.*

SHETUCKET, a river of Connecticut, which is formed by the junction of Willomantic and Mount Hope rivers, and after running eaſt a few miles, purſues a ſouthern courſe, and uniting with Quinabaug river, empties into the Thames in the ſouth part of the townſhip of Norwich.—*ib.*

SHILLUK, a town in Africa on the banks of the Bahr-el-abiad, or true Nile. The houſes are built of clay, and the inhabitants, who are idolaters, have no other clothing than bands of long graſs, which they paſs round the waiſt and between the thighs. They are all black; both ſexes are accuſtomed to ſhave their heads. The people of Shilluk have the dominion of the river, and take toll of all paſſengers, in ſuch articles of traffic as paſs among them. The name Shilluk is not Arabic, and its meaning is unknown.—When aſked concerning their name or country, the people reply Shilluk. When employed in tranſporting Mohammedans acroſs the ferry, they occaſionally exhibit the importance which their ſituation gives them. After the Muſlim has placed himſelf in the boat, they will aſk him, "Who is the maſter of that river?" The other replies, as is uſual, "Ullah or Rubbani"—God is the maſter of it. "No (anſwers the Shilluk), you muſt ſay that ſuch a one (naming his chief) is the maſter of it, or you ſhall not paſs." They are repreſented as ſhewing hoſpitality to ſuch as come among them in a peaceable manner, and as never betraying thoſe to whom they have once accorded protection. The particulars of their worſhip have not been deſcribed. In Mr Browne's map, Shilluk is placed in about 13° N. Lat. and 32° 26′ E. Long.

SHIMENE *Port*, on the north ſide of the iſland of St John, in the Gulf of St Lawrence. Its entrance, weſt of St Peter's harbour, is very narrow; but the baſon within is very ſpacious.—*Morſe.*

SHINING *Mountains*, in the north-weſt part of North-America, are little known. It is conjectured that they terminate in about lat. 47 or 48 N. where a number of rivers riſe, and empty themſelves either into the North Pacific Ocean, into Hudſon's Bay; into the waters which lie between them, or into the Atlantic Ocean. They are called alſo the *Mountains of Bright Stones*, on account of the immenſe number of large cryſtals, ſhooting from the rocks, and ſparkling in the rays of the ſun, ſo as to be ſeen at a great diſtance.—*ib.*

SHIP. See that article, and SHIPBUILDING (*Encycl.*), and likewiſe *FLOATING Bodies* (*Suppl.*) In the *Tranſactions of the Royal Society of London* for 1798, Mr Atwood has completed his diſquiſition on the *Stability* of Ships; but as the memoir cannot be abridged, we muſt refer the ſcientific naval architect to the original for much uſeful information.

A ſmall work has lately been publiſhed by Charles Gore, Eſq; of Weimar in Saxony, upon *the reſpective Velocity of Floating Bodies varying in Form.* It contains merely the reſults of two ſeries of experiments: from the firſt of which ſeries, it ſeems to appear that the form beſt calculated for velocity is a long parallel body, terminating at each end in a parabolic cuneus, and having the extreme breadth in the centre. Alſo, that making the cuneus more obtuſe than is neceſſary to break with fairneſs the curve line into the ſtraight, creates a conſiderable degree of impediment. And Mr Gore is inclined to think, that the length of ſhips, which has already been extended with ſucceſs, to four times the breadth, is capable, with advantage, of ſtill further extenſion, perhaps to five, and, in ſome caſes, even to ſix times.

The ſecond ſet of experiments was inſtituted to aſcertain the reſpective degrees of ſtability, or power of reſiſting the preſſure of the wind, in carrying ſail, on bodies of different forms. The bodies uſed in the experiments had their ſpecific capacities and weights preciſely equal, but their forms different; and from the reſults, it appears that the form of a midſhip body, beſt adapted for ſtability only is a flat bottom, with perpendicular ſides; and that the next beſt adapted is a ſemicircle. But as there exiſts much difficulty in conſtructing the former with ſufficient ſtrength, beſides its being ill adapted to heavy ſeas, as, by the ſudden deſcent in pitching, the bottom will ſtrike the water nearly at right angles, and ſuſtain thereby a tremendous ſhock. And as the latter ſeems to be too inclinable to tranſverſe oſcillation, or rolling, and alſo to be deficient in capacity for many ſervices, our author is of opinion, that a midſhip body, of a compounded form, is moſt applicable to general purpoſes.

On account of the few documents before us, we are unable to ſpeak critically concerning this tract. To benefit naval architecture, we are of opinion, that the method of experiment is more ſure and expeditious than that of calculation: yet concluſions from experiments muſt be drawn with great caution. It is by no means certain that a reſult obtained for a body of a given bulk will obtain for ſimilar bodies which differ in dimenſinns.

We ſhall conclude this ſhort article with a ſtatement of the principles upon which Patrick Miller, Eſq; of Dalſwinton (Scotland), propoſes to conſtruct ſhips and veſſels which cannot founder.

The veſſel is to be kept afloat, without the aid of its ſides, ſolely by the buoyancy of its bottom, which is flat; the bottom never being ſo deeply immerſed as to bring the upper ſurface thereof on a level with the water; ſuch veſſels not being conſtructed for the purpoſe of carrying cargoes, but for that of carrying paſſengers, with the neceſſary ſtores and proviſions; and as theſe veſſels are not kept afloat by the aid of their ſides, but by the buoyancy of their bottom, as above deſcribed, they cannot ſink, and therefore pumps are not required, nor are they in any reſpect neceſſary for the preſervation of ſuch veſſels. The ſaid veſſel is put in motion, during calms, and againſt light winds, by means of wheels. Theſe wheels project beyond the ſides of the veſſel, and are wrought by means of capſtans: the number and the dimenſions of the wheels depend upon the length of the veſſel. Theſe wheels are built with eight arms, which conſiſt entirely of plank. Sliders are uſed to work and to keep the veſſel to windward when under ſail. Theſe ſliders are placed in the centre of the veſſel, from ſtem to ſtern; they are made of plank, and the number and dimenſions muſt depend on the length of the veſſel; and they are raiſed and let down, either by the hand, or by means of a purchaſe, according to the ſize of the veſſel. Veſſels of this conſtruction draw water, in proportion to their dimenſions, as follows: a veſſel of forty feet in length, and from thirteen to nineteen feet in breadth, will draw from thirteen to ſixteen inches of water. One of fifty feet in length, and from ſeventeen to twenty-four feet in breadth, will draw from fifteen to eighteen inches of water. One ſixty feet long, and from twenty to twenty-eight feet broad, will draw from eighteen to twenty-one inches of water. One ſeventy feet long, and from twenty-three to thirty-two feet broad, will draw from twenty-one to twenty-four inches of water. One eighty-feet long, and from twenty-ſeven to thirty-ſeven feet broad, will draw from twenty-four to twenty-ſeven inches of water. One ninety feet long, and from thirty to forty-two feet broad, will draw from twenty-ſeven to thirty inches of water. One of one hundred feet in length, and from thirty-three to forty-ſeven feet in breadth, will draw from thirty to thirty-three inches of water.

As, from the principle upon which this veſſel is conſtructed, ſhe cannot ſink, the invention muſt prove a means of ſaving many lives; and as it will give more room and height between the decks than any veſſel of the ſame dimenſions of another conſtruction, it muſt add greatly to the comfort and accommodation of perſons at ſea of all deſcriptions. It is expected that, from theſe advantages, a more general and friendly intercourſe amongſt nations will take place, which will have the effect to diffuſe knowledge, and to remove national prejudices, thereby promoting the general welfare of mankind. At preſent (ſays Mr Miller), it would be altogether improper to give any deſcription of ſhips of greater dimenſions, leſt it ſhould be converted to a purpoſe very different from that intended by the inventor.

SHIP *Iſland*, lies between Horn and Cat Iſland, on the coaſt of Weſt-Florida, and is about 10 miles ſouth of the Bay of Biloxi. It is 9 miles long and 2 broad; produces pine trees and graſs, and has a tolerable well of water in it.—*Morſe*.

SHIPPANDSTOWN, in Virginia, on the ſouth ſide of the Patowmack, 40 or 50 miles from Alexandria.—*ib.*

SHIPPENSBURG, a poſt-town of Pennſylvania, Cumberland county, on a branch of Conedogwinnet Creek, which empties into the Suſquehannah; and contains about 60 houſes, chiefly built of ſtone. It is 21 miles north by eaſt of Chamberſburg, a like diſtance ſouth-weſt of Carliſle, and 146 weſt of Philadelphia.—*ib.*

SHIPWRECK, a well-known diſaſter, by which numbers of lives are yearly loſt. In that valuable miſcellany entitled, *The Philoſophical Magazine*, we have an account of means for preventing that loſs, when the ſhip is in danger within two or three hundred fathoms of the ſhore; and as the anonymous author (a Frenchman) ſays that he has by experiment aſcertained the efficacy of theſe means, we ſhall ſtate them to our readers.

The only certain means of ſaving the crew of a veſſel in ſuch a ſtate is, to eſtabliſh a rope of communication from the ſhore to the ſhip. But how is this to be done? The author ſays, by fixing the end of the rope to a bomb or cannon ball, and extending the rope afterwards, in a zig zag direction, before the morter or cannon, or ſuſpending it on a piece of wood raiſed ſeveral feet. A rope, ſo placed, will not break (he ſays) by the greateſt velocity which can be given to the bomb or ball; and thus the end of it can be ſent aſhore by a diſcharge of artillery. He prefers the bomb to the cannon ball, for reaſons which he does not aſſign. He propoſes, however, other means to effect his benevolent purpoſe.

"It ought to be remembered (ſays he), that a veſſel is never caſt away, or periſhes on the coaſt, but becauſe it is driven thither againſt the will of the captain, and by the violence of the waves and the wind, which almoſt always blows from the ſea towards the ſhore, without which there would be no danger to be apprehended: conſequently, in theſe circumſtances, the wind comes always from the ſea, either directly or obliquely, and blows towards the ſhore.

"*1ſt*, A common paper kite, therefore, launched from the veſſel and driven by the wind to the ſhore, would be ſufficient to ſave a crew conſiſting of 1500 ſeamen, if ſuch were the number of a ſhip of war. This kite would convey to the ſhore a ſtrong packthread, to the end of which might be affixed a cord, to be drawn on board by means of the ſtring of the kite; and with this cord a rope, or as many as ſhould be neceſſary, might be conveyed to the ſhip.

"*2d*, A ſmall balloon, of ſix or ſeven feet in diameter, and raiſed by rarified air, would be alſo an excellent means for the like purpoſe: being driven by the wind from the veſſel to the ſhore, it would carry thither a ſtring capable of drawing a cord with which ſeveral ropes might be afterwards conveyed to the veſſel. Had not the diſcovery of Montgolfier produced any other benefit, it would be entitled on this account to be conſidered as of great importance.

"*3d*, A ſky rocket, of a large diameter, would be of equal ſervice. It would alſo carry, from the veſſel to the ſhore, a ſtring capable of drawing a rope after it.

"*Laſtly*, A fourth plan for ſaving the crew of a ſhipwrecked veſſel, is that of throwing from the veſſel into the ſea an empty caſk with a cord attached to it. The wind and the waves would drive the caſk to the ſhore, and afford the means of eſtabliſhing that rope of communication already mentioned."

SHIRLEY, a townſhip of Maſſachuſetts, in the north-weſt part of Middleſex county, 41 miles N. W. of Boſton. It was incorporated in 1753, and contains 677 inhabitants.—*Morſe*.

SHIRLEY, a townſhip of Pennſylvania, ſituated in Huntingdon county.—*ib.*

SHOALS, *Iſles of*, a cluſter of eight iſlands, lying 8 miles S. E. of Portſmouth light-houſe, diſcovered in 1614, having a little well ſheltered harbour, (Haley's) of great uſe both to the fiſhermen and merchant veſſels. Theſe barren iſlands are chiefly valuable on account of the fiſheries. Theſe rocky iſlands are ſituated on the coaſt of New-Hampſhire; and to theſe the celebrated Capt John Smith gave his own name, but the ingratitude of man has denied his memory that ſmall honour. From Iſle of Shoals to the Dry Salvage Rock, the courſe is S. ½ W. 8 leagues; to Portſmouth N. N. W. 3 leagues; to Newbury-Port Bar S. W. 7 leagues; to York harbour N. ½ E. 5 leagues. N. lat. 42 59, W. long. 70 33.—*ib.*

SHOENECK, a Moravian ſettlement in Pennſylvania, near Nazareth; begun in 1757.—*ib.*

SHOREHAM, a townſhip of Vermont, Addiſon county, on the eaſt ſide of Lake Champlain, having Orwell on the ſouth and Bridport on the N. a little N. E. of Ticonderoga. It contains 721 inhabitants.—*ib.*

SHREWSBURY, a poſt-town of New-Jerſey, Monmouth county, on the ſea board, having Middletown on the N. Freehold W. and Dover ſouth-weſt. North river divides it from Middletown, and is navigable a few miles. This town is 15 miles north-eaſt by eaſt of Monmouth court-houſe, 14 ſouth-eaſt of Middletown Point, 49 eaſterly of Trenton, 33 ſouth-eaſt by eaſt of Brunſwick, and 79 eaſt north eaſt of Philadelphia. The compact part of the town is pleaſant, and contains an Epiſcopal and a Preſbyterian church, and a meeting-houſe for Friends. On the ſide of a branch of Naveſink river, in this town, is a remarkable cave, in which are 3 rooms, arched with a ſoft porous rock, through which the moiſture ſlowly exudes, and falls in drops on the ſand below. The townſhip contains 4,673 inhabitants, including 2.2 ſlaves. Much genteel company from Philadelphia and New-York reſort here during the ſummer months, for health and pleaſure.—*ib.*

SHREWSBURY, a townſhip of Vermont, in Rutland county, between Clarendon on the weſt, and Saltaſh on the eaſt, and contains 383 inhabitants.—*ib.*

SHREWSBURY, a townſhip in York county, Pennſylvania.—*ib.*

SHREWSBURY, a townſhip in Worceſter county, Maſſachuſetts; 6 miles eaſt of Worceſter, and 40 weſt by ſouth of Boſton. It was incorporated in 1727, and contains 963 inhabitants.—*ib.*

SHUBENACADIE, a river of Nova-Scotia, which riſes within a mile of the town of Dartmouth, on the E. ſide of Halifax harbour, and empties into Cobequid Bay, taking in its courſe the Slewiack and Gay's rivers. The great lake of the ſame name lies on the E. ſide of the road which leads from Halifax to Windſor, and about ſeven miles from it, and 21 miles from Halifax.—*ib.*

SHUTESBURY, a townſhip of Maſſachuſetts, Hampſhire county, on the eaſt ſide of Connecticut river, about 16 miles N. E. of Northampton, and 90 W. by N. of Boſton.—*ib.*

SIARA, or *Scara*, a town on the N. E. coaſt of Brazil, in the captainſhip of its name. S. lat. 3 30, W. long. 39 50. Andrew Vidal, of Negreiros, was chief magiſtrate of this city in the year 1772, in the 124th year of his age, and diſcharged his duty as a judge to entire ſatisfaction; and died 2 years after, in full poſſeſſion of his mental powers. In 1773, 189 of his deſcendants were alive.—*ib.*

SIBALDES, iſlands on the coaſt of Patagonia, in S. America. S. lat. 50 53, W. long. 59 35.—*ib.*

SIBAU *Iſlands*, on the coaſt of Cape Breton Iſland, lie off the ſouth point of Port Dauphin, and afford good anchorage.—*ib.*

SICCA PUNTO, or *Dry Point*, on the north coaſt of S. America, on the Spaniſh Main, is the north-weſt limit of Trieſte Bay, and ſoutherly of the iſland of Curacao.—*ib.*

SICHEM, formerly a ſettlement of the Moravians, on the eaſt line of New-York State; 25 miles E. S. E. of Kingſton, on Hudſon's river.—*ib.*

SIDNEY, a townſhip of New-York State, on the north line of Pennſylvania, oppoſite to the mouth of Chenengo river; having Suſquehannah for its north and eaſtern boundary.—*ib.*

SIDELING *Hill*, a range of hills which lie in the north-weſtern part of Maryland, between Alleghany and Waſhington counties, which are divided by the creek of the ſame name.—*ib.*

SILLA, a large town on the Niger, which bounded Mr Park's travels eaſtward. He gives no deſcription of the place, which he had not ſpirits or health to ſurvey; but fills a page of his work with the reaſons which determined him to proceed no farther. "When I arrived (ſays he), I was ſuffered to remain till it was quite dark, under a tree, ſurrounded by hundreds of people. But their language was very different from the other parts of Bambarra; and I was informed that, in my progreſs eaſtward, the Bambarra tongue was but little underſtood, and that when I reached Jenné, I ſhould find that the majority of the inhabitants ſpoke a different language, called *Jenné Kummo* by the Negroes, and *Kalan Soudan* by the Moors.

"With a great deal of entreaty, the Dooty allowed me to come into his baloon, to avoid the rain; but the place was very damp, and I had a ſmart paroxyſm of fever during the night. Worn down by ſickneſs, exhauſted with hunger and fatigue, half naked, and without any article of value, by which I might procure proviſions, clothes, or lodging, I began to reflect ſeriouſly on my ſituation. I was now convinced, by painful experience, that the obſtacles to my further progreſs were inſurmountable. The tropical rains were already ſet in with all their violence; the rice grounds and ſwamps were everywhere overflowed; and in a few days more, travelling of every kind, unleſs by water, would be completely obſtructed. The kowries which remained of the king of Bambarra's preſent were not ſufficient to enable me to hire a canoe for any great diſtance; and I had but little hopes of ſubſiſting by charity, in a country where the Moors have ſuch influence. But above all, I perceived that I was advancing more and more within the power of thoſe mercileſs fanatics; and from my reception both at SEGO and SANSANDING (ſee theſe articles *Suppl.*), I was apprehenſive that, in attempting to reach even Jenné (unleſs under the protection of ſome man of conſequence amongſt them, which I had no means of obtaining), I ſhould ſacrifice my life to no purpoſe; for my diſcoveries would periſh with me. The proſpect either way was gloomy. In returning to the Gambia, a journey on foot of many hundred miles preſented itſelf to my contemplation, through regions and countries unknown. Nevertheleſs, this ſeemed to be the only alternative; for I ſaw inevitable deſtruction in attempting to proceed to the eaſtward. With this conviction on my mind, I hope my readers will acknowledge that I did right in going no farther. I had made every effort to execute my miſſion in its fulleſt extent which prudence could juſtify. Had there been the moſt diſtant proſpect of a ſucceſsful termination, neither the unavoidable hardſhips of the journey, nor the dangers of a ſecond captivity, ſhould have forced me to deſiſt. This, however, neceſſity compelled me to do; and whatever may be the opinion of my general readers on this point, it affords me inexpreſſible ſatisfaction, that my honourable employers have been pleaſed, ſince my return, to expreſs their full approbation of my conduct." He would be a very unreaſonable man, indeed, who could on this point think differently from Mr Park's employers. Silla is placed in the new map of Africa in about 14° 48′ N. Lat. and 1° 24′ W. Long.

SILLON, in fortification, an elevation of earth, made in the middle of the moat, to fortify it, when too broad. It is more uſually called the *envelope*.

SILVER *Bluff*, a conſiderable height upon the Carolina ſhore of Savannah river; perhaps 30 feet higher than the low lands on the oppoſite ſhore, which are ſubject to inundations in the ſpring and fall. This ſteep bank riſes perpendicularly out of the river, diſcovering various ſtrata of earth. The ſurface of the ground upon this bluff, which extends nearly two miles on the river, and from half a mile to a mile in breadth, is nearly level, and a good fertile ſoil, as appears by the vaſt oaks, hickory, mulberry, black walnut, and other trees and ſhrubs left ſtanding in the old fields which are ſpread abroad to a great diſtance. Here are various veſtiges of the ancients; as Indian conical mounts, terraces, areas, &c. as well as traces of fortreſſes of regular formation, as if conſtructed after the modes of European military architects; which ſome ſuppoſe to be the ancient camps of the Spaniards, who formerly fixed fixed themſelves here, in hopes of finding ſilver.—*Morse.*

SIMANCAS, a village on the eaſtern limit of the kingdom of Leon in Spain, two leagues below Valladolid, on the river Giſuerga. It is mentioned by Dr Robertſon in the introduction to his Hiſtory of America, and is remarkable for the archives or regiſter office of the kingdoms of Leon and Caſtile, kept in the caſtle there. This collection was begun when the kings reſided often at Valladolid; in which city to this day is the chancery or civil and criminal tribunal for almoſt all Spain to the north of the Tagus. It was thought convenient to have thoſe papers kept in the neighbourhood of that court; and this caſtle was particularly fit for that purpoſe, as it is all built of ſtone. Some years ago there were two large halls in this office filled with papers relating to the firſt ſettlement of the Spaniards in South America. There was alſo in the room called the *ancient royal patronage* a box containing treaties with England, in which are many letters and treaties between the kings of England and Spain from about the year 1400 down to 1600. There was alſo in the ſame archives a ſtrong box, with five locks, which, it is ſaid, has not been opened ſince the time of Philip II. and it is conjectured that it contains the proceſs againſt Philip's ſon Prince Charles. But it ſeems ſome of the ſtate papers have been removed to Madrid.

SIMON's, St, the eaſternmoſt of the 3 large iſlands ſituated at the mouth of the Alatamaha river in Georgia, having on the N. N. E. *Little St Simon's Iſland*; and between theſe is the eaſtern mouth of the river. The ſouthern end of the iſland is near the N. mouth of the Alatamaha. It formerly had a ſtrong battery erected here, for the defence of Jekyl Sound, in which 10 or 12 forty gun ſhips may ride in ſafety. This iſland is about 45 miles in length, and from two to four in breadth; has a rich and fruitful ſoil, full of oak and hickory trees, intermixed with meadows and old Indian fields. In the middle of the iſland is the town of Frederica. The bar or entrance of St Simon's is S. by W. 19 leagues from Tybee Inlet.—*Morse.*

Simon's *Fort*, *St*, at the ſouth end of St Simon's Iſland, is 9 or 10 miles from St Simon's Bar; and is remarkable for its white appearance.—*ib.*

SIMSBURY, a townſhip of Connecticut, in Hartford county, 14 miles N. W. of Hartford. Copper ore has been found here.—*ib.*

SINEMAHONING, the N. weſternmoſt branch of Suſquehannah river.—*ib.*

SINEPUXENT, a very long bay on the ſouth-eaſt coaſt of Maryland; a number of long and narrow iſlands ſeparating it from the Atlantic Ocean. Sinepuxent Inlet, is in about lat. 38 10 30 N. and nearly 12 miles eaſt of the town of Snowhill.—*ib.*

SING-SING, an inconſiderable village on the eaſt ſide of Haverſtraw Bay, in Weſt-Cheſter county, 35 miles N. of New-York city.—*ib.*

SINICA, a conſiderable Cherokee town, on the banks of Keowee river. The houſes on the eaſt ſide are on an elevated ſituation, and command a delightful and extenſive proſpect of the whole ſettlement. The inhabitants, about 500 in number, can muſter 100 warriors.—*ib.*

SINO, or *Sinu*, a bay on the N. coaſt of Terra Firma, South-America. There is alſo a town of the ſame name on the S. ſide of the Gulf of Moroſquillo, about 66 miles N. E. of St Sebaſtian, and 40 S. W. of Tolu. —*ib.*

SIOUS, or *Sioux*, a powerful nation of Indians, conſiſting of three different tribes, which can furniſh 9 500 warriors; the Sious who inhabit the head waters of the Miſſiſſippi and Miſſouri, 3,000 warriors; the Sious of the Meadows, 2,500, and the Sious of the Woods, 4,000. The two laſt inhabit on the head and weſtern waters of the Miſſiſſippi, and the iſlands of Lake Superior.—*ib.*

SIPSEY's, a branch of Tombeckbee river, in Georgia, which runs a ſouth weſt by ſouth courſe. Its mouth is in about lat. 31 55 N. and 40 miles N. by W. of the upper mouth of Alabama river.—*ib.*

SIR *Charles Hardy's Iſland*, in the S. Pacific Ocean, was diſcovered in 1767, by Captain Carteret. It is low, level, and covered with wood. S. lat. 4 41, W. long. 154 20.—*ib.*

Sir *Charles Saunders' Iſland*, in the ſame ocean, and diſcovered by the ſame navigator, is about two leagues in length from E. to W. S. lat. 17 28, W. long. 151 4.—*ib.*

SIRIUS, a ſmall iſland in the ſame ocean, diſcovered by Lieutenant Ball, in 1792. It is about 18 miles in circuit. S. lat. 10 52, W. long. 162 30.—*ib.*

SISAL, on the north coaſt of Yucatan, in the Gulf of Mexico, is 4 leagues weſt of Linchanchee, and 8 eaſt of Cape Condecedo. It is the higheſt look out on the whole coaſt.—*ib.*

SISSIBOU, in Nova-Scotia, lies on the eaſt ſide of St Mary's Bay, 28 miles ſouth-eaſt of Annapolis.—*ib.*

SISTER's *Ferry*, a village in S. Carolina, 25 miles from Cooſawatchie, and 102 from Charleſton.—*ib.*

SITUS, in algebra and geometry, denotes the ſituation of lines, ſurfaces, &c. Wolfius delivers ſome things in geometry, which are not deduced from the common analyſis, particularly matters depending on the *ſitus* of lines and figures. Leibnitz has even founded a particular kind of analyſis upon it, called *calculus ſitus*.

SIWA, a town in Egypt, to the weſtward of Alexandria, built on a ſmall fertile ſpot or Oaſis, which is ſurrounded on all ſides by deſert land. A large proportion of this ſpace is filled with date trees; but there are alſo pomegranates, figs, and olives, apricots, and

Siwa.

plantains; and the gardens are remarkably flouriſhing. They cultivate a conſiderable quantity of rice, which, however, is of a reddiſh hue, and different from that of the Delta. The remainder of the cultivable land furniſhes wheat enough for the conſumption of the inhabitants. Water, both ſalt and freſh, abounds, but the ſprings which furniſh the latter are moſt of them tepid; and ſuch is the nature of the water, air, and other circumſtances, that ſtrangers are often affected with agues and malignant fevers.

The greateſt curioſity about Siwa is a ruin of undoubted antiquity, which, according to Mr Browne, reſembles too exactly thoſe of the Upper Egypt, to leave a doubt that it was erected and adorned by the ſame intelligent race of men. The figures of Iſis and Anubis are conſpicuous among the ſculptures; and the proportions are thoſe of the Egyptian temples, though in miniature. What of it remains is a ſingle apartment, built of maſſy ſtones, of the ſame kind as thoſe of which the pyramids conſiſt; and covered originally with ſix large and ſolid blocks, that reach from one wall to the other. The length is 32 feet in the clear, the height about 18, the width 15. A gate, ſituated at one extremity, forms the principal entrance; and two doors, alſo near that extremity, open oppoſite to each other. The other end is quite ruinous; but, judging from circumſtances, it may be imagined that the building has never been much larger than it now is. There is no appearance of any other edifice having been attached to it, and the leſs ſo as there are remains of ſculpture on the exterior of the walls. In the interior are three rows of emblematical figures, apparently deſigned to repreſent a proceſſion; and the ſpace between them is filled with hieroglyphic characters, properly ſo called. The people of Siwa have no tradition concerning this edifice, nor attribute to it any quality, but that of concealing treaſures, and being the haunt of demons. It has, however, been ſuppoſed, with ſome degree of probability, that Siwa is the *Siropum* of Pliny, and that this building was coeval with the famous temple of Jupiter Ammon, and a dependency on it. This may be ſo; but neither the natives of Siwa, nor the various tribes of Arabs who frequent that place, know any thing of the ruins of that temple, about which Mr Browne made every poſſible enquiry. "It may (as he obſerves) ſtill ſurvive the lapſe of ages, yet remain unknown to the Arabs, who traverſe the wide expanſe of the deſert; but ſuch a circumſtance is ſcarcely probable. It may be completely overwhelmed in the ſand; but this is hardly within the compaſs of belief."

The complexion of the people of Siwa is generally darker than that of the Egyptians. Their dialect is alſo different. They are not in the habitual uſe either of coffee or tobacco. Their ſect is that of Malik. The dreſs of the lower claſs is very ſimple, they being almoſt naked: among thoſe whoſe coſtume was diſcernible, it approaches nearer to that of the Arabs of the deſert than of the Egyptians or Moors. Their clothing conſiſts of a ſhirt of white cotton, with large ſleeves, and reaching to the feet: a red Tuniſine cap, without a turban; and ſhoes of the ſame colour. In warm weather they commonly caſt on the ſhoulder a blue and white cloth, called in Egypt *melayé;* and in winter they are defended from the cold by an *ihkram* or blanket. The liſt of their houſehold furniture is very ſhort; ſome earthen ware made by themſelves, and a few mats, form the chief part of it, none but the richer order being poſſeſſed of copper utenſils. They occaſionally purchaſe a few ſlaves from the Murzouk caravan. The remainder of their wants is ſupplied from Cairo or Alexandria, whither their dates are tranſported, both in a dry ſtate and beaten into maſh, which when good in ſome degree reſembles a ſweat meat. They eat no large quantity of animal food; and bread of the kind known to us is uncommon. Flat cakes, without leaven, kneaded, and then half baked, form part of their nouriſhment. The remainder conſiſts of thin ſheets of paſte, fried in the oil of the palm tree, rice, milk, dates, &c. They drink in great quantities the liquor extracted from the date-tree, which they term *date tree water*, though it have often, in the ſtate they drink it, the power of inebriating. Their domeſtic animals are, the hairy ſheep and goat of Egypt, the aſs, and a very ſmall number of oxen and camels. The women are veiled, as in Egypt. After the rains, the ground in the neighbourhood of Siwa is covered with ſalt for many weeks. Siwa is ſituated in 29° 12′ N. Lat. and 44° 54′ E. Long.

SIX MEN'S *Bay*, on the weſt ſide of the iſland of Barbadoes, towards the N. end. It lies between Sunderland Fort to the ſouth, and Six Men's Fort to the N.—*Morſe.*

SIX NATIONS, a confederacy of Indian nations ſo called by the Britiſh and Americans. The French call them Iroquois. Formerly they were called the Five Nations, five only being joined in that alliance; but they now conſiſt of ſix nations, and call themſelves *Aganuſchioni*, that is, the *United People*. Some call them *Mingos;* others *Maquais*. Theſe ſix nations are the *Mohawks*, *Oneidas; Onondagas*, *Senecas*, *Cayugas*, and *Tuſcaroras*. The latter joined the confederacy 70 years ago. In the late war with G. Britain, they were allies of that power, and in 1779 they were entirely defeated by the troops of Congreſs, and their towns all deſtroyed. They now live on grounds called the State Reſervations, which are intermediate ſpaces ſettled on all ſides by white people. In their preſent cramped ſituation, they cannot keep together a great while. They will probably quit the United States and retire over the lakes Ontario and Erie. All the Mohawks and the greater part of the Cayugas, have already removed into Canada. The number of ſouls in all the ſix nations was, in 1796, 4,058. The Stockbridge and Brotherton Indians, who now live among them, added, make the whole number 4,508, of whom 760 live in Canada, the reſt in the United States. By a treaty made in 1794, between the United States on the one part, and the Six Nations and their Indian friends reſiding with them, on the other part, it was ſtipulated that "the ſum of 4,500 dollars ſhould be expended annually and forever, in purchaſing cloathing, domeſtic animals, implements of huſbandry, and other utenſils, and in compenſating uſeful artificers who ſhall reſide among them, and be employed for their benefit." This allowance is under the direction of a ſuperintendant, and is not diſtributed for any private purpoſes. It is apportioned among them according to their numbers, in order to which, there is annually taken an exact cenſus of all theſe Indians. In 1796, the Friends, commonly called Quakers, in their benevolence and

zeal

zeal to promote the welfare of theſe Indians, raiſed a fund to ſupport a number of their ſociety, who offered to go and reſide among them, with a view to promote their civilization, moral improvement, and real welfare. A committee of their ſociety was appointed to accompany theſe friends to humanity, and they were actually on the ſpot, and commenced their work of charity in July of this year. The State of New-York have taken theſe Indians under their protection, and appointed commiſſioners to take care that they receive no wrong from intereſted individuals.—*ib.*

SKANEATETES, a lake in Onondaga county, New-York, 14 miles long from ſouth-eaſt to north-weſt, and little more than one mile wide where broadeſt. It waters the military townſhips of Marcellus and Sempronius, and ſends its waters northerly to Seneca river.—*ib.*

SKENECTADY, an ancient and reſpectable town in Albany county, New-York, 16 miles north-weſt of Albany city, pleaſantly ſituated in a vale bordered with hills to the ſouthward and eaſtward, on the margin of Mohawk river. The houſes, about 150 or 200 in number, are compactly built, chiefly of brick, on regular ſtreets, in the old Dutch ſtile, on the ſouth ſide of the river: few of them are elegant. The public buildings are a Dutch and a Preſbyterian church. The windings of the river, through the town and fields which are often overflowed in the ſpring, afford a rich and charming proſpect about harveſt time. This town, being at the foot of navigation, on a long river which paſſes through a very fine country rapidly ſettling, it would be natural to conclude, would embrace much of its commerce; but originally knowing no other than the fur trade, which, ſince the revolution, has almoſt ceaſed, and having taken no advantage of its happy ſituation for other commerce, the place has conſiderably decayed. The chief buſineſs of this town now is to receive the merchandize from Albany, and put it into batteaux to go up the river, and forward to Albany the returns from the back country. *Union College* was eſtabliſhed and incorporated here in 1794, and is under the direction of 24 truſtees. It took its name from the union of various denominations of Chriſtians in its eſtabliſhment. The Dutch were, however, by far the moſt liberal benefactors to this inſtitution. It is well ſituated for the conveniency of the northern and weſtern parts of the State. In June, 1796, there were 40 ſtudents, divided into 4 claſſes, viz.—1 languages, 2 hiſtory and belles lettres, 3 mathematics, 4 philoſophy. The annual expenſe of education here, including board, tuition, &c. is leſs than 100 dollars. The property of the college conſiſts in various articles, to the following amount, viz.

	dolls.	*cts.*
Bonds and mortgages, producing an annual intereſt of 7 per cent.	21,301	6
Subſcriptions, and other debts due on the books of the treaſurer	4,983	10
Caſh appropriated for the purchaſe of books	1,356	45
Houſe and lot for the preſident	3,500	
Lot for the ſite of the college	3,250	
Houſe and lot heretofore occupied for the academy, a donation from the conſiſtory of the Dutch church	5,000	
Books, &c. in the poſſeſſion of the truſtees, and on the way from Europe	2,381	99
Caſh appropriated by the regents for the purchaſe of books in the hands of the committee	400	
Legacy by Abraham Yates, jun. Eſq. of Albany	250	
	42,422	60

And 1,604 acres of land. The faculty of the college conſiſted, in 1797, of the preſident and one tutor; and the ſalary of the former with an houſe for his family is 1100 dollars, and of the latter 665 dollars per annum, with an additional allowance at preſent of 250 dollars, on account of the extraordinary price of the neceſſaries of life. There were, in 1797, 37 ſtudents, eight in the claſs of languages, twenty in the claſs of hiſtory and belles lettres, ſix in the claſs of mathematics, and three in the claſs of philoſophy. The courſe of ſtudies is, the firſt year Virgil, Cicero's orations, Greek Teſtament, Lucian, Roman antiquities, arithmetic and Engliſh grammar—the ſecond year, geography and the uſe of the globes, Roman hiſtory, hiſtory of America, and the American revolution, Xenophon, Horace, criticiſm and eloquence—the 3d year, the various branches of mathematics, and vulgar and decimal fractions, and the extraction of the roots, geometry, algebra, trigonometry, navigation, menſuration, Xenophon continued, and Homer—and the 4th and laſt year, natural philoſophy, the conſtitution of the United States and of the different States, metaphyſics, or at leaſt that part which treats of the philoſophy of the human mind, Horace continued, and Longinus: and during the courſe of theſe ſtudies, the attention of the claſſes is particularly required to elocution and compoſition in the Engliſh language. A proviſion is alſo made, for ſubſtituting the knowledge of the French language inſtead of the Greek, in certain caſes, if the funds ſhould hereafter admit of inſtituting a French profeſſorſhip. The library conſiſts of about 1000 volumes, and £500 is appropriated to the purchaſe of a philoſophical apparatus. The townſhip of Skenectady contains 3,472 inhabitants; of whom 683 are electors, and 381 ſlaves. It is bounded eaſterly by Half Moon and Water-Vliet, and ſoutherly by the north bounds of the manor of Renſſelaerwick.—*ib.*

SKENESBOROUGH, now called *White-hall*, is a growing townſhip in the north-eaſt corner of the State of New-York, ſituated on Wood Creek, on the ſouth ſide of South Bay. This is a place through which moſt of the communication and trade between the counties on Lake Champlain and Hudſon's river paſſes. It has, however, very bad water, and is unhealthy in ſummer. It is about 8 miles eaſt by north of Fort George, and 6 north by eaſt of Fort Ann. The fortifications here were deſtroyed by Gen. Burgoyne, in July, 1777.—*ib.*

SKIPPACK, a townſhip in Montgomery county, Pennſylvania.—*ib.*

SKIPTON, a village on the north ſide of Patowmack river, about 11 miles ſouth-eaſt of Fort Cumberland, and 28 ſoutherly of Bedford in Pennſylvania.—*ib.*

SKIRMISH BAY, the name given by Lieutenant Broughton to a bay in an iſland, which was diſcovered by by him in latitude 43° 48′ ſouth, and in longitude 183° eaſt. The Chatham armed tender, which Mr Broughton commanded, under Captain Vancouver in his voyage of diſcovery, worked up into the bay, and came to anchor about a mile from the ſhore. The Lieutenant, the maſter, and one of the mates, landed, and found the people ſo extremely inhoſpitable, that they were obliged to fire upon them in their own defence. The land, whether iſland or continent, is of conſiderable magnitude; the part which they ſaw extended nearly 40 miles from eaſt to weſt; and the appearance of the country, according to the deſcription given, is very promiſing. In many reſpects, the natives reſemble thoſe of New-Zealand; from which country they are diſtant about 100 leagues: but their ſkins were deſtitute of any marks, and they had the appearance of being cleanly in their perſons. Their dreſſes were of ſeal or ſea-bear ſkin, and ſome had fine woven mats faſtened round the waiſt. "They ſeemed a cheerful race, our converſation (ſays Mr Broughton) frequently exciting violent burſts of laughter amongſt them. On our firſt landing, their ſurpriſe and exclamations can hardly be imagined: they pointed to the ſun, and then to us, as if to aſk, whether we had come from thence?" Their arms were ſpears, clubs, and a ſmall weapon reſembling the New Zealand patoo.

SKITIKISS, a bay of about 8 leagues extent on the eaſt ſide of Waſhington's Iſles, on the N. W. coaſt of N. America, northward of Cumberland Harbour. The opening is in lat. about 53 15.—*Morſe.*

SKUPPERNONG, a ſmall river of N. Carolina. A canal was finiſhed in 1790, which connects the waters of this ſtream with the lake in Diſmal Swamp, on the ſouth ſide of Albemarle Sound.—*ib.*

SKUTOCK *Hills*, in Hancock county, Diſtrict of Maine, lie north-north-eaſt of the harbour of Gouldſborough. In ſailing from Mount Deſert to Gouldſborough, you muſt ſteer north-north-eaſt for theſe hills, which are more remarkable than any in the eaſtern country. There are 5 of them, and at a diſtance they appear round.—*ib.*

SLABTOWN, a village in Burlington county, New-Jerſey, about half way between Burlington and Mount Holly, 4 or 5 miles from each.—*ib.*

SLAUGHTER *Creek*, a ſhort ſtream on the eaſt ſide of Cheſapeak Bay, Dorcheſter county, Maryland.—*ib.*

SLAVE *Lake* and *River*, in the north-weſt part of N. America. The lake is extenſive and gives riſe to McKenzie's river, which empties into the Frozen Ocean, and receives the river of its name from the weſt end of Athapeſcow Lake; beſides many other rivers from various directions. Slave river runs a north-weſt by north courſe, and is a mile wide at its mouth. The latitude of Slave Lake is 61 26 N. and the centre of the lake is in about long. 115 weſt. The northern bay is 40 leagues deep, and 6 fathoms water. The Dog-ribbed Indians inhabit the north ſhore of this lake.—*ib.*

SLIDING-RULE (ſee that article, as likewiſe *GAUGING-ROD*, GEOMETRY, and *LOGARITHMIC Lines*, Encycl.) is introduced here, for the ſake of a new, and (except in working direct proportions) a more commodious method than the common, of applying the ſlider. This method, which is propoſed by the Rev. W. Pearſon of Lincoln, is as follows:

Invert the ſlider B on any common ſliding rule, whereby the numerical figures will aſcend on it, and on the fixed line A, in contrary directions: now, as the diſtance from unity to any multiplier, on Gunter's line, will invariably extend from any multiplicand to their product, it follows, that if any particular number on the inverted ſlider B be placed oppoſite to any other given number on A, the product of thoſe numbers will ſtand on the ſlider B, againſt unity on A; for, in any poſition of the inverted ſlider, the diſtance from unity to the multiplier on A, inſtead of being carried forward on B, as when the ſlider is in a direct poſition, is brought back thereby to unity again; ſo that unity (or *ten* on ſingle lines where the ſlider is too ſhort for the operation) is invariably the index for the product of any two coincident numbers throughout the lines.

In diviſion, by the ſame proceſs, if the dividend on B be put to the index, or unity on A, the diviſion and quotient will coincide on the two oppoſite lines; ſo that when one is given, and ſought for on either line, the other is ſeen on its oppoſite line at the ſame time.

The next operation which offers itſelf here is reciprocal proportion, which can be effected by no other method than by inverting the ſlider, but which is rendered as eaſy by this application, as direct proportion is in the common way; for if any antecedent number on B inverted be ſet to its conſequent on A, any other antecedent on B, in the ſame poſition, will ſtand againſt its conſequent on A, ſo as that the terms may be in a reciprocal ratio. In ſquaring any number, it will appear, from what has been already ſaid, that if the number to be ſquared be placed on B, inverted againſt the ſame on A, the ſquare will ſtand on B, againſt unity on A. Therefore, to extract the ſquare root of any number, let that number on B ſtand againſt unity on A; and then wherever the coincident numbers are both of the ſame value, that point indicates the root. If two dividing lines of the ſame value do not exactly coincide, the coincident point will be at the middle of the ſpace contained between thoſe two which are neareſt a coincidence; and as there is only one ſuch point, there can be no miſtake in readily aſcertaining it. The finding of a mean proportional between any two numbers is extremely eaſy at one operation; for if one of the numbers on B inverted be ſet to the other on A, the coincident point of two ſimilar numbers ſhews either of thoſe to be the mean, or ſquare root of their product, according to the preceding proceſs. Thus have we a ſhort and eaſy method of multiplying, dividing, working reciprocal proportion, ſquaring and extracting the ſquare root, at one poſition of the inverted ſlider, whereby the eye is directed to only one point of view for the reſult, after the ſlider is fixed: whereas, by the common method of extracting the ſquare root by A and B direct, the ſlider requires to be moved backwards and forwards by adjuſtment, the eye moving alternately to two points, till ſimilar numbers ſtand, one on B againſt unity on A, and the other on A againſt the ſquare number on B; which ſquare number, in the caſe of finding a mean proportional, muſt be found by a previous operation. Hence, for more convenience in the extraction of roots, and meaſuring of ſolids, an additional

ditional line called D has been added to the rule, which renders it more complex, and conſequently ſeldom underſtood by an artificer.

SLOKUM's *Iſland* is the third of the Elizabeth Iſlands in magnitude, being about 5 miles in circuit. It lies off Buzzard's Bay, in Barnſtable county, Maſſachuſetts, and weſt of Tinker's Iſland.—*Morse*.

SMALL *Point*, on the coaſt of Lincoln county, Diſtrict of Maine, forms the eaſt limit of Caſco Bay, and lies N. E. of Cape Elizabeth, the weſtern limit. —*ib*.

SMITH, a townſhip in Waſhington county, Pennſylvania.—*ib*.

SMITHFIELD, a ſmall poſt-town of Virginia, on Pagan Creek, which empties into James's river, in Iſle of Wight county. It is 85 miles ſouth-eaſt of Richmond, and 364 ſouth-ſouth-weſt of Philadelphia. The creek is navigable for veſſels of 20 tons.—*ib*.

Smithfield, a poſt-town, and the capital of Johnſon county, N. Carolina, on the eaſt ſide of Neus river, on a beautiful plain, about 100 miles north-weſt of Newbern, 25 from Raleigh, and 473 from Philadelphia.—*ib*.

Smithfield, a townſhip of Pennſylvania, Philadelphia county.—*ib*.

Smithfield, *Upper* and *Lower*, two townſhips in Northampton county, Pennſylvania.—*ib*.

Smithfield, a townſhip of Rhode-Iſland, Providence county, having the State of Maſſachuſetts on the north, and Cumberland on the N. E. Here are extenſive orchards; and great quantities of ſtone-lime are made, and tranſported to Providence and other places. It contains 3171 inhabitants, including 5 ſlaves.—*ib*.

SMITH's *Cape*, the north point of the entrance into a ſea called the New Diſcovered Sea, and the S. W. point of the iſland formed by that ſea or ſound, which communicates with Hudſon's Straits. It is on the eaſt ſide of Hudſon's Bay. N. lat. 60 48, W. long. 80 55. —*ib*.

Smith's *Iſland*, the ſouthernmoſt of the range of iſlands, in the Atlantic Ocean, along the coaſt of Northampton and Accomack counties, Virginia. It is near the S. point of Cape Charles. Here ſhips frequently come to anchor to wait for pilots to conduct them into Cheſapeak Bay.—*ib*.

Smith's *Iſles*, the range of iſlands which line the above coaſt. They were ſo named in 1608, in honour of Captain John Smith, who landed on the peninſula, and was kindly received by Accomack, the prince of the peninſula, part of which ſtill bears his name.—*ib*.

Smith's *Iſland*, a ſmall iſland at the eaſt end of the iſland of Antigua, and in Exchange Bay. Alſo the name of an iſland in the S. Pacific Ocean, diſcovered by Lieutenant Ball, in the year 1790. S. lat. 9 44, W. long. 161 54.—*ib*.

Smith's *Point* is the ſouthern limit of the mouth of Patowmack river, on the weſt ſide of Cheſapeak Bay, oppoſite to the northern head land, called Point Lookout, and in about lat. 37 54 north.—*ib*.

Smith's *Sound*, on the eaſt coaſt of Newfoundland Iſland, is bounded north by Cape Bonaventure.—*ib*.

SMITHTOWN, a plantation in Lincoln county, Diſtrict of Maine, ſituated on the weſt ſide of Kennebeck river, and contains 521 inhabitants.—*ib*.

Smithtown, a ſmall poſt-town of Suffolk county, Long-Iſland, New-York, 52 miles S. eaſterly of New-York city, and 147 from Philadelphia. The townſhip is bounded ſoutherly by Iſlip, weſterly by Huntington, northerly by the Sound, and eaſterly by the patent of Brookhaven, including Winne-commick. It contains 1022 inhabitants, of whom 167 are electors, and 166 ſlaves.—*ib*.

Smithville, Snow.

SMITHVILLE, the chief town of Brunſwick county, N. Carolina, ſituated near the mouth of Cape Fear river, about 30 miles ſouth of Wilmington.—*ib*.

SMYRNA, *New*, a thriving town in E. Florida. It is ſituated on a ſhelly bluff, on the weſt bank of the ſouth branch of Moſquito river; about 10 miles above the Capes of that river, about 30 miles north of Cape Canaveral, and in lat. 28 north. It is inhabited by a colony of Greeks and Minorquies, eſtabliſhed not long ſince, by Dr Turnbull.—*ib*.

SNAKE *Indians*, a tribe who inhabit the ſouth-weſtern ſide of Miſſouri river, in lat. about 47 N. and long. 107 W. The Shevetoon Indians inhabit on the oppoſite ſide of the river.—*ib*.

SNOW. See that article (*Encycl.*), where we have endeavoured to account for ſnow's contributing to the preſervation and growth of vegetables. It muſt be confeſſed, however, that if ſnow poſſeſſed only the property of preſerving vegetables, and of preventing them from periſhing by the ſeverity of the cold, it is not at all probable that the ancient philoſophers would have conſidered it as depoſiting on the earth nitrous ſalts, as they might have aſcertained, by a very ſimple experiment, that it contains none of that ſalt; for they did not aſcribe the ſame property to rain-water, but they remarked that ſnow burnt the ſkin in the manner of acids, as well as other bodies immerſed in it. Being induced to conclude that there was nitre in the air, it was natural that they ſhould aſcribe to this nitre the burning qualities of ſnow, and conſequently its influence on vegetation.

Such reflections induced Morveau, *alias* Citizen Guyton, to employ J. H. Haſſenfratz to inquire into the cauſe of the difference of the effects of ſnow and rain-water on various ſubſtances. Haſſenfratz found that theſe differences are occaſioned by the oxygenation of the ſnow: and that theſe effects are to be aſcribed to a particular combination of oxygen in this congealed water. He put 1000 grammes of ſnow in a jar, and 1000 grammes of diſtilled water in another. He poured into each of the jars an equal quantity of the ſame ſolution of turnſole. He placed both the jars in a warm temperature; and after the ſnow melted, he remarked that the dye was redder in the ſnow water than in the diſtilled water. He repeated this experiment, and with the ſame reſult. He put into a jar 1000 grammes of diſtilled water, and into another 1000 grammes of ſnow. Into each of the jars he put 6·5 grammes of very pure and clean ſulphat of iron. In the firſt, there was precipitated 0·150 grammes of the oxyd of iron, and 0·010 grammes in the other. As the oxyd of iron was precipitated from a ſolution of the ſulphat by oxygen, it thence follows, that the ſnow contained more oxygen than the diſtilled water; and it follows, from the firſt experiment, that this quantity of oxygen was conſiderable enough to redden the tincture of turnſole.

It is fully demonſtrated by theſe two experiments, that ſnow is oxygenated water, and that it muſt conſequently have on vegetation an action different from that of common ice. The experiments of Dr Ingenhouſs on the germination of ſeeds have taught us, that the preſence and contact of oxygen are abſolutely neceſſary for the plant to expand. They have ſhewn alſo, that the more abundant the oxygen is, the more rapidly will the ſeeds grow. Moſt plants ſuffered to attain to their perfect maturity ſhed on the earth a part of their ſeed. Theſe ſeeds, thus abandoned and expoſed to the action of cold, are preſerved by the ſnow which covers them, at the ſame time that they find in the water it produces by melting, a portion of oxygen that has a powerful action on the principle of germination, and determines the ſeeds that would have periſhed to grow, to expand, and to augment the number of the plants that cover the ſurface of the earth.

A very conſiderable number of the plants which are employed in Europe for the nouriſhment of men, are ſown in the months of September, October, and November. The ſeeds of ſeveral of theſe germinate before the cold commences its action upon them, and changes the principle of their life. The ſnow which covers the reſt, acting on the germ by its oxygenation, obliges them to expand, and to increaſe the number of uſeful plants which the farmer and gardener commit to the earth, and conſequently to multiply their productions.

Here, then, we have three effects of ſnow upon vegetation, all very different, which contribute each ſeparately to increaſe, every year, the number of our plants; to give them more vigour, and conſequently to multiply our crops. Theſe effects are: 1. To prevent the plants from being attacked by the cold, and from being changed or periſhing by its force. 2. To furniſh vegetables with continual moiſture, which helps them to procure thoſe ſubſtances neceſſary for their nutrition, and to preſerve them in a ſtrong healthy ſtate. 3. To cauſe a greater number of ſeeds to germinate, and conſequently to increaſe the number of our plants.

SNOWHILL, a port of entry and poſt-town of Maryland, and the capital of Worceſter county, ſituated on the S. E. ſide of Pokomoke river, which empties through the eaſtern ſhore of Cheſapeak Bay, about 12 miles to the ſouth-weſt. Here are about 60 houſes, a court-houſe, and gaol, and the inhabitants deal principally in lumber and corn. The exports for one year, ending the 30th of September, 1794, amounted to the value of 4,040 dollars. It is 16 miles from Horntown, in Virginia, 82 S. of Wilmington, in Delaware, and 158 S. by W. of Philadelphia.—*Morſe.*

SNOWTOWN, a ſettlement in Lincoln county, Diſtrict of Maine; ſituated between the Weſt Ponds, 7 or 8 miles W. of Sidney, oppoſite to Vaſſalborough, and N. W. of Halowell.—*ib.*

SOAP. See Chemistry *Index*, Suppl.

SOCANDAGA, or *Sagendaga*, the W. branch of Hudſon's river, runs a ſouth and ſouth-eaſt courſe, and, about 15 miles from its mouth, takes a north-eaſt direction, and joins that river about 12 or 15 miles W. by N. of Fort Edward.—*Morſe.*

SOCIETY *Iſlands*, a cluſter of iſlands in the S. Pacific Ocean. To theſe iſlands Capt. Cook was directed by Tupia, in 1769; and he gave them this name in honour of the Royal Society. They are ſituated between the latitudes of 16 10, and 16 55 S. and between the longitudes of 150 57 and 152 W. They are 7 in number; *Huaheine, Ulietea, Otaha, Bolabola, Mourooa, Toobaee*, and *Tabooyamanoo* or *Saunder's Iſland*, which is here included, as being ſubject to Huaheine. The ſoil, the productions, the people, their language, religion, cuſtoms, and manners are ſo nearly the ſame as at Otaheite, that little need be added to the account which has already been given. Nature has been equally bountiful in uncultivated plenty, and the inhabitants are as luxurious and as indolent. A plantain branch is the emblem of peace, and changing names the greateſt token of friendſhip. Their morais are differently conſtructed, though ſerving the ſame purpoſes. It is cuſtomary to give their daughters to ſtrangers who arrive amongſt them; but the pairs muſt be five nights lying near each other, without preſuming to take any other liberty. On the ſixth evening, the father of the young woman treats his gueſt with food, and informs his daughter, that ſhe muſt that night receive him as her huſband. The ſtranger muſt not expreſs the leaſt diſlike, ſhould the partner allotted to him be ever ſo diſagreeable; for this is conſidered as an unpardonable affront, and is puniſhed with inſtant death.—*ib.*

SOCONUSCO, a province of New-Spain, having Chiapa on the N. Guatimala on the E. the N. Pacific Ocean on the S. and Guaxaca on the W. It is about 90 miles long, and almoſt as broad. It does not produce much corn, but great quantities of cocoa and indigo.—*ib.*

SOCONUSCO *Port*, on the W. coaſt of New-Mexico, capital of the province of Soconuſco, in which are the mountains of this name. N. lat. 15 12, W. long. 98 16.—*ib.*

SOCORA, an iſland on the coaſt of South-America.—*ib.*

SODUS, *Great*, a gulf connected with the ſouth ſide of Lake Ontario, by a ſhort and narrow entrance. It is about 8 miles long, and 4 broad, and has an iſland in the eaſtern part. The town called Sodus, ſtands on the W. ſide, near the S. W. part of the bay, or gulf; about 24 miles north of Geneva, 35 ſouth weſtward of Oſwego Fort, and 100 eaſt of Niagara.—*ib.*

SOIL *Cove*, a ſettlement on Deſert Iſland in the Diſtrict of Maine.—*ib.*

SOLANGO, an iſland on the coaſt of Peru; 21 miles N. by W. from Colanche river, and 12 ſouth of Port Callo.—*ib.*

SOLAR, *Morro*, or *Cape Solar*, on the coaſt of Peru, is 6 miles N. by W. of the rocks of Pachacama off the port of Callao.—*ib.*

SOLDERING. Under this title, in the *Encyclopædia*, we have give directions for ſoldering ſilver, braſs, and iron: but there are other metals which muſt ſometimes be ſoldered; and the following account of different ſolders, taken from the *Philoſophical Magazine*, may be uſeful to many of our readers.

"When lead, tin, and biſmuth, are mixed in a certain proportion, they produce a metal exceedingly fuſible, which is known by the name of *ſoft ſolder*: but which, from its ſingular properties, may be applied with advantage to many other uſeful purpoſes. Newton, and after him Kraſt and Muſchenbroek, obſerved, that five parts of biſmuth, three of tin, and two of lead, alſo five parts of biſmuth, four of tin, and one part of lead, melted with a heat of 220 degrees of Fahrenheit;

and they found that various mixtures of this kind were fuſible by a heat not much greater than that of boiling water. At a later period, V. Roſe, a German naturaliſt, diſcovered, that a mixture of four parts of biſmuth, two of tin, and two of lead, as Kunkel recommended for ſoldering tin ; and D'Arcet, among the French, that a mixture of eight parts of biſmuth, three of tin, and five of lead ; or eight of biſmuth, four of tin, and four of lead ; or eight of biſmuth, two of tin, and ſix of lead ; alſo ſixteen of biſmuth, ſeven of tin, and nine of lead—all melted, or at leaſt became ſoft, in boiling water.

" According to the experiments made by Profeſſor Gmelin, reſpecting the fuſion of theſe three metals, a mixture, conſiſting of two parts of biſmuth, one part of tin, and one of lead, which is the ſame as Roſe propoſed, gave a metal that was fuſed in boiling water. A mixture of ſix or more parts of biſmuth, ſix of tin, and three of lead, or one part of biſmuth, two parts of tin, and two of lead, gave, according to Klein, the ſolder uſed by the tin button makers. The ſame workmen uſe alſo for ſoldering, according to Klein, a mixture of four parts of biſmuth, three parts of tin, and five parts of lead. Among the many ſoft ſolders employed by the tin-men, a mixture of one part of biſmuth, two parts of tin, and one part of lead, is, according to Klein, very much employed. Reſpecting this kind of ſolder, the experiments of Profeſſor Gmelin give the following reſult : One part of biſmuth, two parts of tin, and one part of lead, melt in boiling water. According to Klein, the tin-men employ for ſoldering a mixture of one part of biſmuth, twenty-four parts of tin, and four parts of lead. Eight parts of biſmuth, three of tin, and five of lead, gave a metal exceedingly like tin in its colour and brightneſs, but very brittle : in water beginning to boil, it became not only ſoft, but was completely fuſed. This imitation, however, may be better accompliſhed by the mixture of Profeſſor Lightenberg, which conſiſts of five parts of biſmuth, three of tin, and two of lead. This metal is very like the former, though not ſo brittle ; but it ſeemed to melt in hot water even before it came to boil."

As this ſubject has again come under our notice, it may be proper to lay before our readers what M. Van Braam ſays of the Chineſe method of ſoldering frying-pans and other veſſels of caſt-iron, when cracked and full of holes. As the author admits that it *muſt* appear *impoſſible* to thoſe who have not *witneſſed* the proceſs, ſuch of our artiſts as have not been in China will give to the tale what credit they think it deſerves.

" All the apparatus of the workman conſiſts in a little box, 16 inches long and 6 wide, and 18 inches in depth, divided into two parts. The upper contains three drawers with the neceſſary ingredients ; in the lower is a bellows, which when a fire is wanted is adapted to a furnace eight inches long and four inches wide. The crucibles for melting the ſmall pieces of iron intended to ſerve as ſolder are a little larger than the bowl of a common tobacco pipe, and of the ſame earth of which they are made in Europe : thus the whole buſineſs of ſoldering is executed.

" The workman receives the melted matter out of the crucible upon a piece of *wet paper*, approaches it to one of the holes or cracks in the frying-pan, and applies it there, while his aſſiſtant ſmooths it over by ſcraping the ſurface, and afterwards rubs it with a bit of *wet linen*. The number of crucibles which have been deemed neceſſary are thus ſucceſſively emptied, in order to ſtop up all the holes with the melted iron, which conſolidates and incorporates itſelf with the broken utenſil, and which becomes as good as new. The furnace which our author ſaw was calculated to contain eight crucibles at a time ; and while the fuſion was going on, was covered with a ſtone, by way of increaſing the intenſity of the heat."—M. Van Braam affects frequently to correct the miſtakes of Sir George Staunton !

SOLDIER's *Gut*, on the N. E. coaſt of the iſland of St Chriſtopher's, in the W. Indies, eaſtward of Half Moon Bay, and alſo eaſtward of Chriſt Church.—*Morse.*

SOLEBURY, a townſhip in Buck's county, Pennſylvania.—*ib.*

SOLIDAD, *la*, or the *Deſert*, a cloiſter of barefooted Carmelites ; ſituated on a hill 3 leagues N. W. of the city of Mexico, incloſed with a high ſtone wall ſeven leagues in compaſs. The hill, on which the monaſtery ſtands, is ſurrounded with rocks, in which they have dug caves for oratories. Here are gardens and orchards 2 miles in compaſs, filled with the choiceſt European fruit trees. The provincial Chapter of the Order, is held here.—*ib.*

SOLODAD *Port*, on the E. ſide of the eaſternmoſt of the Falkland Iſlands, was formerly called Port Louis. The inner part of the harbour lies in the 57th degree of W. long. and in S. lat. 51 50.—*ib.*

SOLOMON's *Iſles*, or *Land of the Arſacides*, a group of iſlands concerning the exiſtence of which, there has been much diſpute, lie about 1,850 Spaniſh leagues W. of the coaſt of Peru, in the vicinity of New-Guinea, between 154 and 160 E. long. from Paris, and between 6 and 12 S. lat. They were firſt diſcovered by Mendana, in his firſt voyage in 1567. Herrera, in his deſcription of theſe iſlands, reckons 18 principal ones belonging to the group, from 50 to 300 leagues in circumference, beſides many of a ſmaller ſize. The air of theſe iſlands is ſalubrious, the ſoil fertile, the inhabitants numerous, and of different ſhades from white to black. The principal of theſe iſlands are, St Iſabella, St George, St Mark, St Nicholas, Florida, the Iſland of Palms, &c —*ib.*

SOLON, a military townſhip of New-York, Onondago county, about 35 miles N. W. from Suſquehannah river, and 37 ſouthward from Lake Oneida. It is under the juriſdiction of the town of Homer, which was incorporated in 1794.—*ib.*

SOMBELLO *Point*, weſtward of the Gulf of Darien, is 5 miles northward of Franciſco river.—*ib.*

SOMBRERA, *Sombavera*, or *Sombiero*, a ſmall deſert iſland in the Weſt-Indies, about 18 miles N. W. of Anguilla. It is about a league each way, and is thus called by the Spaniards, from its reſemblance to a hat. N. lat. 18 38, W. long. 63 37. It is dependant on Barbuda.—*ib.*

SOMELSDYK, *Fort*, a Dutch fort at the confluence of the rivers Commewine and Cottica ; the latter being an arm of Surrinam river —*ib.*

SOMERS, a townſhip of Connecticut, on the north line of Tolland county, which ſeparates it from the State of Maſſachuſetts. It contains about 1200 inhabitants, and is 24 miles N. E. of Hartford.—*ib.*

SOMERSET, a townſhip in Waſhington county, Pennſylvania.—*ib.*

Somerset, a townſhip of Vermont, Windham county, 10 or 12 miles north-eaſt of Bennington.—*ib.*

Somerset, a poſt-town of Maſſachuſetts, Briſtol county, and on Taunton river. It was incorporated in 1790, and contains 1151 inhabitants. It is 9 miles eaſterly of Warren in Rhode-Iſland, 52 ſoutherly of Boſton, and 311 north-eaſt of Philadelphia.—*ib.*

Somerset, a well cultivated county of New-Jerſey, on the north ſide of the great road from New-York to Philadelphia. The ſoil, eſpecially on Rariton river and its branches, is good, and produces good crops of wheat, of which great quantities are annually exported. It is divided into 6 townſhips, which have 3 churches for Preſbyterians, 5 for the Dutch Reformed, 1 for Dutch Lutherans, and 1 for Anabaptiſts. It contains 12,296 inhabitants, including 1810 ſlaves.—*ib.*

Somerset, the capital of the above county; ſituated on the weſt ſide of Millſtone river. It contains a court-houſe, gaol, and about 30 houſes. It is 23 miles northerly of Trenton, and 72 N. E. by N. of Philadelphia.—*ib.*

Somerset, a county of Maryland, bounded eaſt by the State of Delaware and Worceſter county, and weſt by the waters of Cheſapeak Bay. It contains 15,610 inhabitants, including 7,070 ſlaves. Waſhington Academy, in this county, was inſtituted by law in 1779. It was founded, and is ſupported by voluntary ſubſcriptions and private donations; is authoriſed to receive gifts and legacies, and to hold 2,000 acres of land.—*ib.*

Somerset, a new county of Pennſylvania, bounded north by Huntingdon and ſouth by Alleghany county, in Maryland, and is divided into 5 townſhips.—*ib.*

SOMERSWORTH, a townſhip of Strafford county, New-Hampſhire, containing 943 inhabitants. It was taken from Dover, from which it lies adjoining to the N. E. and incorporated in 1754. A dreadful ſtorm of thunder and lightning happened here in May, 1779.—*ib.*

SONGO *River*, in the Diſtrict of Maine, is formed by two branches which unite in Raymondtown, about 3 miles from Sebago Pond. The longeſt branch riſes in Greenland, about 3 miles from Amariſcoggin river, where is a pond called *Songo Pond*, 2 miles long. This ſtream, which purſues a ſoutherly courſe for at leaſt 70 miles, is ſo free from rapids, that timber may be brought conveniently from within a few miles of its head. The other branch comes from Waterford and Suncook, and paſſes through a number of ſmall ponds; then falling into *Long Pond*, it proceeds through *Brandy Pond*, and meets the other branch. It is boatable its whole length, 25 miles.—*ib.*

SONORA, a ſubdiviſion of the South diviſion of New-Mexico, in North America. Chief town, Tuape.—*ib.*

SONSONATE, a ſea-port town and bay on the coaſt of Mexico.—*ib.*

SORREL *River*, the outlet of Lake Champlain, which, after a courſe of about 69 miles north, empties into the river St Lawrence, in lat. 46 10, and long. 72 25 W. Sorrel Fort, built by the French, is at the weſtern point of the mouth of this river.—*ib.*

SOTOVENTO, a name applied to the Leſſer Antilles, in the Weſt-Indies. Among theſe, the chief may be reckoned Trinidad, Margaretta, Curaſſou, and Tortugas.—*ib.*

Sotovento *Lobos*, or *Leeward Iſland of Sea Wolves or Seals*, on the coaſt of Peru, is 7 leagues from the Barlevento Lobos, or Windward Iſland of Sea Wolves. It is about 6 miles in circuit, and 15 miles from Cape Aguja.—*ib.*

SOUDAN, literally ſignifies the country of the negroes; but it is likewiſe uſed as one of the names of an African kingdom, otherwiſe called Dar-fur. We know not that this kingdom has been viſited by any European beſides Mr Browne, who places it between the 11th and 16th degrees of north latitude, and between the 26th and 30th degrees of eaſt longitude. Theſe numbers are not exact: it does not reach ſo far eaſt as the 30th degree, nor ſo far north as the 16th; but on his map minutes are not marked. On the north, it is bounded by a deſert which ſeparates it from Egypt; on the eaſt, by Kordofan, which is now ſubject to Soudan, and lies between it and Sennaar; and on the ſouth and eaſt, by countries of which the names are hardly known. Mr Browne was induced to viſit Soudan in hopes of being able to trace the Bahr-el abiad, or true Nile, to its ſource: but he was diſappointed; for that river riſes in mountains conſiderably farther ſouth than the limits of this kingdom; and the Sultan, a cruel and capricious tyrant, detained him a priſoner at large almoſt three years.

Soudan, or Dar-Fur, abounds with towns or villages, ill built, of clay, and none of them very large. Of theſe it is not worth while to give an account. Its ſeaſons are divided into rainy and dry. The perennial rains, which fall in Dar-Fur from the middle of June till the middle of September in greater or leſs quantity, but generally both frequent and violent, ſuddenly inveſt the face of the country, till then dry and ſteril, with a delightful verdure. Except where the rocky nature of the ſoil abſolutely impedes vegetation, wood is found in great quantity; nor are the natives aſſiduous completely to clear the ground, even where it is deſigned for the cultivation of grain. As ſoon as the rains begin, the proprietor, and all the aſſiſtants that he can collect, go out to the field; and having made holes at about two feet diſtance from each other, with a kind of hoe, over all the ground he occupies, the *dokn*, a kind of millet, is thrown into them, and covered with the foot, for their huſbandry requires not many inſtruments. The time for ſowing the wheat is nearly the ſame. The *dokn* remains ſcarcely two months before it is ripe; the wheat about three.

The animals in Soudan, both wild and tame, are the ſame as in other parts of Africa in the ſame latitude. Though the Furians breed horſes, and purchaſe very fine ones in Dongola, and from the Arabs to the eaſt of the Nile, the aſs is more uſed for riding; and an Egyptian aſs (for the aſſes of Dar-Fur are diminutive and indocile like thoſe of Britain) fetches from the value of one to that of three ſlaves. The villages of this country, like thoſe of Abyſſinia, are infeſted with hyenas; and in the unfrequented parts of the country are the elephant, the rhinoceros, the lion, the leopard, and all the other quadrupeds of Africa. The Arabs often eat the fleſh of the lion and the leopard; and ſometimes they ſo completely tame thoſe animals, as to carry them looſe into the market place. Our author tamed two lions, of which one acquired moſt of the habits of a dog. He ſatiated himſelf twice a week with the offal of the butchers, and then commonly ſlept for ſeveral hours ſucceſſively. When food was given them, they both grew ferocious towards each other, and towards any one who approached them. Except at that time, though both were males, he never ſaw them diſagree, nor ſhew any ſign of ferocity towards the human race. Even lambs paſſed them unmoleſted.

Among the birds, the *vultur percnopterus*, or white-headed vulture, is moſt worthy of notice. It is of ſurpriſing ſtrength, and is ſaid by the natives to be very long-lived, *ſed fides penes auctores*. "I have lodged (ſays Mr Browne) a complete charge of large ſhot, at about 50 yards diſtance, in the body of this bird: it ſeemed to have no effect on him, as he flew to a conſiderable diſtance, and continued walking afterwards. I then diſcharged the ſecond barrel, which was loaded with ball: this broke his wing; but on my advancing to ſeize him, he fought with great fury with the other. There are many thouſands of them in the inhabited diſtrict. They divide the field with the hyena: what carrion the latter leaves at night, the former come in crowds to feed on in the day. Near the extremity of each wing is a horny ſubſtance, not unlike the ſpur of an old cock. It is ſtrong and ſharp, and a formidable inſtrument of attack. Some fluid exudes from this bird that ſmells like muſk; but from what part of him I am uncertain." The ſerpents found in Soudan are the ſame as in Egypt; but the natives have not the art of charming them, like the Egyptians. The locuſt of Arabia is very common, and is frequently roaſted and eaten, particularly by the ſlaves.

In Dar-Fur there ſeems to be a ſcarcity of metals; but in its neighbourhood to the ſouth and weſt all kinds are to be found. The copper brought by the merchants from the territories of certain idolatrous tribes bordering on Fur, is of the fineſt quality, in colour reſembling that of China, and appears to contain a portion of zinc, being of the ſame pale hue. Iron is found in abundance; but they have not yet learned the art of converting it into ſteel. Silver, lead, and tin, our author never heard mentioned in Soudan, but as coming from Egypt; but of gold, in the countries to the eaſt and weſt, the ſupply is abundant. Alabaſter, and various kinds of marble, are found within the limits of Fur, as is foſſil ſalt within a certain diſtrict; and there is a ſufficient ſupply of nitre, of which, however, no uſe is made.

The reſtraint under which Mr Browne was kept in this inhoſpitable country, prevented him from making a full catalogue of its vegetable productions. Of the trees which ſhade our foreſts or adorn our gardens in Europe, very few exiſt in Dar-Fur. The characteriſtic marks of thoſe ſpecies which moſt abound there, are their ſharp thorns, and the ſolid and unperiſhable quality of their ſubſtance. They ſeem to be much the ſame as thoſe which Bruce found in Abyſſinia. There is a ſmall tree called *enneb*, to the fruit of which they have given the name of grapes. It bears leaves of light green hue; and the fruit, which is of a purple colour, is attached, not in bunches, but ſingly to the ſmaller branches, and interſperſed among the leaves. The internal ſtructure of the fruit is not very unlike the grape, which it alſo reſembles in ſize: but the pulp is of a red hue, and the taſte is ſtrongly aſtringent. The water-melon (*cucurbita citrullus*) grows wild over almoſt all the cultivable lands, and ripens as the corn is removed. In this ſtate it does not attain a large ſize. The inſide is of a pale hue, and has little flavour. As it ripens, the camels, aſſes, &c. are turned to feed on it, and it is ſaid to fatten them. The ſeeds, as they grow blackiſh, are collected to make a kind of tar, *kutran*. Thoſe plants of the melon which receive artificial culture grow to a large ſize, and are of exquiſite flavour. Tobacco is produced in abundance; and our author ſpeaks of cochineal as found in Dar-Fur, or ſome of the neighbouring countries.

The harveſt is conducted in a very ſimple manner. The women and ſlaves of the proprietor are employed to break off the ears with their hands, leaving the ſtraw ſtanding, which is afterwards applied to buildings and various other uſeful purpoſes. They then accumulate them in baſkets, and carry them away on their heads. When thraſhed, which is aukwardly and incompletely performed, they expoſe the grain to the ſun till it become quite dry; after this a hole in the earth is prepared, the bottom and ſides of which are covered with chaff to exclude the vermin. This cavity or magazine is filled with grain, which is then covered with chaff, and afterwards with earth. In this way the maize is preſerved tolerably well. In uſing it for food, they grind it, and boil it in the form of polenta, which is eaten either with freſh or ſour milk, or ſtill more frequently with a ſauce made of dried meat pounded in a mortar, and boiled with onions, &c. The Furians uſe little butter; with the Egyptians and Arabs it is an article in great requeſt. There is alſo another ſauce which the poorer people uſe and highly reliſh; it is compoſed of an herb called *cowel* or *cawel*, of a taſte in part aceſcent and in part bitter, and generally diſagreeable to ſtrangers.

The magiſtracy of one, which ſeems tacitly, if it be not expreſsly, favoured by the diſpenſation of Mohammed, as in moſt other countries profeſſing that religion, prevails in Dar-Fur. The monarch indeed can do nothing contrary to the Koran, but he may do more than the laws eſtabliſhed thereon will authoriſe; and as there is no council to controul or even to aſſiſt him, his power may well be termed deſpotic. He ſpeaks in public of the ſoil and its productions as his perſonal property, and of the people as little elſe than his ſlaves.

His power in the provinces is delegated to officers, who poſſeſs an authority equally arbitrary. In thoſe diſtricts, which have always, or for a long time, formed an integral part of the empire, theſe officers are generally called *Meleks*. In ſuch as have been lately conquered, or, perhaps more properly, have been annexed to the dominion of the Sultan under certain ſtipulations, the chief is ſuffered to retain the title of Sultan, yet is tributary to and receives his appointment from the Sultan of Fur.

Deſpotic and arbitrary as he is, the Sultan here does not ſeem wholly inattentive to that important object, agriculture. Nevertheleſs, it may be eſteemed rather a blind compliance with ancient cuſtom, than individual public ſpirit, in which has originated a practice adopted by him, in itſelf ſufficiently laudable, ſince other of his regulations by no means conduce to the ſame end.

At the beginning of the *Harif*, or wet ſeaſon, which is alſo the moment for ſowing the corn, the king goes out with his Meleks and the reſt of his train; and while the people are employed in turning up the ground and ſowing the ſeed, he alſo makes ſeveral holes with his own hand. The ſame cuſtom, it is ſaid, obtains in Bornou and other countries in this part of Africa. It calls to the mind a practice of the Egyptian kings mentioned by Herodotus.

The population of Dar-Fur is not large. An army of 2000 men was ſpoken of, when Mr Browne was in the country, as a great one; and he does not think that the number of ſouls within the empire can much exceed 200,000. The troops of this country are not famed for ſkill, courage, or perſeverance. In their campaigns, much reliance is placed on the Arabs who accompany them, and who are properly tributaries rather than ſubjects of the Sultan. One energy of barbariſm they indeed poſſeſs in common with other ſavages, that of being able to endure hunger and thirſt; but in this particular they have no advantage over their neighbours. In their perſons the Furians are not remarkable for cleanlineſs. Though obſerving as Mahommedans all the ſuperſtitious formalities of prayer, their hair is rarely combed, or their bodies completely waſhed. The hair of the pubes and axillæ it is uſual to exterminate; but they know not the uſe of ſoap; ſo that with them poliſhing the ſkin with unguents holds the place of perfect ablutions and real purity. A kind of farinaceous paſte is however prepared, which being applied with butter to the ſkin, and rubbed continually till it become dry, not only improves its appearance, but removes from it accidental ſordes, and ſtill more the effect of continued tranſpiration, which, as there are no baths in the country, is a conſideration of ſome importance. The female ſlaves are dexterous in the application of it; and to undergo this operation is one of the refinements of African ſenſuality.

Nothing reſembling current coin is found in Soudan, unleſs it be certain ſmall tin rings, the value of which is in ſome degree arbitrary. The Auſtrian dollars, and other ſilver coins brought from Egypt, are all ſold as ornaments for the women.

The diſpoſition of the Furians is cheerful; and that gravity and reſerve which the precepts of Mahommediſm inſpire, and the practice of the greater number of its profeſſors countenances and even requires, ſeems by no means as yet to ſit eaſy on them. A government perfectly deſpotic, and not ill adminiſtered, as far as relates to the manners of the people, yet forms no adequate reſtraint to their violent paſſions. Prone to inebriation, but unprovided with materials or ingenuity to prepare any other fermented liquor than *buza*, with this alone their convivial exceſſes are committed. But though the Sultan publiſhed an ordinance (March 1795) forbidding the uſe of that liquor under pain of death, the plurality, though leſs publicly than before, ſtill indulge themſelves in it. A company often ſits from ſunriſe to ſun ſet, drinking and converſing, till a ſingle man ſometimes carries off near two gallons of that liquor. The buza has, however, a diuretic and diaphoretic tendency, which precludes any danger from theſe exceſſes. In this country dancing is practiſed by the men as well as the women, and they often dance promiſcuouſly.

The vices of thieving, lying, and cheating, in bargains, with all others nearly or remotely allied to them, as often happen among a people under the ſame circumſtances, are here almoſt univerſal. No property, whether conſiderable or trifling, is ſafe out of the ſight of the owner, nor indeed ſcarcely in it, unleſs he be ſtronger than the thief. In buying and ſelling, the parent glories in deceiving the ſon, and the ſon the parent; and God and the Prophet are hourly invocated, to give colour to the moſt palpable frauds and falſehoods.

The privilege of polygamy, which, as is well known, belongs to their religion, the people of Soudan puſh to the extreme. By their law, they are allowed four free women, and as many ſlaves as they can maintain; but the Furians take both free women and ſlaves without limitation. The Sultan has more than a hundred free women, and many of the Meleks have from twenty to thirty. In their indulgence with women, they pay little regard to reſtraint or decency. The form of the houſes ſecures no great ſecrecy to what is carried on within them; yet even the concealment which is thus offered is not always ſought. The ſhade of a tree, or long graſs, is the ſole temple required for the ſacrifices to the Cyprian goddeſs. In the courſe of licentious indulgence, father and daughter, ſon and mother, are ſometimes mingled; and the relations of brother and ſiſter are exchanged for cloſer intercourſe.

Previouſly to the eſtabliſhment of Iſlamiſm* and kingſhip, the people of Fur ſeem to have formed wandering tribes; in which ſtate many of the neighbouring nations to this day remain. In their perſons they differ from the negroes of the coaſt of Guinea. Their hair is generally ſhort and woolly, though ſome are ſeen with it of the length of eight or ten inches, which they eſteem a beauty. Their complexion is for the moſt part perfectly black. The Arabs, who are numerous within the empire, retain their diſtinction of feature, colour, and language. They moſt commonly intermarry with each other. The ſlaves, which are brought from the country they call *Fertit* (land of idolaters), perfectly reſemble thoſe of Guinea, and their language is peculiar to themſelves.

The revenues of the crown conſiſt of a duty on all merchandiſe imported, which, in many inſtances, amounts to near a tenth; of a tax on all ſlaves exported to Egypt; of all forfeitures for miſdemeanors; of a tenth on all merchandiſe, eſpecially ſlaves, brought from every quarter but Egypt, and when ſlaves are procured by force, this tenth is raiſed to a fifth; of a tribute paid by the Arabs, who breed oxen, horſes, camels, ſheep; of a certain quantity of corn paid annually by every village; beſides many valuable preſents, which muſt be paid by the principal people, both at ſtated times and on particular occaſions. Add to all this, that the king is chief merchant in the country; and not only diſpatches with every caravan to Egypt a great quantity of his own merchandiſe, but alſo employs his ſlaves and dependents to trade with the goods of Egypt on his own account, in the countries adjacent to Soudan.

The commodities brought by the caravans from Egypt are, 1. Amber beads. 2. Tin, in ſmall bars. 3. Coral beads. 4. Cornelian beads. 5. Falſe cornelian

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* Abou
century
a half a

lian beads. 6. Beads of Venice. 7. Agate. 8. Rings, ſilver and braſs, for the ancles and wriſts. 9. Carpets, ſmall. 10. Blue cotton cloths of Egyptian fabric. 11. White cotton ditto. 12. Indian muſlins and cottons. 13. Blue and white cloths of Egypt, called *Melayes*. 14. Sword-blades, ſtrait (German), from Cairo. 15. Small looking glaſſes. 16. Copper face-pieces, or defenſive armour for the horſes heads. 17. Fire arms. 18. Kohhel for the eyes. 19. Rhea, a kind of moſs from European Turkey, for food and a ſcent. 20. *She*, a ſpecies of abſynthium, for its odour, and as a remedy: both the laſt ſell to advantage. 21. Coffee. 22. *Mahleb*, *Krumphille*, *Symbille*, *Sandal*, nutmegs. 23. *Dufr*, the ſhell of a kind of fiſh in the Red Sea, uſed for a perfume. 24. Silk unwrought. 25. Wire, braſs and iron. 26. Coarſe glaſs beads, made at Jeruſalem, called *herſh* and *munjur*. 27. Copper culinary utenſils, for which the demand is ſmall. 28. Old copper for melting and reworking. 29. Small red caps of Barbary. 30. Thread linens of Egypt—ſmall conſumption. 31. Light French cloths, made into beniſhes. 32. Silks of Scio, made up. 33. Silk and cotton pieces of Aleppo, Damaſcus, &c. 34. Shoes of red leather. 35. Black pepper. 36. Writing paper *(papier des trois lunes)*, a conſiderable article. 37. Soap of Syria.

The goods tranſported to Egypt are, 1. Slaves, male and female. 2. Camels. 3. Ivory. 4. Horns of the rhinoceros. 5. Teeth of the hippopotamus. 6. Oſtrich feathers. 7. Whips of the hippopotamus's hide. 8. Gum. 9. Pimento. 10. Tamarinds, made into round cakes. 11. Leather ſacks for water *(ray)* and dry articles *(geraub)*. 12. Peroquets in abundance, and ſome monkeys and Guinea fowls. 13. Copper, white, in ſmall quantity.

SOUEYAWAMINECA, a Canadian ſettlement, in lat. 47 17 30 N.—*Morse*.

SOUFFRIERE, a ſmall town, ſituated at the bottom of a bay, towards the leeward extremity of the iſland of St Lucia. There is nothing in the town itſelf which could have entitled it to notice in this work; but the ground about it is very remarkable. It has been deſcribed by different authors; and our readers will probably not be ill-pleaſed with the following deſcription of this wonderful ſpot by Dr Rollo.

"Souffriere (ſays he) is ſurrounded by hills covered with trees, the declivities of which, and every part capable of produce, are cultivated, and afford good ſugar-cane. This place has its marſhes, but not ſo extenſive, or ſo much to windward as thoſe about Carenage.

"The extremity of the ſouth ſide of Souffriere Bay runs into two ſteep hills of a conical figure, which are nearly perpendicular: they are reckoned the higheſt on the iſland, and are known by the name of the *Sugar-Loaf Hills*. From their height and ſtraitneſs it is impoſſible to aſcend them: we were told it was once attempted by two negroes, but they never returned. They are covered with trees and ſhrubs, and are the ſhelter of goats, ſeveral of which ſometimes deſcend, and are ſhot by the natives.

"After you paſs the hills to windward of Souffriere, a fine clear and level country preſents itſelf. From the back of the Sugar Loaf Hills, and all along the ſea-coaſt, to the diſtance, we ſuppoſe, of from fifteen to twenty miles, this flat or level extends: it is all cultivated and divided into rich eſtates, affording ſugar-cane equal to any in our iſlands. This beautiful ſpot is interſected by many rivers of very clear water, and theſe are conducted by art to the purpoſe of ſugar making. The rains in this part are leſs frequent than on any other part of the iſland; however, they have often a proportion more than ſufficient. The wind here blows from the ſea, or nearly ſo.

"We cannot finiſh this deſcription without taking notice of a volcano in the neighbourhood of Souffriere. You paſs over one or two ſmall hills to the ſouthward of the town, and before any mark of the place is perceived you are ſenſible of the ſmell of ſulphur. The firſt thing you diſcern is a rivulet of black running water, ſending forth ſteams as if nearly boiling. From the proſpect of this you ſoon open on the volcano, which appears in a hollow, ſurrounded cloſe on every ſide by hills. There are only two openings; the one we entered, and another almoſt oppoſite to it on the north ſide. In the hollow there are many pits of a black and thick boiling matter, which ſeems to work with great force. Lava is ſlowly thrown out; and in the centre of the hollow there is a large maſs of it, forming a kind of hill. This we aſcended; but were ſoon obliged to return from the exceſſive heat. The lava is a ſulphur mixed with a calcareous earth and ſome ſaline body. We found ſmall quantities of alum in a perfect ſtate. In the opening, at the north ſide of the hollow, there is a rivulet of very good water. On ſtirring the bottom, over which this water runs, we were ſurpriſed with feeling it very hot; and on placing a tumbler filled with ſome of the water cloſe to the bottom of the rivulet, it ſoon became ſo hot as not to be touched. The liquid which runs from the pits is ſtrongly impregnated with ſulphur, and reſembles a good deal the preparation ſold in the ſhops, known by the name of *aqua ſulphurata*, or *gas ſulphuris*."

SOUND board, the principal part of an organ, and that which makes the whole machine play. This ſound-board, or ſummer, is a reſervoir into which the wind, drawn in by the bellows, is conducted by a port-vent, and thence diſtributed into the pipes placed over the holes of its upper part. This wind enters them by valves, which open by preſſing upon the ſtops or keys, after drawing the regiſters, which prevent the air from going into any of the other pipes beſide thoſe it is required in.

Sound Board denotes alſo a thin broad board placed over the head of a public ſpeaker, to enlarge and extend or ſtrengthen his voice.

Sound-boards, in theatres, are found by experience to be of no ſervice; their diſtance from the ſpeaker being too great to be impreſſed with ſufficient force. But ſound-boards immediately over a pulpit have often a good effect, when the caſe is made of a juſt thickneſs, and according to certain principles.

Sound-Poſt, is a poſt placed withinſide of a violin, &c. as a prop between the back and the belly of the inſtrument, and nearly under the bridge.

SOUTH, a ſhort river of Anne Arundel county, Maryland, which runs eaſterly into Cheſapeak Bay. Its mouth is about 6 miles ſouth of Annapolis city, and is navigable in veſſels of burden 10 or 12 miles.—*Morse*.

South *Amboy*, a townſhip of New-Jerſey, Middleſex county, and contains 2,626 inhabitants, including 183 ſlaves.—*ib*.

South *Anna*, a branch of North Anna river, in Virginia, which together form Pamunky river.—*ib.*

SOUTHBOROUGH, a ſmall townſhip in the eaſtern part of Worceſter county, Maſſachuſetts, incorporated in 1727, contains 840 inhabitants, and is 30 miles W. by S. of Boſton.—*ib.*

SOUTH *Branch Houſe*, a ſtation of the Hudſon's Bay Company, in North-America, ſituated on the eaſtern ſide of Saſkaſhawan river.—*ib.*

SOUTH-BRIMFIELD, a townſhip of Maſſachuſetts, Hampſhire county, about 35 miles S. E. of Northampton, and 80 weſterly of Boſton. It was incorporated in 1762, and contains 606 inhabitants.—*ib.*

SOUTHBURY, a town of Connecticut, Litchfield county, 20 miles N. E. of Danbury, and 51 N. W. of Hartford.—*ib.*

SOUTH *Eaſt*, a townſhip of New-York, ſituated in Dutcheſs county, bounded ſoutherly by Weſt Cheſter county, and weſterly by Fredericktown. It contains 921 inhabitants; of whom 261 are electors, and 13 ſlaves.—*ib.*

SOUTH CAROLINA, one of the United States of America; bounded N. by North-Carolina; E. by the Atlantic Ocean; S. and S. W. by Savannah river, and a branch of its head waters, called Tugulo river, which divides this State from Georgia. It lies between 32 and 35 N. lat. and between 78 and 81 W. long. from London. It is in length about 200 miles, in breadth 125, and contains 20,000 ſquare miles. It is divided into 9 diſtricts. *Charleſton*, *Beaufort*, and *Georgetown*, conſtitute what is called the *Lower Country*, and contain 19 pariſhes, and 28,694 white inhabitants; ſend to the legiſlature 70 repreſentatives, and 20 ſenators, and pay taxes to the amount of £28,081 : 5 : 11. *Ninety-Six*, *Waſhington*, *Pinckney*, *Camden*, *Orangeburg*, and *Cheraw* diſtricts, are comprehended in the *Upper Country*, and contain 23 counties, and 110,902 white inhabitants; ſend to the legiſlature 54 repreſentatives, and 17 ſenators, and pay taxes to the amount of £8,390 : 2 : 3. The great inequality of repreſentation is obvious; attempts have been made by the Upper diſtricts, to remedy this evil, but hitherto without effect. By a late arrangement the name of county, is given to the ſubdiviſion of theſe diſtricts only, in which county courts are eſtabliſhed. In the Lower diſtricts, the ſubdiviſions are called pariſhes, and made only for the purpoſe of electing the members of the State legiſlature. The total number of inhabitants in 1790, 249,073, of whom 107,094 were ſlaves. This State is watered by many navigable rivers, the principal of which are Savannah, Ediſto, Santee, Pedee, and their branches. The Santee is the largeſt river in the State. Thoſe of a ſecondary ſize, as you paſs from N. to S. are Wakkamaw, Black, Cooper, Aſhepoo, and Combahee rivers. In the third claſs are comprehended thoſe rivers which extend but a ſhort diſtance from the ocean, and ſerve, by branching into numberleſs creeks, as drains to carry off the rain water which comes down from the large inland ſwamps, or are merely arms of the ſea. The tide in no part of the State, flows above 25 miles from the ſea. A canal of 21 miles in length, connecting Cooper and Santee rivers, is nearly completed, which, by eſtimation, will coſt 400,000 dollars; and the company are allowed to raiſe a toll of 20 per cent. on the ſum actually expended. Another canal is ſoon to be begun to unite the Ediſto with the Aſhley. It is alſo in contemplation to make a waggon road from the ſettlements in S. Carolina, over the mountains to Knoxville, in Tenneſſee; and a ſum of money has been voted for that purpoſe. The only harbours of note, are thoſe of Charleſton, Port-Royal, and Georgetown. The climate is different in different parts of the State. Along the ſea-coaſt, bilious diſeaſes and fevers of various kinds are prevalent between July and October. The probability of dying is much greater between the 20th of June and the 20th or October, than in the other eight months in the year. One cauſe of theſe diſeaſes, is, a low marſhy country, which is overflowed for the ſake of cultivating rice. The exhalations from theſe ſtagnated waters, from the rivers, and from the neighbouring ocean, and the profuſe perſpiration of vegetables of all kinds, which cover the ground, fill the air with moiſture. This moiſture falls in frequent rains and copious dews. From actual obſervation, it has been found that the average annual fall of rain, for ten years, was 42 inches, without regarding the moiſture that fell in fogs and dews. The great heat of the day relaxes the body, and the agreeable coolneſs of the evening invites to an expoſure to theſe heavy dews. But not only does the water on the low grounds and rice ſwamps become in a degree putrid, and emit an unwholeſome vapour, but when it is dried up or drawn off from the ſurface of the ground, a quantity of weeds and graſs which have been rotted by the water, and animals and fiſh which have been deſtroyed by it, are expoſed to the intenſe heat of the ſun, and help to infect the air with a quantity of poiſonous effluvia. Within the limits of Charleſton, the caſe is very different, and the danger of contracting diſeaſes ariſes from indolence and exceſs. Though a reſidence in or near the ſwamps is very injurious to health, yet it has been ſatisfactorily aſcertained, that by removing three miles from them, into the pine land which occupies the middle ground between the rivers, an exemption from autumnal fevers may be obtained. The diſagreeable effects of this climate, experience has proved, might in a great meaſure be avoided, by thoſe inhabitants whoſe circumſtances will admit of their removal from the neighbourhood of the rice ſwamps, to healthier ſituations, during the months of July, Auguſt, September, and October; and in the worſt ſituations, by temperance and care. Violent exerciſe on horſeback, chiefly, expoſure to the meridian rays of the ſun, ſudden ſhowers of rain, and the night air, are too frequently the cauſes of fevers and other diſorders. Would the ſportſmen deny themſelves, during the fall months, their favourite amuſements of hunting and fiſhing, or confine themſelves to a very few hours, in the morning or evening—would the induſtrious planter viſit his fields only at the ſame hours—or would the poorer claſs of people pay due attention to their manner of living, and obſerve the precautions recommended to them by men of knowledge and experience, much ſickneſs and many diſtreſſing events might be prevented. The upper country, ſituated in the medium between extreme heat and cold, is as healthful as any part of the United States. Except the high hills of Santee, the Ridge, and ſome few other hills, this country is like one extenſive plain, till you reach the Tryon and Hogback Mountains, 220 miles north-weſt of Charleſton. The elevation of theſe mountains above their baſe, is 3840 feet, and above the ſea-coaſt, ſea-coaſt, 4640. There is exhibited from the top of theſe mountains an extenſive view of this State, North-Carolina, and Georgia. And as no object intervenes to obſtruct the view, a man with *teleſcopic* eyes might diſcern veſſels at ſea. The mountains weſt and north-weſt riſe much higher than theſe, and form a ridge, which divides the waters of Tenneſſee and Santee rivers. The ſea-coaſt is bordered with a chain of fine ſea iſlands, around which the ſea flows, opening an excellent inland navigation, for the conveyance of produce to market. North of Charleſton harbour, lie Bull's, Dewee's and Sullivan's iſlands, which form the north part of the harbour. James' iſland lies on the other ſide of the harbour, oppoſite Charleſton, containing about 50 families. Further ſouth-weſt is John's iſland, larger than James'; Stono river, which forms a convenient and ſafe harbour, divides theſe iſlands. Contiguous to John's iſland, and connected with it by a bridge, is Wadmelaw; eaſt of which are the ſmall iſles of Keywaw and Simmon. Between theſe and Ediſto Iſland, is N. Ediſto Inlet, which alſo affords a good harbour for veſſels of eaſy draſt of water. South of Ediſto Iſland is S. Ediſto Inlet, through which enter, from the northward, all the veſſels bound to Beaufort, Aſheepoo, Combahee, and Cooſaw. On the ſouth-weſt ſide of St Helena Iſland lies a cluſter of iſlands, one of the largeſt of which is Port Royal. Adjacent to Port Royal lie St Helena, Ladies Iſland, Paris Iſland, and the Hunting Iſlands, 5 or 6 in number, bordering on the ocean, ſo called from the number of deer and other wild game found upon them. All theſe iſlands, and ſome others of leſs note, belong to St Helena pariſh. Croſſing Broad river, you come to Hilton Head, the moſt ſouthern ſea iſland in Carolina. Weſt and ſouth-weſt of Hilton Head, lie Pinckney's, Bull's, Dawfuſkies', and ſome ſmaller iſlands, between which and Hilton Head, are Calibogie river and ſound, which form the outlet of May and New rivers. The ſoil on theſe iſlands is generally better adapted to the culture of indigo and cotton than the main, and leſs ſuited to rice. The natural growth is the live oak, which is ſo excellent for ſhip timber; and the palmetto or cabbage tree, the utility of which, in the conſtruction of forts, was experienced during the late war. The whole State, to the diſtance of 80 or 100 miles from the ſea, generally ſpeaking, is low and level, almoſt without a ſtone, and abounds more or leſs, eſpecially on and near the rivers, with ſwamps or marſhes, which, when cleared and cultivated, yield, in favourable ſeaſons, on average, an annual income of from 20 to 40 dollars for each acre, and often much more: but this ſpecies of ſoil cannot be cultivated by white men, without endangering both health and life. Theſe ſwamps do not cover an hundredth part of the State of Carolina. In this diſtance, by a gradual aſcent from the ſea-coaſt, the land riſes about 190 feet. Here, if you proceed in a W. N. W. courſe from Charleſton, commences a curiouſly uneven country. The traveller is conſtantly aſcending or deſcending little ſand-hills, which nature ſeems to have diſunited in a frolic. If a pretty high ſea were ſuddenly arreſted, and transformed into ſand-hills, in the very form the waves exiſted at the moment of transformation, it would preſent the eye with juſt ſuch a view as is here to be ſeen. Some little herbage, and a few ſmall pines, grow even on this ſoil. The inhabitants are few, and have but a ſcanty ſubſiſtence on corn and ſweet potatoes, which grow here tolerably well. This curious country continues till you arrive at a place called the *Ridge*, 140 miles from Charleſton. This ridge is a remarkable tract of high ground, as you approach it from the ſea, but level as you advance N. W. from its ſummit. It is a fine high, healthy belt of land, well watered, and of a good ſoil, and extends from the Savannah to Broad river, in about 6 30 W. long. from Philadelphia. Beyond this ridge, commences a country exactly reſembling the northern States, or like Devonſhire in England, or Languedoc in France. Here hills and dales, with all their verdure and variegated beauty, preſent themſelves to the eye. Wheat fields, which are rare in the low country, begin to grow common. Here Heaven has beſtowed its bleſſings with a moſt bounteous hand. The air is much more temperate and healthful than nearer to the ſea. The hills are covered with valuable woods, the vallies watered with beautiful rivers, and the fertility of the ſoil is equal to every vegetable production. This, by way of diſtinction, is called the *Upper Country*, where are different modes, and different articles of cultivation; where the manners of the people, and even their language have a different tone. The land ſtill riſes by a gradual aſcent; each ſucceeding hill overlooks that which immediately precedes it, till, having advanced 220 miles in a N. W. direction from Charleſton, the elevation of the land above the ſea-coaſt, is found by menſuration to be 800 feet. Here commences a mountainous country, which continues riſing to the weſtern terminating point of this State. The ſoil may be divided into four kinds; *firſt*, the pine barren, which is valuable only for its timber. Interſperſed among the pine barren, are tracts of land free of timber and every kind of growth but that of graſs. Theſe tracts are called *Savannas*, conſtituting a *ſecond* kind of ſoil, good for grazing. The *third* kind is that of the ſwamps and low grounds on the rivers, which is a mixture of black loam and fat clay, producing naturally canes in great plenty, cypreſs, bays, loblolly pines, &c. In theſe ſwamps rice is cultivated, which conſtitutes the ſtaple commodity of the State. The high lands, commonly known by the name of oak and hickory lands, conſtitute the *fourth* kind of ſoil. The natural growth is oak, hickory, walnut, pine and locuſt. On theſe lands, in the low country, are cultivated Indian corn principally; and in the back country, beſides theſe, they raiſe tobacco in large quantities, wheat, rye, barley, oats, hemp, flax, and cotton. From experiments which have been made, it is well aſcertained that olives, ſilk, and madder may be as abundantly produced in South-Carolina, and we may add in Georgia alſo, as in the ſouth of France. There is little fruit in this State, eſpecially in the lower parts of it. They have oranges, which are chiefly ſour, and figs in plenty, a few limes and lemons, pomegranates, pears, and peaches; apples are ſcarce, and are imported from the northern States. Melons, eſpecially the water-melon, are raiſed here in great perfection. The river ſwamps, in which rice can be cultivated with any tolerable degree of ſafety and ſucceſs, do not extend higher up the rivers than the head of the tides; and in eſtimating the value of this ſpecies of rice land, the height which the tide riſes is taken into conſideration, thoſe lying where it riſes to a proper pitch for overflowing

ing the ſwamps being the moſt valuable. The beſt inland ſwamps, which conſtitute a ſecond ſpecies of rice land, are ſuch as are furniſhed with reſerves of water. Theſe reſerves are formed by means of large banks thrown up at the upper parts of the ſwamps, whence it is conveyed, when needed, to the fields of rice. At the diſtance of about 110 miles from the ſea, the river ſwamps terminate, and the high lands extend quite to the rivers, and form banks, in ſome places, ſeveral hundred feet high from the ſurface of the water, and afford many extenſive and delightful views. Theſe high banks are interwoven with layers of leaves, and different coloured earth, and abound with quarries of free-ſtone, pebbles, flint, cryſtals, iron ore in abundance, ſilver, lead, ſulphur, and coarſe diamonds. The ſwamps, above the head of the tide, are occaſionally planted with corn, cotton, and indigo. The ſoil is very rich, yielding from 40 to 50 buſhels of corn an acre. It is curious to obſerve the gradations from the ſea-coaſt to the upper country, with reſpect to the produce, the mode of cultivation, and the cultivators. On the iſlands upon the ſea-coaſt, and for 40 or 50 miles back, and on the rivers much farther, the cultivators are all ſlaves. No white man, to ſpeak generally, ever thinks of ſettling a farm, and improving it for himſelf, without negroes: if he has no negroes, he hires himſelf as overſeer to ſome rich planter, who has more than he can or will attend to, till he can purchaſe for himſelf. The articles cultivated are corn, rye, oats, every ſpecies of pulſe, and potatoes, which, with the ſmall rice, are food for the negroes; rice, indigo, cotton, and ſome hemp, for exportation. The culture of cotton is capable of being increaſed equal to almoſt any demand. The ſoil was cultivated, till lately, almoſt wholly by manual labour. The plough, till ſince the peace, was ſcarcely uſed. Now the plough and harrow, and other improvements are introduced into the rice ſwamps with great ſucceſs, and will no doubt become general. In the middle ſettlements, negroes are not ſo numerous. The maſter attends perſonally to his own buſineſs. The land is not properly ſituated for rice. It produces tolerable good indigo weed, and ſome tobacco is raiſed for exportation. The farmer is contented to raiſe corn, potatoes, oats, rye, poultry, and a little wheat. In the upper country, there are but few negroes; generally ſpeaking, the farmers have none, and depend, like the inhabitants of the northern States, upon the labour of themſelves and families for ſubſiſtence; the plough is uſed almoſt wholly. Indian corn in great quantities, wheat, rye, barley, oats, potatoes, &c. are raiſed for food; and tobacco, wheat, cotton, hemp, flax and indigo, for exportation. From late experiments it has been found that vines may be cultivated, and wine made to great advantage: ſnake root, pink root, and a variety of medicinal herbs grow ſpontaneouſly; alſo, ginſeng on and near the mountains. This country abounds with precious ores, ſuch as gold, ſilver, lead, black lead, copper and iron; but it is the misfortune of thoſe who direct their purſuits in ſearch of them, that they are deficient in the knowledge of chemiſtry, and too frequently make uſe of improper menſtruums in extracting the reſpective metals. There are likewiſe to be found pellucid ſtones of different hues, rock cryſtal, pyrites, petrified ſubſtances, coarſe cornelian, marble beautifully variegated, vitreous ſtone and vitreous ſand; red and yellow ochres, which, when roaſted and ground down with linſeed oil, make a very excellent paint; alſo, potter's clay of a moſt delicate texture, fuller's earth, and a number of dye-ſtuffs, among which is a ſingular weed which yields four different colours, its leaves are ſurpriſingly ſtyptic, ſtrongly reſembling the taſte of alum; likewiſe, an abundance of chalk, crude alum, ſulphur, nitre, vitriol, and along the banks of rivers large quantities of marle may be collected. There are alſo a variety of roots, the medicinal effects of which it is the barbarous policy of thoſe who are in the ſecret to keep a profound myſtery. The rattle ſnake root, ſo famous among the Indians for the cure of poiſon, is of the number. The next is the venereal root, which, under a vegetable regimen, will cure a confirmed lues. Another root, when reduced to an impalpable powder, is ſingularly efficacious in deſtroying worms in children. There is likewiſe a root, an ointment of which, with a poultice of the ſame, will in a ſhort ſpace of time diſcuſs the moſt extraordinary tumors, particularly what is termed the white ſwelling; this root is very ſcarce. There is another root, a decoction of which, in new milk, will cure the bloody dyſentery; the patient muſt avoid cold, and much judgment is requiſite in the potion to be adminiſtered. There is alſo a plant, the leaves of which, being bruiſed, and applied to the part affected, relieve rheumatic pains; it occaſions a conſiderable agitation of the parts, attended with moſt violent and acute pains, but never fails to procure immediate eaſe. There is alſo a plant, the leaves of which have a moſt fœtid ſmell; theſe leaves being boiled, and any perſon afflicted with cutaneous complaints, once bathing therein, will be radically cured. There is a root, which acts as an excellent purge, and is well calculated for the labouring part of mankind, as it is only neceſſary to chew it in its crude ſtate, and it requires no manner of aid to facilitate its operation. An equally efficacious and ſimple purge is obtained from a weed, the ſtalk of which is red, is about 3 feet high, and the flower white; the leaves run from the bottom of the ſtalk in oppoſite and correſponding lines; the ſeed is about the ſize of a wheat grain, globular in the centre, and oblate at both ends; it is full of oil, and taſtes like a walnut kernel: 20 grains of this, chewed and ſwallowed, is, in point of mildneſs and efficacy, equal to any rhubarb; and the pleaſantneſs of its taſte, as a deception to weak ſtomachs, appears to have been a deſign of Providence: in its operation it reſembles caſtor oil. A very ſovereign remedy is extracted from the bark of a tree, which may be uſed to great advantage in the diſeaſes incident to this climate. Every climate, ſome believe, has its peculiar diſeaſe, and every diſeaſe its peculiar antidote under the ſame climate. In addition to the above is another ſpecies of bark, of a ſweet and nauſeous taſte; the tree grows contiguous to a very powerful chalybeate ſpring; the bark, when ſufficiently maſticated, operates as a very potential purge and emetic, and in the hands of a ſkilful chemiſt may be rendered very ſerviceable. In this country is a tree which bears a large pod, incloſing a kind of mucilage, the juice of which is very ſharp; the bark ſmells like tanned leather, and when prepared like hemp, makes the very beſt of cordage. Alſo another tree, which bears an ear like a corn-cob, covered with berries, containing a large proportion of oil. There is likewiſe a very ſingular tree, which affords a moſt ſu-

perb

perb ſhade; it produces a round ball, which, in the heat of ſummer, opens and enlarges a number of male inſects, which become very troubleſome wherever they lodge; this happens generally ſome diſtance from their parent tree. The hand of nature never formed a country with more natural advantages, or bleſſed it with a more ſerene or healthful climate. It abounds with game of all kinds, is a very fine fruit country, and is peculiarly adapted to the growth of vines, the olive, ſilk, and coffee trees, and the production of cotton. It is a perfect garden of medical herbs, and its medicinal ſprings are not inferior to any in Europe. The iron-works, known by the name of the *Æra Ætna iron-works*, are ſituated in York county, within two miles of the Catawba river. Within the compaſs of two miles from the furnace, there is an inexhauſtible quantity of ore, which works eaſy and well in the furnace. The metal is good for hammers, gudgeons, or any kind of machinery and hollow ware, and will make good bar-iron. Some trial has been made of it in ſteel, and it promiſes well. Nothing is neceſſary for preparing the ore for uſe, but burning. The ore conſiſts of large rocks above the ſurface; the depth not yet known. In the cavities between, lie an ochre and ſeed ore. It is ſaid there will be no occaſion to ſink ſhafts or drive levers for 50 years to come. The Æra furnace was built in 1787—the Ætna in 1788. The neareſt landing at preſent (1795) is Camden, 70 miles from the furnace. The proprietors of the works, and ſeven others have obtained a charter to open the Catawba to the N. Carolina line, and a charter from N. Carolina to open the river 80 miles higher in that State, and it is expected that boats will come within 40 miles of the works this ſummer, (1795) as there are boats already built for the purpoſe which are to carry 30 tons, and in the courſe of another ſummer will be brought within two miles of the works. The works are within two miles of the river, and the creek can be made navigable to the works. Mr William Hill, one of the principal proprietors of theſe works, has contrived a method, by means of a fall of water, of blowing all the fires both of the forges and furnaces, ſo as to render unneceſſary the uſe of wheels, cylinders, or any other kind of bellows. The machinery is ſimple and cheap, and not liable to the accident of freezing. In the middle, and eſpecially in the upper country, the people are obliged to manufacture their own cotton and woollen cloths, and moſt of their huſbandry tools: but in the lower country, the inhabitants, for theſe articles, depend almoſt entirely on their merchants. Late accounts from the interior parts of this State inform, that cotton, hemp and flax are plenty; that they have a conſiderable ſtock of good ſheep; that great exertions are made, and much done in the houſehold way; that they have long been in the habit of doing ſomething in family manufactures, but within a few years paſt great improvements have been made. The women do the weaving, and leave the men to attend to agriculture. This State furniſhes all the materials, and of the beſt kind, for ſhip building. The live oak, and the pitch and yellow pines, are of a ſuperior quality. Ships might be built here with more eaſe, and to much greater advantage, than in the middle and eaſtern States. A want of ſeamen, is one reaſon why this buſineſs is not more generally attended to. So much attention is now paid to the manufacture of indigo, in this State, that it bids fair to rival that of the French. It is to be regretted, that it is ſtill the practice of the merchants concerned in the Carolina trade, to ſell at foreign markets the Carolina indigo of the firſt quality, as French. The ſociety for the information and aſſiſtance of perſons emigrating from other countries, in a printed paper, which bears their ſignature, ſay that "A monied capital may be profitably employed, 1. In erecting mills, for making paper, for ſawing lumber, and eſpecially for manufacturing wheat flour. There are hundreds of valuable mill ſeats unimproved, and the woods abound with pine trees. A buſhel of wheat may be purchaſed in South-Carolina for half a dollar, which will make as good flour as that which in the vicinity of proper mills ſells for double that price. Such is the cheapneſs and fertility of the ſoil, that half a dollar a buſhel for wheat would afford a great profit to the cultivators thereof. 2. In tanning and manufacturing leather.—Cattle are raiſed with ſo much eaſe, in a country where the winters are both mild and ſhort, that hides are remarkably cheap. The profits of tanners and ſhoe-makers muſt be conſiderable, when it is a well known fact, that the hides of full grown cattle, and a ſingle pair of ſhoes ſell for nearly the ſame price. 3. In making bricks—Theſe now ſell for 9 dollars a thouſand, and the call for them is ſo great, that the bricklayers are not fully ſupplied. 4. In making pot-aſh—The aſhes that might be collected in Charleſton, and from the woods burnt in clearing new lands in the country, would furniſh the means of carrying on the manufacture of pot-aſh to great advantage." Gentlemen of fortune, before the late war, ſent their ſons to Europe for education. During the war and ſince, they have generally ſent them to the middle and northern States. Thoſe who have been at this expenſe in educating their ſons, have been but comparatively few in number, ſo that the literature of the State is at a low ebb. Since the peace, however, it has begun to flouriſh. There are ſeveral reſpectable academies in Charleſton, one at Beaufort, on Port Royal Iſland, and ſeveral others in different parts of the State. Three colleges have lately been incorporated by law, one at Charleſton, one at Winnſborough, in the diſtrict of Camden, the other at Cambridge, in the diſtrict of Ninety-Six. The public and private donations for the ſupport of theſe three colleges, were originally intended to have been appropriated jointly, for the erecting and ſupporting of one reſpectable college. The diviſion of theſe donations has fruſtrated this deſign. Part of the old barracks in Charleſton has been handſomely fitted up, and converted into a college, and there are a number of ſtudents; but it does not yet merit a more dignified name than that of a reſpectable academy. The Mount Sion college, at Winneſborough, is ſupported by a reſpectable ſociety of gentlemen, who have long been incorporated. This inſtitution flouriſhes and bids fair for uſefulneſs. The college at Cambridge is no more than a grammar ſchool. That the literature of this State might be put upon a reſpectable footing, nothing is wanting but a ſpirit of enterprize among its wealthy inhabitants. The legiſlature, in their ſeſſion in January, 1795, appointed a committee, to inquire into the practicability of, and to report a plan for, the eſtabliſhment of ſchools in the different parts of the State. Since the revolution, by which all denominations were put on an equal footing,

ing, there have been no diſputes between different religious ſects. They all agree to differ. The upper parts of this State are ſettled chiefly by Preſbyterians, Baptiſts and Methodiſts. From the moſt probable calculations, it is ſuppoſed that the religious denominations of this State, as to numbers, may be ranked as follows: Preſbyterians, including the Congregational and Independent churches, Epiſcopalians, Baptiſts, Methodiſts, &c. The little attention that has been paid to manufactures, occaſions a vaſt conſumption of foreign imported articles; but the quantity and value of their exports generally leave a balance in favour of the State, except when there have been large importations of negroes. The amount of exports from the port of Charleſton, in the year ending Nov. 1787, was then eſtimated, from authentic documents, at £ 505,279 : 19 : 5 ſterling money. The number of veſſels cleared from the cuſtom-houſe the ſame year, was 947, meaſuring 62,118 tons; 735 of theſe, meaſuring 41,531 tons, were American; the others belonged to Great-Britain, Spain, France, the United Netherlands, and Ireland. The principal articles exported from this State, are rice, indigo, tobacco, ſkins of various kinds, beef, pork, cotton, pitch, tar, roſin, turpentine, myrtle wax, lumber, naval ſtores, cork, leather, pink root, ſnake root, ginſeng, &c. In the moſt ſucceſsful ſeaſons, there have been as many as 140,000 barrels of rice, and 1,300,000 pounds of indigo exported in a year. From the 15th Dec. 1791, to Sept. 1792, 108,567 tierces of rice, averaging 550lb. nett weight each, were exported from Charleſton. In the year ending Sept. 30, 1791, the amount of exports from this State was 2,693,267 dolls. 97 cents, and the year ending September, 1795, to 5,998,492 dollars 49 cents. Charleſton is by far the moſt conſiderable city on the ſea-coaſt, for an extent of 600 miles. From it are annually exported about the value of two millions and a half of dollars, in native commodities; and it ſupplies, with imported goods, a great part of the inhabitants of North-Carolina and Georgia, as well as thoſe of S. Carolina. The harbour thereof is open all the winter, and its contiguity to the Weſt-India iſlands gives the merchants ſuperior advantages for carrying on a peculiarly lucrative commerce. A waggon road of fifteen miles only is all that is wanted, to open a communication with the inhabitants of Tenneſſee. Knoxville, the capital of that State, is 100 miles nearer to Charleſton than to any other conſiderable ſea-port town on the Atlantic Ocean. The reformation in France occaſioned a civil war between the Proteſtant and Catholic parties in that kingdom. During theſe domeſtic troubles, Jaſper de Coligni, a principal commander of the proteſtant army, fitted out 2 ſhips, and ſent them with a colony to America, under the command of Jean Ribaud, for the purpoſe of ſecuring a retreat from perſecution. Ribaud landed at what is now called Albemarle river, in North-Carolina. This colony, after enduring incredible hardſhips, were extirpated by the Spaniards. No farther attempts were made to plant a colony in this quarter, till the reign of Charles II. of England.

SOUTHERN STATES; the States of *Maryland*, *Virginia*, *Kentucky*, *North-Carolina*, *Tenneſſee*, *South-Carolina*, and *Georgia*, bounded N. by Pennſylvania, are thus denominated. This diſtrict of the Union contains upwards of 1,900,000 inhabitants, of whom 648,439 are ſlaves, which is *thirteen fourteenths* of the whole number of ſlaves in the United States. The influence of ſlavery has produced a very diſtinguiſhing feature in the general character of the inhabitants, which, though now diſcernible to their diſadvantage, has been ſoftened and meliorated by the benign effects of the revolution, and the progreſs of liberty and humanity. The following may be conſidered as the principal productions of this diviſion—tobacco, rice, indigo, wheat, corn, cotton, tar, pitch, turpentine and lumber. In this diſtrict is fixed the permanent ſeat of the general government, viz. the city of Waſhington.—*ib.*

SOUTHFIELD, a townſhip of New-York, Richmond county, bounded northerly by the N. ſide of the road leading from Van Duerſon's Ferry to Richmond-Town and the Fiſh-Kill; eaſterly by Hudſon's river. It contains 855 inhabitants.—*ib.*

SOUTH *Georgia*, a cluſter of barren iſlands, in the S. Atlantic Ocean to the eaſt of Cape Horn, the ſouthern point of S. America: in lat. about 54 30 ſouth, and long. 36 30 weſt. One of theſe is ſaid to be between 50 and 60 leagues in length.—*ib.*

SOUTH *Hadley*, a townſhip of Maſſachuſetts, Hampſhire county, on the eaſt bank of Connecticut river, 12 miles northerly of Springfield, 6 ſouth eaſt of Northampton, and 90 weſt of Boſton. It was incorporated in 1753, and contains 759 inhabitants. The locks and canals in South Hadley, on the eaſt ſide of Connecticut river, made for the purpoſe of navigating round the falls in the river, were begun in 1793, and completed in 1795. The falls are about 3 miles in length; and ſince the completion of theſe locks and canals, there has been a conſiderable increaſe of tranſportation up and down the river. Some mills are already erected on theſe canals, and a great variety of water works may, and doubtleſs will, ſoon be erected here, as nature and art have made it one of the moſt advantageous places for theſe purpoſes, in the United States. Canals are alſo opening by the ſame Company, at Miller's Falls, in Montgomery, about 25 miles above theſe, and on the ſame ſide of the river.—*ib.*

SOUTH *Hampton*, a county of Virginia, between James's river, and the State of N. Carolina. It contains 12,864 inhabitants, including 5,993 ſlaves. The court-houſe is 36 miles from Norfolk, 25 from Greenville, and 399 from Philadelphia.—*ib.*

SOUTH *Hampton*, a townſhip of New-Hampſhire, Rockingham county, on the ſouthern line of the State, which ſeparates it from Maſſachuſetts; 16 miles ſouth-weſt of Portſmouth, and 6 north-weſt of Newbury-Port. It was taken from Hampton, and incorporated in 1742; and contains 448 inhabitants.—*ib.*

SOUTH *Hampton*, a townſhip of Maſſachuſetts, Hampſhire county, and ſeparated from Eaſt Hampton by Pawtucket river. It was incorporated in 1753, and contains 829 inhabitants; about 9 miles S. W. of Northampton, and 109 S. W. by W. of Boſton.—*ib.*

SOUTH *Hampton*, a townſhip of New-York, Suffolk county, Long Iſland. It includes Bridgehampton, formerly called Saggaboneck, and Mecox; and, by means of Sagg Harbour, carries on a ſmall trade. It contains 3,408 inhabitants, of whom 431 are electors, and 146 ſlaves. It is 12 miles from Sagg Harbour, 18 from Suffolk court-houſe, and 95 eaſt of New-York.—*ib.*

SOUTH *Hampton*, two townſhips of Pennſylvania, the one in Buck's county, the other in that of Franklin.—*ib.*

SOUTH *Hampton*, a townſhip in the eaſtern part of Nova Scotia, and in Halifax county. It was formerly called Tatmagouche, and is 35 miles from Onſlow.—*ib.*

SOUTH *Hempſtead*, a townſhip of New-York, Queen's county, Long Iſland, had its name altered in 1796 by the legiſlature into Hempſtead. The inhabitants, 3,826 in number, have the privilege of oyſtering, fiſhing, and clamming, in the creeks, bays, and harbours of North Hempſtead, and they in return have the ſame right in South Hempſtead. Of the inhabitants, 575 are electors, and 326 ſlaves.—*ib.*

SOUTHHOLD, or *Southold*, a townſhip of New-York, Suffolk county, Long Iſland. It includes Fiſher's Iſland, Plumb Iſland, Robin's Iſland, Gull Iſlands, and all that part of the manor of St George on the north ſide of Peaconock, extending weſtward to the eaſt line of Brook Haven. It contains a number of pariſhes, and houſes for public worſhip, and 3,219 inhabitants; of whom 339 are electors, and 182 ſlaves. It was ſettled in 1640, by the Rev. John Young and his adherents, originally from England, but laſt from Salem in Maſſachuſetts.—*ib.*

SOUTH *Huntington*, a townſhip in Weſtmoreland county, Pennſylvania.—*ib.*

SOUTHINGTON, the ſouth-weſternmoſt townſhip of Hartford county, Connecticut, 20 miles ſouth-weſt of Hartford, and 22 north of New-Haven.—*ib.*

SOUTH *Kingſton*, a townſhip of Rhode-Iſland, Waſhington county, on the weſtern ſide of Narraganſet Bay. It contains 4,131 inhabitants, including 135 ſlaves.—*ib.*

SOUTH *Mountains*, a part of the Alleghany Mountains, in Pennſylvania. Near this mountain, about 14 miles from the town of Carliſle, a valuable copper mine was diſcovered in Sept. 1795.—*ib.*

SOUTH KEY, a ſmall iſland, one of the Bahamas, in the Weſt-Indies. N. lat. 22 21, W. long. 74 6.—*ib.*

SOUTH SEA, now more uſually diſtinguiſhed by the name of *Pacific Ocean*, was ſo named by the Spaniards, after they had paſſed over the mountains of the Iſthmus of Darien or Panama, from north to ſouth. It might properly be named the Weſtern Ocean, with regard to America in general; but from the Iſthmus it appeared to them in a ſouthern direction. In the beautiful iſlands in this ocean, the cold of winter is never known; the trees hardly ever loſe their leaves through the conſtant ſucceſſion of vegetation, and the trees bear fruit through the greateſt part of the year. The heat is always alleviated by alternate breezes, whilſt the inhabitants ſit under the ſhadow of groves, odoriferous, and loaded with abundance. The ſky is ſerene; the nights beautiful; and the ſea, ever offering its inexhauſtible ſtores of food, and an eaſy and pleaſing conveyance.—*ib.*

SOUTH THULE, or *Southern Thule*, in the S. Atlantic Ocean, is the moſt ſouthern land which has at any time been diſcovered by navigators. S. lat. 59 34, W. long. 27 45.—*ib.*

SOUTHWICK, a townſhip of Maſſachuſetts, in the S. W. part of Hampſhire county, 110 miles S. W. by W. of Boſton, and 12 S. W. of Springfield. It was incorporated in 1770, and contains 841 inhabitants.—*ib.*

SOUTH WEST *Point*, in Tenneſſee, is formed by the confluence of Clinch with Tenneſſee river, where a block-houſe is erected.—*ib.*

SOUTH WASHINGTON, a town of N. Carolina, on the N. E. branch of Cape Fear river, which is navigable thus far for boats. It is 23 miles from Croſs Roads near Duplin court-houſe, and 36 from Wilmington.—*ib.*

SOUTOUX, an Indian village in Louiſiana, on the weſt ſide of Miſſiſippi river, oppoſite to the Nine Mile Rapids, 22 miles below Wieſpincan river, and 28 above Riviere a la Roche. N. lat. 41 50.—*ib.*

SOWAL, in the language of Bengal, a queſtion or requeſt.

SOW *and* PIGS, a number of large rocks lying off the ſouth-weſt end of Catahunk Iſland, one of the Elizabeth Iſlands, on the coaſt of Maſſachuſetts.—*Morſe.*

SPALLANZANI (Lazarus), was born at Scandiano, in the dutchy of Modena, on the 10th of January 1729. He was ſon of Jean Nicholas Spallanzani, an eſteemed juriſconſult, and of Lucia Zugliani. He commenced his ſtudies in his own country, and at the age of fifteen years went to Reggio de Modena in order to continue them. The Jeſuits, who inſtructed him in the belles lettres, and the Dominicans, who heard of his progreſs, were each deſirous of attaching him to them; but his paſſion for extending his knowledge led him to Bologna, where his relation Laura Baſſi, a woman juſtly celebrated for her genius, her eloquence, and her ſkill in natural philoſophy and the mathematics, was one of the moſt illuſtrious profeſſors of the Inſtitute and of Italy. Under the direction of this enlightened guide, he learned to prefer the ſtudy of Nature to that of her commentators, and to judge of the value of the commentary by its reſemblance to the original. He inſtantly availed himſelf of the wiſdom of that lady's counſels, and was not long before he experienced the happy effects of it. How agreeable it is to ſee him in 1765 painting his gratitude for his inſtructor, to whom he dedicated a Latin diſſertation at that time, in which he mentions the applauſes that Laura Baſſi received at Modena, when ſhe entered the auditory of her pupil, then become profeſſor. The taſte of Spallanzani for philoſophy was not excluſive; he already thought, like all great men, that the ſtudy of antiquity and the belles lettres was requiſite to give to ideas that clearneſs, to expreſſions that accuracy, and to reaſonings that connection, without which the fineſt thoughts become barren. He ſtudied his own language with care, and perfected himſelf in the Latin tongue; but above all, he attached himſelf to the Greek and the French. Homer, Demoſthenes, St Baſil, were his favourite authors. Spallanzani applied himſelf to juriſprudence at the inſtance of a father whom he tenderly loved: he was upon the point of receiving the degree of doctor of civil law, when Anthony Valliſneri, profeſſor of natural hiſtory at Padua, perſuaded him to renounce this vocation, by promiſing to obtain the conſent of his father, who was ſenſibly touched by his ſon's devotion to his will, and who thereby left him at liberty to follow his own inclinations. From that moment he gave himſelf up with more ardour than ever to the ſtudy of mathematics, continuing that alſo of the living and dead languages.

Spallanzani was preſently known all over Italy, and his own country was the firſt to do homage to his talents. The univerſity of Reggio, in 1754, choſe him to be profeſſor in logic, metaphyſics, and Greek. He taught there for ten years; and during that period conſecrated all the time he could ſpare from his leſſons to the obſervation of Nature. Now and then an accidental diſcovery would increaſe his paſſion for natural hiſtory, which always augmented by new ſucceſſes. His obſervations upon the animalculæ of infuſions fixed the attention of Haller and of Bonnet; the latter of whom aſſiſted him in his glorious career, and thenceforth diſtinguiſhed him as one of the learned interpreters of Nature.

In 1760 Spallanzani was called to the univerſity of Modena; and although his intereſt would have made him accept the advantageous offers of the univerſity of Coimbra, of Parma, and of Ceſena; yet his patriotiſm and his attachment to his family confined his ſervices to his own country. The ſame conſiderations engaged him to refuſe the propoſitions made him by the academy of Peterſburg ſome years after. He remained at Modena till the year 1768, and he ſaw raiſed by his care a generation of men conſtituting at this time the glory of Italy. Among them may be counted *Venturi*, profeſſor of natural philoſophy at Modena; *Belloni*, biſhop of Carpi; *Luccheſini*, ambaſſador of the late king of Pruſſia; and the poet *Angelo Mazzo* of Parma.

During his reſidence at Modena, Spallanzani publiſhed, in 1765, *Saggio di Oſſervazioni Microſcopiche concernente il Syſtema di Needham e Buffon.* He therein eſtabliſhes the *animality* of what had been called, but not generally aſſented to as, *microſcopic animalculæ*, by the moſt ingenious, and at the ſame time ſolid, experiments. He ſent this work to Bonnet, who formed his opinion of the author accordingly, and who lived to ſee the accompliſhment of the prophecy he drew from it. From that moment the moſt intimate acquaintance was formed between them, and it laſted during their lives, of which it conſtituted the chief happineſs. In the ſame year Spallanzani publiſhed a diſſertation truly original: *De Lapidibus ab Aqua reſilientibus.* In that work he proves, by ſatisfactory experiments, contrary to the commonly received opinion, that the ducks and drakes (as they are called) are not produced by the elaſticity of the water, but by the natural effect of the change of direction which the ſtone experiences in its movement, after the water has been ſtruck by it, and that it has been carried over the bend or hollow of the cup formed by the concuſſion.

In 1768 he prepared the philoſophers for the ſurpriſing diſcoveries he was about to offer them throughout his life, in publiſhing his *Prodromo di un Opera da Imprimerſi ſopra le Riproduzioni Animali.* He therein lays down the plan of a work which he was anxious to get up on this important ſubject; but this ſimple proſpectus contains more real knowledge than all the books which had appeared, becauſe it taught the method that ought to be followed in this dark reſearch, and contained many unexpected facts; ſuch as the pre-exiſtence of tadpoles at the fecundation, in many ſpecies of toads and frogs; the reproduction of the head cut off from ſnails, which he had already communicated to Bonnet in 1766, and which was diſputed for ſome time, in ſpite of the repeated confirmation of this phenomenon by Heriſſant and Lavoiſier. He demonſtrated it again afterwards in the *Memorie della Societa Italiana;* as alſo the renewal of the tail, the limbs, and even the jaws, taken from the aquatic ſalamander. Theſe facts continue to aſtoniſh even at this day, when they are thought of, notwithſtanding every one has had the opportunity of familiariſing himſelf with them: and we hardly know which we ought moſt to admire, the expertneſs of Spallanzani in affording ſuch deciſive proofs, or his boldneſs in ſearching after them, and ſeizing them. We have to regret, that the project of his great undertaking is not realized; but various circumſtances prevented him from giving way to the ſolicitations of his friends for its accompliſhment. Perhaps he deſpaired of throwing upon every part of it all the light which at firſt he thought he might be able; and found it prudent to mature his ideas by new meditations: this may probably have been as powerful a cauſe as that other calls and occupations, perpetually accumulating, ſhould not have allowed him to purſue it as he had intended. He has always laid Nature open to full view; and the thinneſt veil darkened her till he ſucceeded in removing it altogether.

The phyſiology of Haller that Spallanzani ſtudied, fixed his attention upon the circulation of the blood, in which he diſcovered ſeveral remarkable phenomena. He publiſhed, in 1768, a ſmall tract: *Dell'Azione del Cuore ne' Vaſi Sanguigni nuovi Oſſervazioni*, and he reprinted it in 1773, with three new diſſertations, *De' Fenomeni della Circolazione oſſervata nel' Giro univerſali de' Vaſi: De' Fenomeni della Circolazione Languente; De' Moti del Sangue, independente del Azione del Cuore e del Pulſare delle Arterie.* This work, but little known, contains a ſeries of obſervations and experiments, of the moſt ingenious and delicate nature, upon a ſubject of which the ſurface only is known. It merits the attention of thoſe who are intereſted in the progreſs of phyſiology.

When the univerſity of Padua was re-eſtabliſhed upon a larger ſcale, the Empreſs Maria Thereſa directed the Count de Firmian to invite him to fill a chair, as profeſſor of natural hiſtory; his great reputation rendered him eligible for this diſtinction, ſolicited by many celebrated men, and he merited it by his ſucceſs, and by the crowd of ſtudents who thronged to his leſſons. Only great men make excellent maſters, becauſe their ideas are the moſt perſpicuous, the moſt extenſive, and beſt connected.

Spallanzani united a vaſt extent of knowledge to a fine genius; a method ſimple, but rigorous in its nature; and he connected what he knew to principles firmly eſtabliſhed. His ardent love of truth made him diſcuſs, with the utmoſt care, the theories which prevailed; to found their ſolidity, and diſcover their weak ſides. The great art which he had acquired, of interpreting Nature by herſelf, diffuſed ſuch a light over his leſſons, as made every thing perſpicuous that was capable of affording inſtruction. An eloquence at once plain and lively animated his diſcourſe; the purity and elegance of his ſtyle charmed all who heard it: in ſhort, it was known that he always occupied himſelf about the means of rendering his leſſons uſeful, which he prepared

Spallanzani.

pared a year beforehand. They became always new and engaging, by his new obſervations, and by the enlarged views that his meditations preſented to him. The learned perſons who attended his lectures were pleaſed to become his ſcholars, in order to know better what they already knew, and to learn that which otherwiſe they would perhaps never have known.

In arriving at the univerſity, Spallanzani took the *Contemplation de la Nature* of Bonnet for the text of his leſſons: he filled up the vacancies in it, he unfolded the ideas, and confirmed the theories by his experiments. He believed, with reaſon, that the book which inſpired him with the love of natural hiſtory by reading it, was the moſt proper to give birth to it in the minds of his diſciples.

He tranſlated it into Italian, and enriched it with notes; he added a preface to it, wherein he pointed out the ſubjects of the vegetable and animal economy, which in an eſpecial manner deſerved the attention of his pupils; and ſometimes pointing out to them the means of ſucceeding in their reſearches. It was thus he at firſt devoted himſelf to the pleaſing employment of inſtructor of his countrymen, and that he became the model of thoſe who were deſirous of inſtructing uſefully. He publiſhed the firſt volume of his tranſlation in 1769, and the ſecond in 1770.

The connection of Spallanzani with Bonnet had an influence upon his genius, which bent to the ſevere method of the philoſopher of Geneva. He prided himſelf in being his pupil, and he unceaſingly meditated upon his admirable writings; and thus it was that he became deſirous of ſeeking in Nature for the proofs of Bonnet's opinion upon the generation of organized bodies, and that this charming ſubject fixed his attention for a long time.

He publiſhed, in 1776, the two firſt volumes of his *Opuſcoli di Fiſica Animale e Vegetabile:* they are the explanation of a part of the microſcopic obſervations which had already appeared.

If the art to obſerve be the moſt difficult, it is nevertheleſs the moſt neceſſary of all the arts; but it ſuppoſes every quality, every talent: and further, though each believes himſelf more or leſs conſummate therein, yet it is obvious, that only great men have exerciſed it in a diſtinguiſhed manner. Genius alone fixes the objects worthy of regard; that alone directs the ſenſes to the obſcurities which it is neceſſary to diſſipate; it watches over them to prevent error; it animates them to follow by the ſcent, as it were, that which they have but a diſtant view of: it takes off the veil which covers what we are looking after; it ſupports the patience which waits the moment for gratifying the ſight in the midſt of obſtacles multiplying one upon another: in ſhort, it is genius that concentrates the attention upon an object, which communicates that energy to him for imagining, that ſagacity for diſcovering, that promptneſs for perceiving, without which we ſee only one ſide of truth, when we do not happen to let it eſcape altogether. But this is not all; for after Nature has been read with preciſion, it is neceſſary to interpret her with fidelity; to analyſe by the thought the phenomena anatomiſed by the ſenſes; to conſider of the ſpecies by obſerving the individual, and to anticipate the general propoſitions by conſidering the unconnected facts. Here prudence and circumſpection will not always ſecure us againſt error, if an ardent love for the truth does not aſſay obſervations and their conſequences in its crucible, and thereby reduce every thing to *ſcoriæ* which is not truth.

Such was Spallanzani in all his reſearches; ſuch we ſee him in all his writings. Occupied by the great phenomenon of generation, he examined the opinion of Needham to demonſtrate its want of foundation. The latter, not ſatisfied with the microſcopic obſervations of Spallanzani, which weakened the imagined vegetative force to put the matter in motion, challenged the profeſſor of Reggio to a reperuſal of what he had written; but he proved to the other, that we in common practice always ſee that which has been *well obſerved*, but that we never again ſee that which we have been contented with *imagining we ſaw*.

Spallanzani has received much praiſe for the politeneſs with which he carried on this controverſy, and for the ſevere logic with which he demonſtrates to Needham the cauſes of his error; and proves, that the animalculæ of infuſions are produced by germs; that there are ſome of them which defy, like certain eggs and ſeeds, the moſt exceſſive cold, as well as the heat of boiling water. On this occaſion, he treats on the influence of cold upon animals, and proves that the lethargic numbneſs of ſome, during winter, does not depend upon the impreſſion the blood may receive from it; ſince a frog, deprived of his blood, becomes lethargic when he is reduced to the ſame cold ſtate by an immerſion in ice, and ſwims as before when reſtored to warmth. In the ſame manner he ſhews that odours, various liquors, the vacuum, act upon animalculæ as upon other animals; that they are oviparous, viviparous, and hermaphrodite. Thus, in running over theſe diſtant regions of Nature with this illuſtrious traveller, we are always meeting with new facts, profound remarks, precious details and ſome curious anecdotes; in ſhort, an univerſal hiſtory of theſe beings which are the moſt numerous of the globe, although their exiſtence is ſcarcely ſuſpected, and whoſe organization is in many reſpects different from that of known animals.

The ſecond volume of this work is a new voyage into the moſt unknown parts: a ſublime pencil had already painted it, but the picture was not done after Nature. Spallanzani here gives a hiſtory of the ſpermatic animalculæ, which the eloquent hiſtorian above alluded to always confounds with the animalculæ of infuſions. We cannot but admire the modeſt diffidence of this new demonſtrator, ſtruggling againſt his own opinion and the authority of Buffon; and he appears to admit, with repugnance, the reſults of his multiplied, and in a thouſand ways varied, obſervations, which expoſe the feebleneſs of the ſyſtem of organic moleculæ.

Spallanzani afterwards deſcribes the volvox and the ſlow-moving animalculæ *(rotiſère* and *tardigrade)*, thoſe coloſſuſes of the microſcopic world, ſo ſingular by their figure and organization, but more ſingular ſtill by their faculty of reſuming life, after a total ſuſpence of all the apparent acts of it during many years.

We will not here ſpeak of the experiments of Spallanzani on the death of animals in cloſe veſſels, becauſe he took up the ſubject again, and enlarged and exemplified it by the new lights of chemiſtry; but this collection he concludes with another on the hiſtory of vegetable

getable mould growing on the ſurface of liquors and moiſt ſubſtances, the ſeeds of which he ſhews to float in the air; and he remarks that theſe microſcopic champignons or muſhrooms diſtinguiſh themſelves from other plants by their tendency to grow in all directions, without conforming to the almoſt univerſal law of perpendicularity of ſtalk to the ground.

Spallanzani was placed at the head of the univerſity's cabinet of natural hiſtory, but he was little more than titular depoſitary of a treaſure which no longer exiſted. He laid the foundations, however, for its renewal, and by his care it is become one of the moſt precious and uſeful. He enriched it through his repeated travels by land and ſea, in Europe, in Aſia, acroſs the Apennines, the Alps, the Krapacks, at the bottom of mines, on the top of volcanoes, at the mouth of craters: ſupported by his ardent paſſion in the midſt of perils, he preſerved the *ſang froid* of the philoſopher to contemplate theſe wonders, and the piercing eye of an obſerver to ſtudy them. It is thus that he always diſtinguiſhed the proper objects for improving ſcience by favouring inſtruction; it is thus that he filled this depoſitary with treaſures, that all the gold in the world could not have obtained, becauſe gold never ſupplies the genius and the diſcernment of the enlightened naturaliſt.

In 1779 Spallanzani ran over Switzerland and the Griſons; he then went to Geneva, where he ſpent a month with his friends, who admired him the more in his converſations after having admired him in his writings. He then returned to Pavia, and publiſhed, in 1780, two new volumes of his *Diſſertazione di Fiſica Animale e Vegetabile*. He therein reveals the ſecrets of the interpretation of two very obſcure phenomena, concerning the vegetable and animal economy.

Some experiments made by Spallanzani upon *digeſtion*, for his leſſons, engaged him to ſtudy this dark operation: he repeated Reaumur's experiments upon the gallinaceous birds; and he obſerved that the trituration, which is in this caſe an aid to digeſtion, could not, however, be a very powerful means. He ſaw that the gizzard of thoſe birds which pulveriſe the ſtones of fruit to pieces, as if done with needles or other ſharp-pointed inſtruments, did not digeſt the powder ſo formed: that it was neceſſary it ſhould undergo a new operation in the ſtomach, before it could become fit chyle for affording the elements of the blood and other humours. He eſtabliſhed the point, that the digeſtion was performed in the ſtomach of numerous animals by the powerful action of a juice which diſſolves the aliments; and to render his demonſtration the more convincing, he had the courage to make ſeveral experiments on himſelf which might have proved fatal, and had the addreſs to complete his proofs by artificial digeſtions, made in glaſſes upon the table, by mixing the chewed aliments with the gaſtric juice of animals, which he knew how to extract from their ſtomachs. But this book, ſo original by the multitude of experiments and curious obſervations which it contains, is ſtill more worthy of attention by the philoſophic ſpirit which detected it.

This ſubject is one of the moſt difficult in phyſiology: the obſerver is always compelled to act and to look with darkneſs around him; he is obliged to manage the animal with care, to avoid the derangement of his operations; and when he has laboriouſly completed his experiments, it is neceſſary that he ſhould well diſtinguiſh the conſequences, ſometimes erroneous, which may be drawn from thoſe of obſervation, which never deceive when they are immediate. Spallanzani, in this work, is truly a fine ſpectacle; ſcrupulouſly analyſing the facts in order to diſcover their cauſes with certainty; inventing happy reſources for ſurmounting the obſtacles which renew themſelves; comparing Nature with his experiments, to judge of them; catching hold in his obſervations of every thing that is eſſential in them; meaſuring their ſolidity by the augmentation or diminution of ſuppoſed cauſes; drawing the beſt-founded concluſions, and rejecting the moſt plauſible hypotheſes; modeſtly expoſing the errors of thoſe who have gone before him, and employing analogy with that wiſe circumſpection which inſpires confidence in an inſtrument at once ſo dangerous and ſo uſeful. But let it be known, Spallanzani had a capacity in particular for diſcovering the truth, while the greater part of obſervators ſcarcely ever attain it; and then, after having deſcribed around them a circuitous trace, he runs upon it by a ſtraight line, and poſſeſſes himſelf of it ſo as that it cannot eſcape him.

This work put John Hunter out of humour; and he publiſhed, in 1785, *Some Obſervations upon Digeſtion*, wherein he threw out ſome bitter ſarcaſms againſt Spallanzani; who took ample revenge by publiſhing this work in Italian, and addreſſing to *Caldani*, in 1788, *Una Lettera Apologetica in Riſpoſta alle Oſſervazione del Signor Giovanni Hunter*. He expoſes, with moderation, but with an irreſiſtible logic, the overſights of the Engliſh phyſiologiſt, and points out his errors in a manner which left him no hope of a reply.

The ſecond volume treats of the generation of animals and plants. Spallanzani proves, by experiments as ſatisfactory as they are ſurpriſing, the pre-exiſtence of germs to fecundation; he ſhews the exiſtence of tadpoles in the females of five different ſpecies of frogs, in toads, and in ſalamanders, before their fecundation: he recounts the ſucceſs of ſome artificial fecundations upon the tadpoles of thoſe five ſpecies, and even upon a quadruped. He in the ſame manner ſhews the ſeed in the flowers, before the emiſſion of their farina; and by a ſubtle anatomy of which one can hardly form an idea, he exhibits to the eye in the flower of the *ſpartium junceum*, the ſiliqua, its ſeeds, with their lobes, and the embryo plant; he purſues them in their expanſion before and after fecundation, and leaves not a doubt but that the ſeeds and the pericarpia exiſted long before the bloſſoming of the buds, and conſequently a long time before they could have been fecundated. He has repeated theſe obſervations upon various ſpecies of plants with the ſame reſults; in ſhort, he has raiſed the individuals of plants with female flowers which have borne fecundated ſeeds, although they were out of the reach even of ſuſpicion of a communication with the farina of the male flowers. Such is the ſeries of ſurpriſing phenomena Spallanzani adds to the hiſtory of Nature.

According to cuſtom, he availed himſelf of the academical vacation of 1781, to make a journey, the object of which was to add to the cabinet of Pavia. He ſet out in the month of July for Marſeilles, where he commenced a new hiſtory of the ſea, which had preſented him with a crowd of novel and curious facts upon numerous genera of the inhabitants of the ocean.

He went likewiſe to Finale, to Genoa, to Maſſa, and to Carrara, to obſerve the quarries of marble ſo famous with the ſtatuaries; he returned to Spezzia, and thence brought to Pavia an immenſe harveſt of fiſhes, cruſtaceous and teſtaceous, which he depoſited in that cabinet of which his voyages and travels had rendered him ſo worthy to be the guardian. He viſited, in the ſame view, and with the ſame ſucceſs, the coaſts of Iſtria in 1782; the Apennine Mountains in 1783, where he noticed the terrible hurricanes, and the ſurpriſing vapours which rendered that year ſo famous in meteorology. The cabinet of Pavia thus every year ſaw its riches increaſe; and in the ſame proportion it became the object of ſtrangers admiration; but every one admired ſtill more the immenſe labour of Spallanzani, who had collected every part of it.

The Emperor Joſeph knew this when he came into Lombardy: he deſired to have a converſation with Spallanzani; and his majeſty expreſſed his approbation by preſenting him with his medal in gold.

The univerſity of Padua offered to Spallanzani, in 1785, the chair of natural hiſtory, which the death of Anthony Valliſneri had left vacant, promiſing him more conſiderable advantages than thoſe which he enjoyed at Pavia; but the archduke doubled his penſion, and allowed him to accompany to Conſtantinople the Chevalier Zuliani, who had juſt been nominated ambaſſador from the republic of Venice.

He left this city the 21ſt of Auguſt; and during his voyage made ſeveral obſervations upon the marine productions he met with in thoſe climates, as well as upon the meteorological events of every day, among which he had the advantage of beholding a ſpecies of water-ſpout. He touched at ſeveral iſlands in the Archipelago, which he examined, and went aſhore at Troy to viſit the places ſung by the poet whom he preferred to all others; and in treading upon that ground ſo anciently famous, he made ſome geological obſervations truly original. One may judge before hand of the intereſt we ſhall feel in reading the Voyage of Spallanzani, by ſome memoirs which have appeared in the *Memorie della Societa Italiana* upon the water-ſpouts at ſea, the ſtroke of the torpedo, divers marine productions, and the iſland of Cytherea, where he diſcovered a mountain compoſed of various ſpecies of foſſils. Spallanzani arrived at Conſtantinople the 11th of October, and remained there eleven months: he muſt have been greatly out of his element in that country of ignorance and ſuperſtition, if he had not had Nature to ſtudy, and Zuliani to hear him. The phyſical and moral phenomena of this country, quite new to him, fixed his attention; he ſtrayed over the borders of the two ſeas, and climbed up the neighbouring hills; he viſited the iſland of Chalki, where he made known to the Turks a mine of copper, the exiſtence of which they never ſo much as ſuſpected. He went to the Principi iſland, a few miles diſtant from Conſtantinople, where he diſcovered an iron mine equally unthought of by the Turks. He returned to Europe loaded with ſpoils from the Eaſt, compoſed of the creatures of the three kingdoms, peculiar to thoſe regions: after having been uſeful to the Orientals, who were incapable of appreciating his merit, or rather of imagining he could have any, he ſet out on his return for Italy the 16th of Auguſt, 1786.

A voyage by ſea was in every reſpect the moſt ſafe and the moſt commodious; but Spallanzani conſidered the dangers and the inconveniencies of the road as nothing when employed in any beneficial purſuit; he braved all the perils of thoſe deſert regions, where there is no police, no ſecurity. When he arrived at Buchareſt, he was retained there during nine days by the celebrated and unhappy Mauroceni, hoſpodar of Walachia. This prince, the friend of ſcience, received him with diſtinction, preſented him with many of the rarities of his country, furniſhed him with horſes for travelling, and alſo gave him an eſcort of thirty troopers throughout the whole extent of his dominions. Spallanzani paſſed by Hermanſtadt in Tranſylvania, and arrived at Vienna the 7th of December, after having viewed the numerous mines of Tranſylvania, of Hungary, and of Germany, which lay in the neighbourhood of his route. Spallanzani remained five days in this capital of Auſtria; he had two very long audiences with the Emperor Joſeph II.; was well received by the higheſt nobility in that metropolis, and viſited by the men of letters. At length arrived at Pavia; the ſtudents came to meet him out of the gates of the city, and accompanied him home, manifeſting their joy all the way by repeated ſhouts. Their great deſire to hear him, drew him almoſt immediately to the auditory, where they forced him to aſcend the chair from which he had been accuſtomed to deliver his lectures to them. Spallanzani, affected by this ſcene, teſtified with eloquence his gratitude and attachment;—friendly wiſhes, cries of joy, clapping of hands, recommenced with more force, and he was obliged to requeſt them to deſiſt, and allow him to take in his houſe that repoſe which was more neceſſary than ever. He had in the courſe of this year above 500 ſtudents.

Spallanzani had acquired glory enough to merit the attacks of envy: but his diſcoveries were too new, too original, too ſolid to be diſputed; envy itſelf was therefore forced to admire him: but that unworthy paſſion, being tired out by the increaſing reputation of that great man, watched the moment to prove that it had not forgotten him. Envy and malignity then called in queſtion his uprightneſs in the adminiſtration of the cabinet of Pavia; the whole of which was the fruit of his own labours: but the darts aimed at his honour only made it ſhine with new luſtre. The integrity of Spallanzani appeared even more pure after the juridical examination of the tribunals. But let us ſtop here; Spallanzani had the fortitude to forget this event which had torn his heart to pieces; the greater part of his enemies acknowledged their miſtake, abjured their hatred, and did not deſpair of regaining his friendſhip.

The cabinet of Pavia was always the object of Spallanzani's thoughts; amidſt the numerous rarities which he had placed there, he only ſaw thoſe that were wanting. Struck with its deficiency in volcanic matters, which had neither ſeries nor order, and conſequently excited little intereſt, being a mute article with reſpect to inſtruction (although Italy was the theatre where the fires of volcanoes had for ſo many ages exerciſed their deſolating powers), he took the reſolution, with which his talents, his courage, and his zeal, inſpired him. He was deſirous to inſtruct his pupils, his nation, himſelf, concerning the phenomena ſo ſtriking, and yet ſo little known, and to collect the documents of their hiſtory in the places where they have always been the terror of thoſe who ſurrounded them, and where they have been uſeleſsly the ſubject of the obſervations of the philoſopher. He therefore prepared himſelf for this great enterpriſe by deep ſtudies. He ſet out for Naples, in the ſummer of 1788, and aſcended mount Veſuvius; he looked attentively into its crater, examined and made notes in his books, and embarked for the Lipari iſlands. He diſſected, as it were, the uninhabited volcanoes, with the exactneſs of a naturaliſt anatomiſing a butterfly, and the intrepidity of a warrior defying the moſt imminent dangers. It was then that he had the boldneſs to walk over that ſulphurous cruſt, cleft with chinks, trembling, ſmoking, burning, and ſometimes treacherouſly covering the hearth of the volcano. He paſſed into Sicily, where he climbed up to Etna, and coaſted its immenſe crater. His curioſity not being exhauſted, he would collect around him, and have in his mind, all the ſingular phenomena that Sicily contained; he examined the ſtones and the mountains, and diſcovered many new marine animals; he approached Scylla and Charybdis, and in a boat croſſed the frothy billows of thoſe deadly rocks, celebrated for ſo many ſhipwrecks, and ſo often ſung by the poets; but in the very midſt of their frightful waves, he diſcovered the cauſe of their fury (See SCYLLA, *Suppl.*) It was thus that, at the age of 60, he picked up thoſe numberleſs anecdotes which fill his voyages in the two Sicilies; and that he compared the deſcription which Homer, Pindar, Virgil, Diodorus Siculus, and Strabo, have given of theſe ever famous places, with that which he made himſelf. In this manner he ſhewed the connection of ancient literature with natural hiſtory.

We find in the voyages of Spallanzani a new volcanology. He therein teaches the way to meaſure the intenſity of the fire of volcanoes, to glance at the cauſes, to touch almoſt, in the analyſis which he makes of the lava, that particular gas which, reſembling a powerful lever, tears from the bowels of the earth, and raiſes up to the top of Etna, thoſe torrents of ſtone in fuſion which it diſgorges; to ſurvey the nature of thoſe pumice-ſtones, which he has ſince explained in his artificial pumice-ſtones. He concludes this charming work with ſome intereſting inquiries into the nature of ſwallows, their mild diſpoſitions, rapid flight; ſuggeſting that an advantage might be drawn from them in the way of aerial poſt; their migrations determined by the temperature of the air, and the birth of inſects it occaſions: in ſhort, he diſcuſſes the famous problem of their remaining benumbed during winter; and proves, that artificial cold, much greater than that ever naturally felt in our climates, does not render theſe birds lethargic. He next ſpeaks of a ſpecies of owl, hitherto very ill deſcribed; and, laſtly, of eels and their generation, which is a problem ſtill in ſome meaſure to be ſolved; but he carries it on by his inquiries to that ſtep which alone remains to be made for obtaining a complete ſolution; or to get over it eaſily by a ſmall number of obſervations in thoſe times and places pointed out, but which the academical occupations of Spallanzani forced him to give up to others.

Spallanzani followed the progreſs of the French chemiſtry with much ſatisfaction, nor was he long before he adopted it; it was calculated for a juſt conception like his, delighting to give an account of every phenomenon he obſerved. The ſolidity of principles in this new doctrine, the preciſion in its way of proceeding, the elegance of its interpretation, the generality of its conſequences, preſently replaced in his mind the heſitations and the obſcurities of the ancient chemiſtry; and his heart anticipated with pleaſure the triumphs that it was about to obtain.

In 1791, Spallanzani publiſhed a letter addreſſed to Profeſſor Fortis, upon the Pennet Hydroſcope. He there relates the experiments which he had directed to be made for aſcertaining the degree of confidence which might be allowed to the ſingular talents of this man; but he ingenuouſly confeſſes, that he is not decided upon the reality of the phenomenon.

Spallanzani has often diſcovered that which might have been deemed impoſſible. In 1795 he made a diſcovery of this nature, which he publiſhed in his *Lettere ſopra il ſoſpetto d'un nuovo ſenſo nei Pipiſtrelli.* We therein learn that the bats, if blinded, act in every reſpect with the ſame preciſion as thoſe which have their eyes; that they in the ſame manner avoid the moſt trifling obſtacles, and that they know where to fix themſelves on ceaſing their flight. Theſe extraordinary experiments were confirmed by ſeveral natural philoſophers, and gave occaſion to ſuſpect a new ſenſe in theſe birds, becauſe Spallanzani thought he had evinced by the way of excluſion, that the other ſenſes could not ſupply the deficiency of that ſight which he had deprived them of; but the anatomical details of Profeſſor Jurine, upon the organ of hearing in this ſingular bird, made him incline afterwards towards the idea, that the ſenſe of hearing might in this caſe ſupply that of ſight, as in all thoſe where the bats are in the dark.

Spallanzani concluded his literary career for the public, by a letter addreſſed to the celebrated Giobert; *Sopra la piante chiuſe ne' vaſi dentro l'aqua e l'aria, eſpoſte a l' immediàta lume ſolare e a l'ombra.* It is a misfortune for this part of the ſcience, that his death has deprived us of the diſcoveries he was about to make in it.

Theſe numerous works, printed and applauded, did not however contain all the ſeries of Spallanzani's labours. He had been occupied a conſiderable time upon the phenomena of reſpiration; their reſemblances and differences in a great number of ſpecies of animals; and he was buſily employed in reducing to order his reſearches upon this ſubject, which will aſtoniſh by the multitude of unforeſeen and unexpected facts He has left a precious collection of experiments and new obſervations upon animal reproductions, upon ſponges, the nature of which he determines, and upon a thouſand intereſting phenomena which he knew how to draw out of obſcurity. He had almoſt finiſhed his voyage to Conſtantinople, and had amaſſed conſiderable materials for a Hiſtory of the Sea, when an end was put to his life and his labours.

On the 4th of February 1799, he was ſeized with a retention of urine, the ſame night was unquiet, and in the morning he loſt all powers of reaſon, which he never recovered but during very ſhort intervals. His intimate friends, Tourdes, a French phyſician, and the celebrated Profeſſor Scarpa, did every thing which could be expected from genius, experience, and friendſhip, to ſave him; but he died the 17th, after having edified thoſe around him by his piety. This lamentable event overwhelmed all his family in ſorrow, occaſioned the tears to flow from all his friends, filled his diſciples with a deep affliction, and excited the regret of a nation proud of having given him birth.

The reader cannot but have perceived in this ſketch the ſtrain of panegyric, rather than the calm narrative of impartial biography. It is, in fact, an abridged tranſlation of an *eloge* by a *citizen* philoſopher of Geneva, who has adopted the calendar, and probably the principles of republican France. Some abatement therefore will naturally be made by every Briton of the praiſes beſtowed upon the piety of Spallanzani; but after proper allowance of this kind, truth will proclaim him a very great man. Accordingly, France, Germany, England, all were eager to avail themſelves of his works by means of tranſlations. He was admitted into the academies and learned ſocieties of London, Stockholm, Gottingen, Holland, Lyons, Bologna, Turin, Padua, Mantua, and Geneva. He was a correſpondent of the academy of ſciences of Paris and of Montpelier: and received from the great Frederic himſelf the diploma of member of the academy of Berlin.

SPANIARDS *Bay*, on the eaſt coaſt of Cape Breton Iſland, is round the point of the ſouth entrance into Port Dauphin, to the ſouthward of which is Cape Charbon. Its mouth is narrow, but it is wider within till it branches into two arms, both of which are navigable 3 leagues, and afford ſecure harbouring. N. lat. 46 20, W. long. 58 29.—*Morse.*

SPANISH AMERICA contains immenſe provinces, moſt of which are very fertile. 1. In *North-America*, Louiſiana, California, Old Mexico or New Spain, New Mexico, both the Floridas. 2. In the *Weſt-Indies*, the iſland of Cuba, Porto Rico, Trinidad, Margaretta, Tortuga, &c. 3. In *South-America*, Terra Firma, Peru, Chili, Tucuman, Paraguay, and Patagonia. Theſe extenſive countries are deſcribed under their proper heads. All the exports of Spain, moſt articles of which no other European country can ſupply, are eſtimated at only 80,000,000 livres, or 3,333,333l. ſterl. The moſt important trade of Spain is that which it carries on with its American provinces. The chief imports from theſe extenſive countries conſiſt of gold, ſilver, precious ſtones, pearls, cotton, cocoa, cochineal, red-wood, ſkins, rice, medicinal herbs and barks, as ſaſſafras, Peruvian bark, &c. Vanilla, Vicunna wool, ſugar and tobacco. In 1784, the total amount of the value of Spaniſh goods exported to America, was 195,000,000 reales de vellon; foreign commodities, 238,000,000 r. d. v. The imports from America were valued at 900,000,000 r. d. v. in gold, ſilver, and precious ſtones; and upwards of 300,000,000 in goods. In the Gazeta de Madrid, 1787, (Feb. 20) it was ſtated, that the exports to America (the Indies) from the following 12 harbours, Cadiz, Corunna, Malaga, Seville, St Lucar, Santander, Canarias, Alicante, Barcelona, Tortoſa, Gipon, St Sebaſtian, amounted, in 1785, to 767,249,787 r. d. v. the duties paid on theſe exports amounted to 28,543,702 r. d. v. The imports, both in goods and money, from America and the W. India iſlands, amounted in the ſame year to 1,266,071,067 r. d. v. and the duties to 65,472,195 r. d. v. The profits of the merchants from the whole American trade was valued at 5,000,000 dollars.—*ib.*

SPANISH *Creek*, is at the head of St Mary's river in Florida.—*ib.*

SPANISH *Main*, that part of the coaſt of America, which extends from the Moſquito ſhore, along the northern coaſt of Darien, Carthagena, and Venezuela, to the Leeward Iſles.—*ib.*

SPANISH *River*, a river and ſettlement in Cape Breton Iſland, and the preſent ſeat of government.—*ib.*

SPANISHTOWN, or *St Jago de la Vega*, in the county of Middleſex, is the capital of the iſland of Jamaica. It is ſituated on the banks of the river Cobre, about 6 miles from the ſea, and contains about 5 or 600 houſes, and about 5,000 inhabitants, including free people of colour. It is the reſidence of the governor or commander in chief, who is accommodated with a magnificent palace. Here the legiſlature ſits, and the court of chancery and the ſupreme judicial courts are held.—*ib.*

SPARHAWK's *Point*, on the northern ſhore of Piſcataqua river, abreaſt of which ſhips can anchor in 9 fathoms.—*ib.*

SPARTA, a poſt-town of New-Jerſey, Suſſex county, 117 miles from Philadelphia.—*ib.*

SPARTANBURGH, a county of Pinckney diſtrict, formerly in that of Ninety-Six, S. Carolina, containing 8,800 inhabitants, of whom 7,907 are whites, and 866 ſlaves. It ſends two repreſentatives, and one ſenator, to the State legiſlature. The court-houſe is 30 miles from Pinckney, 35 from Greenville, and 746 from Philadelphia.—*ib.*

SPEAR, *Cape*, on the E. ſide of Newfoundland Iſland, is about 3 or 4 miles S. E. by S. from St John's. The extreme breadth of the iſland extends from this Cape to Anguille, on the W. ſide. N. lat. 47 32, W. long. 52 15.—*ib.*

SPECIES, in algebra, are the letters, ſymbols, marks, or characters, which repreſent the quantities in any operation or equation.

SPECIES, in optics, the image painted on the retina by the rays of light reflected from the ſeveral points of the ſurface of an object, received in by the pupil, and collected in their paſſage through the cryſtalline, &c.

SPECTACLES (See *Encycl.*) are certainly the moſt valuable of all optical inſtruments, though there is not the ſame ſcience and mechanical ingenuity diſplayed in the making of them as in the conſtruction of microſcopes and teleſcopes. A man, eſpecially if accuſtomed to ſpend his time among books, would be much to be pitied, when his ſight begins to fail, could he not, in a great meaſure, reſtore it by the aid of ſpectacles; but there are ſome men whoſe ſight cannot be aided by the uſe either of convex or concave glaſſes. The following method adopted by one of theſe to aid his ſight is certainly worthy of notice:

When about ſixty years of age, this man had almoſt entirely loſt his ſight, ſeeing nothing but a kind of thick miſt, with little black ſpecks which appeared to float in the air. He knew not any of his friends, he could not even diſtinguiſh a man from a woman, nor could he walk in the ſtreets without being led. Glaſſes were of no uſe to him; the beſt print, ſeen through the beſt ſpectacles, ſeemed to him like a daubed paper. Wearied with this melancholy ſtate, he thought of the following expedient.

He procured ſome ſpectacles with very large rings; and, taking out the glaſſes, ſubſtituted in each circle a conic tube of black Spaniſh copper. Looking through the large end of the cone he could read the ſmalleſt print placed at its other extremity. Theſe tubes were of different lengths, and the openings at the end were alſo of different ſizes; the ſmaller the aperture the better could he diſtinguiſh the ſmalleſt letters; the larger the aperture the more words or lines it commanded; and conſequently the leſs occaſion was there for moving the head and the hand in reading. Sometimes he uſed one eye, ſometimes the other, alternately relieving each, for the rays of the two eyes could not unite upon the ſame object when thus ſeparated by two opaque tubes. The thinner theſe tubes, the leſs troubleſome are they. They muſt be totally blackened within ſo as to prevent all ſhining, and they ſhould be made to lengthen or contract, and enlarge or reduce the aperture at pleaſure.

When he placed convex glaſſes in theſe tubes, the letters indeed appeared larger, but not ſo clear and diſtinct as through the empty tube: he alſo found the tubes more convenient when not fixed in the ſpectacle rings; for when they hung looſely they could be raiſed or lowered with the hand, and one or both might be uſed as occaſion required. It is almoſt needleſs to add, that the material of the tubes is of no importance, and that they may be made of iron or tin as well as of copper, provided the inſides of them be ſufficiently blackened. See *La Nouvelle Bigarure* for February 1754, or *Monthly Magazine* for April 1799.

SPECTRE of the Broken, a curious phenomenon obſerved on the ſummit of the *Broken*, one of the Harz mountains in Hanover. We have the following account of it by M. Haue. "After having been here (ſays he) for the thirtieth time, and having procured information reſpecting the abovementioned atmoſpheric phenomenon, I was at length, on the 23d of May 1797, ſo fortunate as to have the pleaſure of ſeeing it; and perhaps my deſcription may afford ſatisfaction to others who viſit the Broken through curioſity. The ſun roſe about four o'clock, and, the atmoſphere being quite ſerene towards the eaſt, his rays could paſs without any obſtruction over the Heinrichſhöhe. In the ſouth-weſt, however, towards Achtermannſhöhe, a briſk weſt wind carried before it thin tranſparent vapours, which were not yet condenſed into thick heavy clouds.

"About a quarter paſt four I went towards the inn, and looked round to ſee whether the atmoſphere would permit me to have a free proſpect to the ſouth weſt; when I obſerved, at a very great diſtance towards Achtermannſhöhe, a human figure of a monſtrous ſize. A violent guſt of wind having almoſt carried away my hat, I clapped my hand to it by moving my arm towards my head, and the coloſſal figure did the ſame.

"The pleaſure which I felt on this diſcovery can hardly be deſcribed; for I had already walked many a weary ſtep in the hopes of ſeeing this ſhadowy image, without being able to gratify my curioſity. I immediately made another movement by bending my body, and the coloſſal figure before me repeated it. I was deſirous of doing the ſame thing once more—but my coloſſus had vaniſhed. I remained in the ſame poſition, waiting to ſee whether it would return: and in a few minutes it again made its appearance on the Achtermannſhöhe. I paid my reſpects to it a ſecond time, and it did the ſame to me. I then called the landlord of the Broken; and having both taken the ſame poſition which I had taken alone, we looked towards the Achtermannſhöhe, but ſaw nothing. We had not, however, ſtood long, when two ſuch coloſſal figures were formed over the above eminence, which repeated our compliments by bending their bodies as we did; after which they vaniſhed. We retained our poſition; kept our eyes fixed on the ſame ſpot, and in a little the two figures again ſtood before us, and were joined by a third. Every movement that we made by bending our bodies theſe figures imitated—but with this difference, that the phenomenon was ſometimes weak and faint, ſometimes ſtrong and well defined. Having thus had an opportunity of diſcovering the whole ſecret of this phenomenon, I can give the following information to ſuch of my readers as may be deſirous of ſeeing it themſelves. When the riſing ſun, and according to analogy the caſe will be the ſame at the ſetting ſun, throws his rays over the Broken upon the body of a man ſtanding oppoſite to fine light clouds floating around or hovering paſt him, he needs only fix his eyes ſtedfaſtly upon them, and, in all probability, he will ſee the ſingular ſpectacle of his own ſhadow extending to the length of five or ſix hundred feet, at the diſtance of about two miles before him."

If our memory does not deceive us, there is in one of the volumes of the *Mancheſter Tranſactions* an account of a ſimilar phenomenon obſerved by Dr Ferrier, on a hill ſomewhere in England.

SPECULUM for reflecting teleſcopes. Under this title (*Encycl.*) we have given the compoſition of the mixt metal of which it has been found by experience that the beſt ſpeculums are made; we have likewiſe given, under the ſame title, ſome directions for caſting ſpeculums: but owing to a circumſtance in which the public can take no intereſt, we neglected to give directions for grinding and poliſhing them, and omitted ſome other circumſtances, which, though not ſo important as theſe, are certainly worthy of notice. Theſe omiſſions it is the object of this article to ſupply.

When the metal is taken out of the flaſks (See n° 3. of the article referred to), which it ſhould be as ſoon as it has become ſolid, and while it is yet red-hot, care muſt be taken to keep the face downwards to prevent it from ſinking. Holding it in that poſition by the git, force out the ſand from the hole in the middle of the mirror with a piece of wood or iron, and place the ſpeculum in an iron pot, with a large quantity of hot aſhes or ſmall coals, ſo as to bury the ſpeculum in them a ſufficient depth. If the ſand is not forced out of the hole in the manner above directed, the metal, by ſinking as it cools, will embrace the ſand in the middle of the ſpeculum ſo tight, as to cauſe it to crack before it becomes entirely cold. And if the metal is not taken out of the ſand, and put in a pot with hot aſhes or coals to anneal it, the moiſture from the ſand will always break the metal. Let the ſpeculum remain in the aſhes till the whole is become quite cold. The git may be eaſily taken off by marking it round with a common fine half round file, and giving it then a gentle blow. The metal is then to be rough ground and figured.

It may be proper, however, before we proceed to deſcribe that proceſs, to give an account of another compoſition for the ſpeculum of a reflecting teleſcope, which

which has been employed with great ſucceſs, by Rochon director of the marine obſervatory at Breſt. Of this compoſition the principal ingredient is platinum; which, in grains, muſt be purified in a ſtrong fire by means of nitre and the ſalt of glaſs, or that flux which in the Engliſh glaſs-houſes is called by the workmen *ſandiſer*. To the platinum, when purified, add the eighth part of the metal employed in the compoſition of common ſpecula: for tin without red copper would not produce a good effect. This mixture is then to be expoſed to the moſt violent heat, which muſt be ſtill excited by the oxygen gas that diſengages itſelf from nitre when thrown into the fire. One melting would be inſufficient: five or ſix are requiſite to bring the mixture to perfection. It is neceſſary that the metal ſhould be in a ſtate of complete fuſion at the moment when it is poured into the mould. By this proceſs I have been enabled (ſays our author) to conſtruct a teleſcope with platinum, which magnifies the diameters of objects five hundred times, with a degree of clearneſs and diſtinctneſs requiſite for the niceſt obſervations. The large ſpeculum of platinum weighs fourteen pounds: it is eight inches in diameter, and its focus is ſix feet. Though the high price of platinum will, in all probability, for ever prevent it from coming into general uſe for the ſpeculums of teleſcopes, we thought it proper to notice this diſcovery, and ſhall now proceed to the grinding of the ſpeculum.

For the accompliſhing of this object, a very complicated proceſs is recommended in Smith's Optics, and one not much more ſimple by Mr Mudge in the 67th volume of the *Philoſophical Tranſactions*; but according to Mr Edwards, whoſe ſpeculums are confeſſedly the beſt, neither of theſe is neceſſary. Beſides a common grindſtone, all the tools that he made uſe of are a rough grinder, which ſerves alſo as a poliſher, and a bed of hones. When the ſpeculum was cold, he ground its ſurface bright on a common grindſtone, previouſly brought to the form of the gage; and then took it to the rough grinder.

This tool is compoſed of a mixture of lead and tin, or of pewter, and is made of an elliptical form, of ſuch dimenſions, that the ſhorteſt diameter of the ellipſe is equal to the diameter of the mirror or ſpeculum, and the longeſt diameter is to the ſhorteſt in the proportion of ten to nine. This rough grinder may be fixed upon a block of wood, in order to raiſe it higher from the bench; and as the metal is ground upon it with fine emery, Mr Mudge, with whom, in this particular, Mr Edwards agrees, directs a hole or pit to be made in the middle of it as a lodgement for the emery, and deep grooves to be cut out acroſs its ſurface with a graver for the ſame purpoſe. By means of a handle, fixed on the back of the metal with ſoft cement, the ſpeculum can be whirled round upon this grinder ſo rapidly, that a common labourer has been known to give a piece of metal, four inches in diameter, ſo good a face and figure as to fit it for the hones in the ſpace of two hours. The emery, however fine, will break up the metal very much; but that is remedied by the ſubſequent proceſſes of honing and poliſhing.

When the metal is brought to a true figure, it muſt be taken to a convex tool, formed of ſome ſtones from a place called Edgedon in Shropſhire, ſituated between Ludlow and Biſhop's Caſtle. The common blue hones, uſed by many opticians for this purpoſe, will ſcarcely touch the metal of Mr Edwards's ſpeculums; but where they muſt be employed for want of the others, as little water ſhould be uſed as poſſible when the metal is put upon them; becauſe it is found by experience that they cut better when but barely wet, than when drenched with water. The ſtones, however, from Edgedon are greatly preferable; for they cut the metal more eaſily, and having a very fine grain, they bring it to a ſmooth face. Theſe ſtones are directed by Mr Mudge to be cemented in ſmall pieces upon a thick round piece of marble, or of metal made of tin and lead like the former compoſition, in ſuch a manner, that the lines between the ſtones may run ſtraight from one ſide to the other; ſo that placing the teeth of a very fine ſaw in each of theſe diviſions, they may be cleared from one end to the other of the cement which riſes between the ſtones. As ſoon as the hones are cemented down, this tool muſt be fixed in the lathe, and turned as exactly true to the gage as poſſible. It ſhould be of a circular figure, and but very little larger than the metal intended to be figured upon it. If it be made conſiderably larger, it will grind the metal into a larger ſphere and a bad figure; and if it be made exactly of the ſame ſize, it will work the metal indeed into a figure truly ſpherical, but will be apt to ſhorten its focus, unleſs the metal and tool be worked alternately upwards. On theſe accounts, Mr Edwards recommends it to be made about one twentieth part longer in diameter than the ſpeculum, becauſe he has found that it does not then alter its focus; and he earneſtly diſſuades the uſe of much water on the hone pavement at the time of uſing it, otherwiſe, he ſays, that the metal in different parts of it will be of different degrees of brightneſs.

When the metal is brought to a very fine face and figure by the bed of ſtones, it is ready to receive a poliſh, which is given to it by the elliptical rough grinder covered with pitch. With reſpect to the conſiſtency of this pitch, Mr Mudge and Mr Edwards give very different directions. Whilſt the former ſays that it ſhould be neither too hard nor too ſoft, the latter affirms that the harder the pitch is, the better figure it will give to the metal. Pitch may be eaſily made of a ſufficient hardneſs by adding a proper quantity of roſin; and when it is hardened in this way, it is not ſo brittle as pitch alone, which is hardened by boiling. Mr Edwards adviſes to make the mixture juſt ſo hard as to receive, when cold, an impreſſion from a moderate preſſure of the nail of one's finger. When the elliptical tool is to be covered with this mixture, it muſt be made pretty warm, and in that ſtate have the mixture poured upon it when beginning to cool in the crucible. Our author recommends this coating to be made every where of about the thickneſs of half-a-crown; and to give it the proper form, it muſt, when ſomewhat cool, be preſſed upon the face of the mirror, which has firſt been dipped in cold water, or covered over with very fine writing paper. If it be not found to have taken the exact figure from the firſt preſſure, the ſurface of the pitch muſt be gently warmed, and the operation repeated as before. All the ſuperfluous pitch is now to be taken away from the edge of the poliſher with a penknife, and a hole to be made in the middle, accurately round, with a conical piece of wood. This hole ſhould go quite through the tool, and ſhould be made of the

ſame

ſame ſize, or ſomewhat leſs than the hole in the middle of the ſpeculum. Mr Edwards ſays, that he has always found that ſmall mirrors, though without any hole in the middle, poliſh much better, and take a more correct figure, for the poliſher's having a hole in the middle of it.

The poliſher being thus formed, it muſt be very gently warmed at the fire, and divided into ſeveral ſquares by the edge of a knife. Theſe, by receiving the ſmall portion of metal that works off in poliſhing, will cauſe the figure of the ſpeculum to be more correct than if no ſuch ſquares had been made. Mr Mudge directs the poliſher to be ſtrewed over with very fine *putty*; but Mr Edwards prefers Colcothar of vitriol. (See that article, *Encycl.*) Putty (ſays he) gives metals a white luſtre, or, as workmen call it, a ſilver hue; but good colcothar of vitriol will poliſh with a very fine and high black luſtre, ſo as to give the metal finiſhed with it the complection of poliſhed ſteel. To know if the colcothar of vitriol is good, put ſome of it into your mouth, and if you find it diſſolves away it is good; but if you find it hard, and crunch between your teeth, then it is bad, and not well burned. Good colcothar of vitriol is of a deep red, or of a deep purple colour, and is ſoft and oily when rubbed between the fingers; bad colcothar of vitriol is of a light red colour, and feels harſh and gritty. The colcothar of vitriol ſhould be levigated between two ſurfaces of poliſhed ſteel, and wrought with a little water; when it is worked dry, you may add a little more water, to carry it lower down to what degree you pleaſe. When the colcothar of vitriol has been wrought dry three or four times, it will acquire a black colour, and will be low enough, or ſufficiently fine, to give an exquiſite luſtre. This levigated colcothar of vitriol muſt be put into a ſmall phial, and kept with ſome water upon it. When it is to be uſed, every part of the pitch-poliſher muſt be firſt bruſhed over with a fine camel's hair bruſh, which has been dipped in pure water, and rubbed gently over a piece of dry clean ſoap. The waſhed colcothar of vitriol is then to be put upon the poliſher; and Mr Edwards directs a large quantity of it to be put on at once, ſo as to ſaturate the pitch, and form a fine coating. If a ſecond or third application of this powder be found neceſſary, it muſt be uſed very ſparingly, or the poliſh will be deſtroyed which has been already attained. When the metal is nearly poliſhed, there will always appear ſome black mud upon its ſurface, as well as upon the tool. Part of this muſt be wiped away with ſome very ſoft waſh leather; but if the whole of it be taken away, the poliſhing will not be ſo well completed.

With reſpect to the *parabolic figure* to be given to the mirror, Mr Edwards aſſures us, that a very little experience in theſe matters will enable any one to give it with certainty, by poliſhing the ſpeculum in the common manner, only with croſs ſtrokes in every direction, upon an elliptical tool of the proper dimenſions.

SPEIGHT's-TOWN, on the W. ſhore of the iſland of Barbadoes, towards the N. part; formerly much reſorted to by ſhips from Briſtol, and from thence called Little Briſtol; but moſt of the trade is now removed to Bridgetown. It is in St Peter's pariſh, having Sandy Fort, and Margaret's Fort, about a mile S. and Haywood's Fort on the N. at half the diſtance. N. lat. 10 9, W. long. 59 21.—*Morſe*.

SPENCER, a flouriſhing townſhip in Worceſter county, Maſſachuſetts, taken from Leiceſter, and incorporated in 1753, and contains 1322 inhabitants, and lies 11 miles ſouth-weſtward of Worceſter, on the poſt-road to Springfield, and 58 S. W. of Boſton.—*ib.*

SPESUTIE, a ſmall iſland at the head of Cheſapeak Bay.—*ib.*

SPINDLE, in geometry, a ſolid body generated by the revolution of ſome curve line about its baſe or double ordinate: in oppoſition to a conoid, which is generated by the rotation of the curve about its axis or abſciſs, perpendicular to its ordinate. The ſpindle is denominated circular, elliptic, hyperbolic, or parabolic, &c. according to the figure of its generating curve.

Spindle, in mechanics, ſometimes denotes the axis of a wheel, or roller, &c. and its ends are the pivots.

SPINNING machine. The ancient Greeks were not, like the modern philoſophers, unwilling to acknowledge their obligations to Providence for all the comforts and enjoyments of life, nor felt pride in deriving every thing from their own talents. They were even diſpoſed to think that thoſe very talents were inſpired. Their firſt inſtructors, the poets, gave to Apollo the honour of that power of invention and imagination by which they inſtructed and charmed their admiring hearers. The propheteſs dictated her oracles, the poet ſung his enraptured ſtrain only when inſpired. The happy thought of twining a thread, and working it into a blanket, when viewed by that ingenious and acutely ſenſible people in all its importance, as the protector of the human race from the ſeverity of the weather, ſeemed a preſent from heaven, as the inſpiration of a divinity; and the diſtaff and the loom were Minerva's firſt title to a ſeat among the great gods on Olympus.

We are much inclined to be of the ſame opinion. When we obſerve, that in all the countries which have been diſcovered by the navigators of the three laſt centuries, the diſtaff and ſpindle, and the needle, have been found, we own ourſelves much diſpoſed to think that they are the reſults of inſtinct. Our inſtincts are not all ſimple and blind, like that which directs the new-born animal to the breaſt of its mother without knowing why. We have inſtincts of intellect as well as of appetite; and the logic of common converſation is an example of many ſuch. We doubt not but that the noble-minded inhabitants of Pelew would have worſhipped as a divinity an Engliſh maiden with her ſpinning wheel and fly. Surely he who ſhould carry them this homely but ingenious machine, and a potter's wheel, would do them more ſervice than if he taught them all the ſcience of a Newton, with all the philoſophy of the 18th century into the bargain. We do not know, except perhaps the ſteam engine, any mechanical invention that has made ſuch amazing addition to the activity and induſtry and opulence of this highly favoured iſland, as the invention of Mr Arkwright for ſpinning by water, where dead matter is made to perform all that the niceſt finger can do when directed by the never-ceaſing attention of the intelligent eye. Minerva has the undiſputed honours of the diſtaff and ſpindle. We know not to what benefactor we owe the fly-wheel. Mr Arkwright has the honour of combining them both, and inſpiring them with his own ſpirit; for we may truly ſay of the contrivance which pervades the wonderful machinery of a cotton mill,

Totoſque infuſa per artus
Mens agitat molem et magno ſe corpore miſcet.

To give an intelligible and accurate deſcription of a cotton mill would be abundant employment for a volume. Our limits admit of nothing like this; but as we are certain that many of our readers have viewed a cotton mill with wonder, but not with intelligence, nor with leiſure to trace the ſteps by which the wool from the bag ultimately aſſumes the form of a very fine thread. Bewildered by ſuch a complication of machinery, all in rapid motion, very few, we imagine, are able to recollect with diſtinctneſs and intelligence the eſſential part of the proceſs by which the form of the cotton is ſo wonderfully changed. Such readers will not think a page or two miſemployed, if they are thereby able to underſtand this particular, to which all the reſt of the proceſs is ſubſervient.

We paſs over the operation of carding, by which all the clots and inequalities of the cotton wool are removed, and the whole is reduced to an uniform thin fleece, about 20 inches broad. This is gradually detached from the finiſhing card, and, if allowed to hang down from it, would pile up on the floor as long as the mill continues to work; but it is guided off from the card, very tenderly, in a horizontal direction, by laying its detached end over a roller, which is ſlowly turned round by the machine. Another roller lies above the fleece, preſſing it down by its weight. By this preſſure, a gentle hold is taken of the fleece, and therefore the ſlow motion of the rollers draws it gently from the card at the ſame rate as it is diſengaged by the comb; but between the card and the rollers a ſet of ſmooth pins are placed in two rows, leading from the card to the rollers, and gradually approaching each other as we approach the rollers. By theſe pins the broad fleece is hemmed in on both ſides, and gradually contracted to a thick roll; and in this ſtate paſſes between the rollers, and is compreſſed into a pretty firm flat riband, about two inches broad, which falls off from the rollers, and piles up in deep tinplate cans ſet below to receive it.

Spinning Machine.

It is upon this ſtripe or riband of cotton wool that the operation of ſpinning begins. The general effect of the ſpinning proceſs is to draw out this maſſive roll, and to twiſt it as it is drawn out. But this is not to be done by the fingers, pulling out as many cotton fibres at once as are neceſſary for compoſing a thread of the intended fineneſs, and continuing this manipulation regularly acroſs the whole end of the riband, and thus, as it were, nibbling the whole of it away. The fingers muſt be directed, for this purpoſe, by an attentive eye. But in performing this by machinery, the whole riband muſt be drawn out together, and twiſted as it is drawn. This requires great art, and very delicate management. It cannot be done at once; that is, the cotton roll cannot firſt be ſtretched or drawn out to the length that is ultimately produced from a tenth of an inch of the roll, and then be twiſted. There is not coheſion enough for this purpoſe: we ſhould only break off a bit of the roll, and could make no farther uſe of it. The fibres of cotton are very little implicated among each other in the roll, becauſe the operation of carding has laid them almoſt parallel in the roll; and though compreſſed a little by its contraction from a fleece of 20 inches to a riband of only 2, and afterwards compreſſed between the diſcharging rollers of the carding machine, yet they cohere ſo ſlightly, that a few fibres may be drawn out without bringing many others along with them. For theſe reaſons, the whole thickneſs and breadth of two or three inches of the riband is ſtretched to a very minute quantity, and then a very ſlight degree of twiſt is given it, viz. about three turns in the inch; ſo that it ſhall now compoſe an extremely ſoft and ſpungy cylinder, which cannot be called a thread or cord, becauſe it has ſcarcely any firmneſs, and is merely rounder and much ſlenderer than before, being ſtretched to about thrice its former length. It is now called ſlab, or roove.

Although it be ſtill extremely tender, and will not carry a weight of two ounces, it is much more coheſive than before, becauſe the twiſt given to it makes all the longitudinal fibres bind each other together, and compreſs thoſe which lie athwart; therefore it will require more force to pull a fibre from among the reſt, but ſtill not nearly enough to break it. In drawing out a ſingle fibre, others are drawn out along with it; and if we take hold of the whole aſſemblage, in two places, about an inch or two inches aſunder, we ſhall find that we may draw it to near twice its length without any riſk of its ſeparating in any intermediate part, or becoming much ſmaller in one part than another. It ſeems to yield equably over all.

Such is the ſtate of the ſlab or roove of the firſt formation. It is uſually called the *preparation*; and the operation of ſpinning is conſidered as not yet begun. This preparation is the moſt tedious, and requires more attendance and hand labour than any ſubſequent part of the proceſs. For the ſtripes or ribands from which it is made are ſo light and bulky, that a few yards only can be piled up in the cans ſet to receive them. A perſon muſt therefore attend each thread of ſlab, to join freſh ſtripes as they are expended. It is alſo the moſt important in the manufacture; for as every inch of the ſlab meets with preciſely the ſame drawing and the ſame twiſting in the ſubſequent parts of the proceſs, therefore every inequality and fault in the ſlab (indeed in the fleece as it quits the finiſhing card) will continue through the whole manufacture. The ſpinning of cotton yarn now divides into two branches. The firſt, performed by what are called *jennies*, perfectly reſembles the ancient ſpinning with the diſtaff and ſpindle; the other, called *ſpinning of twiſt*, is an imitation of the ſpinning with the fly-wheel. They differ in the ſame manner as the ſpinning with the old wool or cotton-wheel differs from the ſpinning with the flax-wheel. Mr Arkwright's chief invention, the ſubſtitution of machinery for the immediate work of the human finger, is ſeen only in the manufacture of twiſt. We ſhall therefore confine our attention to this.

The reſt of the proceſs is little more than a repetition of that gone through in making the firſt ſlab or roove. It is formed on bobins. Theſe are ſet on the back part of the drawing frame; and the end of the ſlab is brought forwards toward the attending workman. As it comes forward, it is ſtretched or drawn to about $\frac{4}{3}$ of its former length, or lengthened $\frac{1}{3}$; and is then twiſted about twice as much as before, and in this ſtate wound up on another bobin. In ſome mills two rooves, after having been properly drawn, are brought together through one hole, and twiſted into one; but we believe that, in the greater number of mills,

mills, this is deferred to the ſecond drawing. It is only after the firſt drawing that the produce of the operation gets the name of *ſlab*; before this it is called *preparation*, or *roove*, or by ſome other name. The ſlab is ſtill a very feeble, ſoft, and delicate yarn, and will not carry much more weight than it did before in the form of roove. The perfection of the ultimate thread or yarn depends on this extreme ſoftneſs; for it is this only which makes it ſuſceptible of an equable ſtretching; all the fibres yielding and ſeparating alike.

The next operation is the *ſecond drawing*, which no way differs from the firſt, except in the different proportions of the lengthening, and the proportion between the lengthening and the ſubſequent twiſt. On theſe points we cannot give any very diſtinct information. It is different in different mills, and with different ſpecies of cotton wool, as may be eaſily imagined. The immediate mechaniſm or manipulation muſt be ſkilfully accommodated to the nature of that friction which the fibres of cotton exert on each other, enabling one of them to pull others along with it. This is greatly aided by the contorted curled form of a cotton fibre, and a conſiderable degree of elaſticity which it poſſeſſes. In this reſpect it greatly reſembles woollen fibres, and differs exceedingly from thoſe of flax: and it is for this reaſon that it is ſcarcely poſſible to ſpin flax in this way: its fibres become lank, and take any ſhape by the ſlighteſt compreſſion, eſpecially when damp in the ſlighteſt degree. But beſides this, the ſurface of a cotton fibre has a harſhneſs or roughneſs, which greatly augments their mutual friction. This is probably the reaſon why it is ſo unfit for tents and other dreſſings for wounds, and is refuſed by the ſurgeon even in the meaneſt hoſpitals. But this harſhneſs and its elaſticity fit it admirably for the manufacture of yarn. Even the ſhortneſs of the fibre is favourable; and the manufacture would hardly be poſſible if the fibre were thrice as long as it generally is. If it be juſt ſo long that in the finiſhed thread a fibre will rather break than come out from among the reſt, it is plain that no additional length can make the yarn any ſtronger with the ſame degree of compreſſion by twining. A longer fibre will indeed give the ſame firmneſs of adherence with a ſmaller compreſſion. This would be an advantage in any other yarn; but in cotton yarn the compreſſion is already as ſlight as can be allowed; were it leſs, it would become woolly and rough by the ſmalleſt uſage, and is already too much diſpoſed to teazle out. It can hardly be uſed as ſewing thread. Now ſuppoſe the fibres much longer; ſome of them may chance to be ſtretched along the ſlab through their whole length. If the ſlab is pulled in oppoſite directions, by pinching it at each end of ſuch fibres, it is plain that it will not ſtretch till this fibre be broken or drawn out; and that while it is in its extended ſtate, it is acting on the other fibres in a very unequable manner, according to their poſitions, and renders the whole apt to ſeparate more irregularly. This is one great obſtacle to the ſpinning of flax by ſimilar machinery; and it has hitherto prevented (we believe) the working up of any thing but the *ſhorts* or tow, which is ſeparated from the long fine flax in the operation of hatcheling.

A third, and ſometimes even a fourth, drawing is given to the ſlab formed on the bobins of this ſecond operation. The ſlab produced is now a ſlender, but ſtill extremely ſoft cord, ſuſceptible of conſiderable extenſion, without riſk of ſeparation, and without the ſmalleſt chance of breaking a ſingle fibre in the attempt. In one or more of the preparatory drawings now deſcribed, two, and ſometimes three ſlabs, of a former drawing, are united before the twiſt is given them. The practice is different in different mills. It is plain, that unleſs great care be taken to preſerve the ſlab extremely ſoft and compreſſible during the whole proceſs, the ſubſequent drawing becomes more precarious, and we run a riſk of at laſt making a bad and looſe thread inſtead of a uniform and ſimple yarn. Such a thread will have very little lateral connection, and will not bear much handling without ſeparating into ſtrands. The perfection of the yarn depends on having the laſt ſlab as free of all appearance of ſtrands as poſſible.

The laſt operation is the ſpinning this ſlab. This hardly differs from the foregoing drawings in any thing but the twiſt that is given it after the laſt ſtretching in its length. This is much greater than any of the preceding, being intended to give the yarn hardneſs and firmneſs, ſo that it will now break rather than ſtretch any more.

The reader, moderately acquainted with mechanics, cannot but perceive that each of the operations now deſcribed, by which the roove is changed into the ſoft ſlab, and each of theſe into one ſlenderer and ſomewhat firmer, by alternately teazling out and twining the ſoft cord, is a ſubſtitute for a ſingle pull of the finger and thumb of the ſpinſter, which ſhe accommodates preciſely to the peculiar condition of the lock of wool which ſhe touches at the moment. She can follow this through all its irregularities; and perhaps no two ſucceeding plucks are alike. But when we cannot give this momentary attention to every minute portion, we muſt be careful to introduce the roove in a ſtate of perfect uniformity; and then every inch being treated in the ſame manner, the final reſult will be equable—the yarn will be uniform.

We are now to deſcribe the mechaniſm by which all this is effected. But we do not mean to deſcribe a cotton mill; we only mean to deſcribe what comes into immediate contact with the thread; and in ſo doing, to confine ourſelves to what is neceſſary for making the reader perceive its ability to perform the required taſk. We ſee many caſes where individuals can apply this knowledge to uſeful purpoſes. More than this would, we think, be improper, in a national point of view.

Pl
XI

Let ABC repreſent the ſection of a roller, whoſe pivot D does not turn in a pivot hole, but in the bottom of a long narrow notch DE, cut in an iron ſtandard. *a b c* is the ſection of another iron roller, whoſe pivot *d* is in the ſame notches at each end, while the roller itſelf lies or reſts on the roller ABC below it. The ſurfaces of theſe rollers are fluted lengthwiſe like a column: only the flutings are very ſmall and ſharp, like deep ſtrokes of engraving very cloſe together. It is plain, that if the roller ABC be made to turn ſlowly round its axis by machinery, in the direction ABC (as expreſſed by the dart), the roughneſs of the flutings will take hold of the ſimilar roughneſs of the upper roller *a b c*, and carry it round alſo in the direction of the dart, while its pivots are engaged in the notches DE, which they cannot quit. If therefore we introduce the end F of the cotton ſtring or riband, Spinning Machine.

band, formed by the carding machine, it will be pulled in by this motion, and will be delivered out on the other ſide at H, conſiderably compreſſed by the weight of the upper roller, which is of iron, and is alſo preſſed down by a lever which reſts on its pivots, or other proper places, and is loaded with a weight. There is nothing to hinder this motion of the riband thus compreſſed between the rollers, and it will therefore be drawn thro' from the cans. The compreſſed part at H would hang down, and be piled up on the floor as it is drawn through; but it is not permitted to hang down in this manner, but is brought to another pair of ſharp fluted iron rollers K and L. Suppoſing this pair of rollers to be of the ſame diameter, and to turn round in the ſame time, and in the ſame direction with the rollers ABC, *a b c*; it is plain that K and L drag in the compreſſed riband at I, and would deliver it on the other ſide at M, ſtill more compreſſed. But the roller K is made (by the wheelwork) to turn round more ſwiftly than ABC. The difference of velocity at the ſurface of the rollers is, however, very ſmall, ſeldom exceeding one part in 12 or 15. But the conſequence of this difference is, that the ſkein of cotton HI will be lengthened in the ſame proportion; for the upper rollers preſſing on the under ones with a conſiderable force, their ſharp flutings take good hold of the cotton between them; and ſince K and L take up the cotton faſter than ABC, and *a b c* deliver it out, it muſt either be forcibly pulled through between the firſt rollers, or it muſt be ſtretched a little by the fibres ſlipping among each other, or it muſt break. When the extenſion is ſo very moderate as we have juſt now ſaid, the only effect of it is merely to begin to draw the fibres (which at preſent are lying in every poſſible direction) into a more favourable poſition for the ſubſequent extenſions.

The fibres being thus drawn together into a more favourable poſition, the cotton is introduced between a third pair of rollers O, P, conſtructed in the ſame way, but ſo moved by the wheelwork that the ſurface of O moves nearly or fully twice as faſt as the ſurface of K. The roller P being alſo well loaded, they take a firm hold of the cotton, and the part between K and O is nearly or fully doubled in its length, and now requires a little twining to make it roundiſh, and to conſolidate it a little.

It is therefore led ſloping downwards into a hole or eye in the upper pivot of the firſt fly, called a *jack*. This turns round an upright axis or ſpindle; the lower end of which has a pulley on it to give it motion by means of a band or belt, which paſſes round a drum that is turned by the machinery. This jack is of a very ingenious and complicated conſtruction. It is a ſubſtitute for the fly of the common ſpinning wheel. If made preciſely in the form of that fly, the thread, being ſo very bulky and ſpongy, and unable to bear cloſe packing on the bobin, would ſwag out by the whirling of the fly, and would never coil up. The bobin therefore is made to lie horizontally; and this occaſions the complication, by the difficulty of giving it a motion round a horizontal axis, in order to coil up the twiſted roove. Mr Arkwright has accompliſhed this in a very ingenious manner; the eſſential circumſtances of which we ſhall here briefly deſcribe. A is a roller of hard wood, having its ſurface cut into ſharp flutes longitudinally. On the axis, which projects through the ſide of the general frame, there is a pulley P, connected by a band with another pulley Q, turning with the horizontal axis QR. This axis is made to turn by a contrivance which is different in every different cotton mill. The ſimpleſt of all is to place above the pulley C (which is turned by the great band of the machinery, and thus gives motion to the jack), a thin circular diſc D, looſe upon the axis, ſo as to turn round on it without obſtruction. If this diſc exceed the pulley in breadth about $\frac{1}{10}$th of an inch, the broad belt which turns the pulley will alſo turn it; but as its diameter is greater than that of the pulley, it will turn ſomewhat ſlower, and will therefore have a relative motion with reſpect to the axis QR. This can be employed, in order to give that axis a very ſlow motion, ſuch as one turn of it for 20 or 30 of the jack. This we leave to the ingenuity of the reader. The bobin B, on which the roove is to be coiled up, lies on this roller, its pivots paſſing through upright ſlits in the ſides of the general frame. It lies on A, and is moved round by it, in the ſame manner as the uppermoſt of a pair of drawing rollers lies on the under one, and receives motion from it. It is evident that the fluted ſurface of A, by turning ſlowly round, and carrying the weight of the bobin, compreſſes a little the cotton that is between them; and its flutings, being ſharp, take a ſlight hold of it, and cauſe it to turn round alſo, and thus coil up the roove, pulling it in through the hole E in the upper pivot (which reſembles the fore pivot or eye of a ſpinning wheel fly) in ſo gentle a manner as to yield whenever the motion of the bobin is too great for the ſpeed with which the cotton ſkein is diſcharged by the rollers O and P.—*N. B.* The axis QR below, alſo gives motion to a guide within the jack, which leads the roove gradually from one end of the bobin to the other, and back again, ſo as to coil it with regularity till the bobin is full. The whole of this internal mechaniſm of the jack is commonly ſhut up in a tin cylinder. This is particularly neceſſary when the whirling motion muſt be rapid, as in the ſecond and third drawings. If open, the jacks would meet with much reſiſtance from the air, which would load the mill with a great deal of uſeleſs work.

The reader is deſired now to return to the beginning of the proceſs, and to conſider it attentively in its different ſtages. We apprehend that the deſcription is ſufficiently perſpicuous to make him perceive the efficacy of the mechaniſm to execute all that is wanted, and prepare a ſlab that is uniform, ſoft, and ſtill very extenſible; in ſhort, fit for undergoing the laſt treatment, by which it is made a fine and firm yarn.

As this part of the proceſs differs from each of the former, merely by the degree of twiſt that is given to the yarn, and as this is given by means of a fly, not materially different from that of the ſpinning wheel for flax, we do not think it at all neceſſary to ſay any thing more about it.

The intelligent reader is ſurely ſenſible that the yarn produced in this way muſt be exceedingly uniform. The uniformity really produced even exceeds all expectation; for even although there be ſome ſmall inequalities in the carded fleece, yet if theſe are not matted clots, which the card could not equaliſe, and only conſiſt of a little more thickneſs of cotton in ſome places than in others, when ſuch a piece of the ſtripe comes to the firſt roller, it will be rather more ſtretched by the ſecond, and again by the bobin, after the firſt very ſlight twining. That this may be done with greater certainty, the weights of the firſt rooving rollers are made very ſmall, ſo that the middle part of the ſkein can be drawn through, while the outer parts remain faſt held.

We are informed that a pound of the fineſt Bourbon cotton has been ſpun into a yarn extending a few yards beyond 119 miles!

SPIRITU SANTO, a town on the S. ſide of the iſland of Cuba, oppoſite to the N. W. part of the cluſter of iſles and rocks called Jardin de la Reyna, and about 45 miles north-weſterly of La Trinidad. —*Morse*

Spiritu Santo, or *Tampay Bay*, called alſo Hillſborough Bay, lies on the W. coaſt of the peninſula of Eaſt-Florida; has a number of ſhoals and keys at its mouth, and is 9 leagues N. N. W. ¼ W. of Charlotte Harbour, and 56 S. E. by S. ½ E. of the bay of Apalache. N. lat. 27 36, W. long. 82 54.—*ib.*

Spiritu Santo, a town of Brazil in S. America. It is ſituated on the ſea-coaſt in a very fertile country, and has a ſmall caſtle and harbour. S. lat. 20 10, W. long. 41.—*ib.*

Spiritu Santo, a lake towards the extremity of the peninſula of E. Florida; ſouthward from the chain of lakes which communicate with St John's river.—*ib.*

SPLIT ROCK, a rocky point which projects into Lake Champlain, on the W. ſide, about 56 miles N. of Skeenſborough, bears this name. The lake is narrow, and no where exceeding two miles from Skeenſborough to this rock, but here it ſuddenly widens to 5 or 6 miles, and the waters become pure and clear.—*ib.*

SPOTSWOOD, a ſmall town of New-Jerſey, Middleſex county, near the W. ſide of South river, which empties into the Rariton in a S. E. direction. The ſituation is good for extenſive manufactories, and there is already a paper-mill here. It is on the Amboy ſtage-road, 9 miles ſouth eaſt of Brunſwick, and 10 weſt by ſouth of Middleton Point.—*ib.*

SPOTSYLVANIA, a county of Virginia, bounded north by Stafford, and eaſt by Caroline county. It contains 11,252 inhabitants of whom 5,933 are ſlaves. —*ib.*

Elater SPRING, in phyſics, denotes a natural faculty, or endeavour, of certain bodies to return to their firſt ſtate, after having been violently put out of the ſame by compreſſing, or bending them, or the like. This faculty is uſually called by philoſophers *elaſtic force*, or *elaſticity*.

SPRINGFIELD, a townſhip of Vermont, Windſor county, on the W. ſide of Connecticut river, oppoſite to Charleſton, in New-Hampſhire. It has Weathersfield N. and Rockingham on the S. and contains 1,097 inhabitants.—*Morse.*

Springfield, a poſt-town of Maſſachuſetts, Hampſhire county, on the eaſt ſide of Connecticut river; 20 miles S. by E. of Northampton, 97 weſt-ſouth-weſt of Boſton, 28 north of Hartford, and 250 north-eaſt of Philadelphia. The townſhip of Springfield was incorporated in 1635 or 1645. It contains 1574 inhabitants: a Congregational church, a court-houſe, and a number of dwelling-houſes, many of which are both commodious and elegant. The town lies chiefly on one long ſpacious ſtreet, which runs parallel with the river. A ſtream from the hills at the eaſtward of the town, falls into this ſtreet, and forms two branches, which take their courſe in oppoſite directions, one of them running northerly and the other ſoutherly along the eaſtern ſide of the ſtreet, and afford the inhabitants, from one end to the other, an eaſy ſupply of water for domeſtic uſes. Here a conſiderable inland trade is carried on; and there is alſo a paper-mill. The ſuperintendant and ſome of the principal workmen now in the armoury here, were originally manufacturers in Bridgewater, which is famous for its iron-works.—*ib.*

Springfield, a townſhip of New-York, Otſego county, 11 miles N. of Otſego, and between it and the lake of that name. It is 61 miles W. of Albany, has a good ſoil, and increaſes in population.—*ib.*

Springfield, a townſhip of New-Jerſey, Burlington county, of a good ſoil and famed for excellent cheeſe, ſome farmers make 10,000lbs in a ſeaſon. The inhabitants are principally Quakers, who have 3 meeting-houſes. The chief place of the townſhip, where buſineſs is tranſacted, is a village called Job's-town, 10 miles from Burlington, and 18 from Trenton. In this townſhip is a hill, 3 miles in length, called Mount Piſgah, which furniſhes ſtone for building. Here is alſo a grammar ſchool.—*ib.*

Springfield, a townſhip in Eſſex county, New-Jerſey, on Rahway river, which furniſhes fine mill-ſeats; 8 or 10 miles N. W. of Elizabeth-Town. Turf for firing is found here.—*ib.*

Springfield, the name of 4 townſhips of Pennſylvania, viz. in Buck's, Fayette, Delaware, and Montgomery counties.—*ib.*

SPRUCE *Creek*, urges its winding courſe through the marſhes, from the mouth of Piſcataqua river, 5 or 6 miles up into Kittery, in York county, Diſtrict of Maine.—*ib.*

SPURWING, a river of the Diſtrict of Maine, which runs through Scarborough to the weſtward of Cape Elizabeth, and is navigable a few miles for veſſels of 100 tons.—*ib.*

SQUAM, a lake, part of which is in the townſhip of Holderneſs, in Grafton county, New-Hampſhire; but the one half of it is in Strafford county. It is about 5 miles long, and 4 broad.—*ib.*

Squam, a ſhort river of New-Hampſhire, the outlet of the above lake, which runs a ſouth-weſtern courſe, and joins the Pemigewaſſet at the town of New-Cheſter, and 10 miles above the mouth of the Winnepiſeogee branch.—*ib.*

Squam *Beach*, on the ſea-coaſt of New-Jerſey, between Barnegat Inlet and Cranbury New-Inlet.—*ib.*

Squam *Harbour*, on the N. E. ſide of Cape Ann, Maſſachuſetts. When a veſſel at anchor off Newbury-Port Bar, parts a cable and loſes an anchor with the wind at N. E. or E. N. E. if ſhe can carry double-reefed ſails, ſhe may run S. S. E. 5 leagues, which courſe if made good, will carry her a little to the eaſtward of Squam Bay. Squam (*Pidgeon Hill*) lies in lat. 42 40 N. and long. 70 36.—*ib.*

T. SQUARE, or *Tee Square*, an inſtrument uſed in drawing, ſo called from its reſemblance to the capital letter T.

SQUARE HANDKERCHIEF, (Mouchoir Quarre)

re) an iſland of ſome extent in the Weſt-Indies, which lies between lat. 21 5 and 21 24 N. and between long. 70 19 and 70 49 W.—*ib.*

SQUEAUGHETA *Creek*, in New-York, a N. head water of Alleghany river. Its mouth is 19 miles N. W. of the *Ichua Town*.—*ib.*

STAATESBURGH, in New-York ſtate, lies on the eaſt ſide of Hudſon's river, between Khynbeck and Poughkeepſie; about 31 miles ſouth of Hudſon, and 80 northward of New-York city.—*ib.*

STAEBROECK, a town of Dutch Guiana, in South-America, on the eaſt ſide of Demarara river, a mile and a half above the poſt which commands its entrance. It is the ſeat of government and the depoſitory of the records. The ſtation for the ſhipping extends from the fort to about 2 miles above the town. They anchor in a line from 2 to 4 abreaſt.—*ib.*

STAFFORD, a county of Virginia, bounded north by Prince William county, and eaſt by the Patowmac, It contains 9,588 inhabitants, including 4,036 ſlaves. —*ib.*

Stafford, a townſhip of Connecticut, in Tolland county, on the ſouth line of Maſſachuſetts, 12 or 15 miles north-eaſt of Tolland. In this town is a furnace for caſting hollow ware, and a medicinal ſpring, which is the reſort of valetudinarians.—*ib.*

Stafford, *New*, a townſhip of New-Jerſey, in Monmouth county, and adjoining Dover on the ſouth-weſt. It conſiſts chiefly of pine barren land, and contains 883 inhabitants.—*ib.*

STAGE *Iſland*, in the Diſtrict of Maine, lies ſouth of Parker's and Arrowſike iſlands, on the N. ſide of Small Point, conſiſting of 8 acres not capable of much improvement; and is only remarkable for being the firſt land inhabited in New-England, by a civilized people. It is not now inhabited.—*ib.*

STAMFORD, a townſhip of Vermont, in Bennington county, it corners on Bennington to the ſouth-eaſt, and contains 272 inhabitants, and has good intervale land.—*ib.*

Stamford, a poſt-town of Connecticut, Fairfield county, on a ſmall ſtream called Mill river, which empties into Long-Iſland Sound. It contains a Congregational and Epiſcopal church, and about 45 compact dwelling-houſes. It is 10 miles ſouth-weſt of Norwalk; 44 ſouth-weſt of New-Haven; 44 N. E. of New-York; and 139 N. E. of Philadelphia. The townſhip was formerly called *Rippowams*, and was ſettled in 1641.—*ib.*

Stamford, a townſhip of N. York, in Ulſter county, taken from Woodſtock, and incorporated in 1792. Of its inhabitants, 127 are electors.—*ib.*

STANDISH, a townſhip of the Diſtrict of Maine, on the weſt line of Cumberland county, between Preſumſcut and Saco rivers. It was incorporated in 1785, and contains 716 inhabitants; 18 miles N. W. of Portland, and 163 N. of Boſton.—*ib.*

STANFORD, a townſhip of New-York, Dutcheſs county, taken from Waſhington, and incorporated in 1793.—*ib.*

Stanford, the capital of Lincoln county, Kentucky; ſituated on a fertile plain, about 10 miles ſouth-ſouth-eaſt of Danville, 40 ſouth by weſt of Lexington, and 52 ſouth-ſouth-eaſt of Frankfort. It contains a ſtone court-houſe, a gaol, and about 40 houſes.—*ib.*

STANWIX, *Old Fort*, in the ſtate of New-York, is ſituated in the townſhip of Rome, at the head of the navigable waters of Mohawk river. Its foundation was laid in 1759, by Gen Broadſtreet, and built upon, by the troops of the United States, during the late war. The Britiſh made an unſucceſsful attempt to take it in 1777.—*ib.*

STAPELIA, a genus of plants belonging to the claſs pentandria, in the Linnæan arrangement, and to the order digynia. The generic characters are the following: The *calyx* is monophyllous, quinquefid, acute, ſmall, and permanent. The *corolla* is monopetalous, flat, large, and divided, deeper than the middle, into five parts, with broad, flat, pointed *laciniæ*. The *nectarium* is ſmall, ſtar-ſhaped, flat, quinquefid, with linear *laciniæ*; and embracing with its ragged points the ſeed-forming parts. Another ſmall ſtar, which is alſo flat and quinquefid, covers the ſeminiferous parts with its entire acute *laciniæ*. The *ſtamina* are five in number; the *filaments* are erect, flat, and broad; and the *antheræ* are linear, on each ſide united to the ſide of the filament. The *piſtillum* has two *germina*, which are oval and flat on the inſide. There are no *ſtyles*; and the *ſtigmata* are obſolete. The *ſeed-veſſel* conſiſts of two oblong, awl-ſhaped, unilocular and univalved follicles. The *ſeeds* are numerous, imbricated, compreſſed, and crowned with a *pappus* or down.

This ſingular tribe of plants is peculiar to the ſandy deſerts of Africa and Arabia. They are extremely ſucculent. From this peculiarity of ſtructure, the power of retaining water to ſupport and nouriſh them, they are enabled to live during the prevalent droughts of thoſe arid regions. On this account the ſtapelia has been compared to the camel; and we are told that, by a very apt ſimilitude, it has been denominated "the *camel* of the vegetable kingdom." We muſt confeſs ourſelves quite at a loſs to ſee the propriety or aptitude of this compariſon. In many parts of the animal and vegetable economy there is doubtleſs a very obvious and ſtriking analogy: but this analogy has been often carried too far; much farther than fair experiment and accurate obſervation will in any degree ſupport. It is perhaps owing to this inaccuracy in obſerving the peculiarity of ſtructure and diverſity of functions, that a reſemblance is ſuppoſed to exiſt, as in the preſent caſe, where in reality there is none. The camel is provided with a bag or fifth ſtomach, in addition to the four with which ruminant animals are furniſhed. This fifth ſtomach is deſtined as a reſervoir to contain water; and it is ſufficiently capacious to receive a quantity of that neceſſary fluid, equal to the wants of the animal, for many days; and this water, as long as it remains in the fifth ſtomach, is ſaid to be perfectly pure and unchanged. The *ſtapelia*, and other ſucculent plants, have no ſuch reſervoir. The water is equally, or nearly ſo, diffuſed through the whole plant. Every veſſel and every cell is fully diſtended. But beſides, this water, whether it be received by the roots, or abſorbed from the atmoſphere, has probably undergone a complete change, and become, after it has been a ſhort time within the plant, a fluid poſſeſſed of very different qualities.

The peculiar economy in the ſtapelia, and other ſucculent plants, ſeems to exiſt in the abſorbent and exhalant ſyſtems. The power of abſorption is as much increaſed as the power of the exhalant or perſpiratory veſſels is diminiſhed. In theſe plants, a ſmall quantity of nouriſhment is required. There is no ſolid part to be formed, no large fruit to be produced. They generally have very ſmall leaves, often are entirely naked; ſo that taking the whole plant, a ſmall ſurface only is expoſed to the action of light and heat, and conſequently a much ſmaller proportion of water is decompoſed than in plants which are much branched and furniſhed with leaves.

Two ſpecies of ſtapelia only were known at the beginning of the century. The unfortunate Forſkal, the companion of Niebhur, who was ſent out by the king of Denmark to explore the interior of Arabia, and who fell a ſacrifice to the peſtilential diſeaſes of thoſe inhoſpitable regions, diſcovered two new ſpecies. Thunberg, in his *Prodromus*, has mentioned five more. Forty new ſpecies have been diſcovered by Mr Maſſon of Kew Gardens, who was ſent out by his preſent Majeſty for the purpoſe of collecting plants round the Cape of Good Hope. Deſcriptions of theſe, with elegant and highly finiſhed coloured engravings, have lately been publiſhed. They are chiefly natives of the extenſive deſerts called *Karro*, on the weſtern ſide of the Cape.

STAR, in fortification, denotes a ſmall fort, having five or more points, or ſaliant and re-entering angles, flanking one another, and their faces 90 or 100 feet long.

STARCH (ſee *Encycl.*) is commonly made of wheat, and the very beſt ſtarch can perhaps be made of nothing elſe. Wheat, however, is too valuable an article of food to be employed as the material of ſtarch, when any thing elſe will anſwer the purpoſe; and it has long been known that an inferior kind of ſtarch may be made of potatoes. Potatoes, however, are themſelves a valuable article of food; and it is therefore an object of importance to try if ſtarch may not be made of ſomething ſtill leſs uſeful.

On the 8th of March 1796, a patent was granted to Lord William Murray for his diſcovery of a method by which ſtarch may be extracted from horſe-cheſnuts. That method is as follows:

Take the horſe-cheſnuts out of the outward green prickly huſks; and then, either by hand, with a knife or other tool, or elſe with a mill adapted for that purpoſe, very carefully pare off the brown rind, being particular not to leave the ſmalleſt ſpeck, and to entirely eradicate the ſprout or growth. Next take the nuts, and raſp, grate, or grind them fine into water, either by hand, or by a mill adapted for that purpoſe. Waſh the pulp, which is thereby formed in this water, as clean as poſſible, through a coarſe horſe-hair ſieve; this again waſh through a finer ſieve, and then again through a ſtill finer, conſtantly adding clean water, to prevent any ſtarch from adhering to the pulp. The laſt proceſs is, to put it with a large quantity of water (about four gallons to a pound of ſtarch) through a fine gauze, muſlin, or lawn, ſo as entirely to clear it of all bran or other impurities. As ſoon as it ſettles, pour off the water; then mix it up with clean water, repeating this operation till it no longer imparts any green, yellow, or other colour to the water. Then drain it off till nearly dry, and ſet it to bake, either in the uſual mode of baking ſtarch, or elſe ſpread out before a briſk fire; being very attentive to ſtir it frequently to prevent its hotning, that is to ſay, turning to a paſte or jelly, which, on being dried, turns hard like horn. The whole proceſs ſhould be conducted as quickly as poſſible.

Mention is here made of a mill which may be employed to grind the horſe-cheſnuts; but none is deſcribed as proper for that purpoſe. Perhaps the following mill, which was invented by M. Baumé for grinding potatoes, with a view to extract ſtarch from them, may anſwer for grinding horſe-cheſnuts.

Plate XLII.

He had a grater made of plate iron, in a cylindrical form (fig. 1.) about ſeven inches in diameter, and about eight inches high; the burs made by ſtamping the holes are on the inſide. This grater is ſupported upon three feet AAA, made of flat iron bars, ſeven feet high, ſtrongly rivetted to the grater; the bottom of each foot is bent horizontally, and has a hole in it which receives a ſcrew, as at A, fig. 4. A little below the upper end of the three feet is fixed a croſs piece B (fig. 1. and 4.), divided into three branches, and rivetted to the feet. This croſs piece not only ſerves to keep the feet at a proper diſtance from each other, and to prevent their bending; but the centre of it having a hole cut in it, ſerves to ſupport an axis or ſpindle of iron, to be preſently deſcribed.

The upper end of this cylindrical grater has a diverging border of iron C (fig. 1. 4. and 7.), about ten inches in diameter at the top, and five inches in height.

Within this cylindrical grater is placed a ſecond grater (fig. 2. and 3.), in the form of a cone, the point of which is cut off. The latter is made of thick plate iron, and the burs of the holes are on the outſide; it is fixed, with the broad end at the bottom, as in fig. 4. At the upper end of the cone is rivetted a ſmall triangle, or croſs piece of iron, conſiſting of three branches D (fig. 2.), in the middle of which is made a ſquare hole, to receive an axis or ſpindle; to give more reſiſtance to this part of the cone, it is ſtrengthened by means of a cap of iron E, which is fixed to the grater by means of rivets, and has alſo a ſquare hole made in it, to let the axis paſs through.

Fig. 3. repreſents the ſame cone ſeen in front; the baſe F has alſo a croſs piece of three branches, rivetted to a hoop of iron, which is fixed to the inner ſurface of the cone; the centre of this croſs piece has alſo a ſquare hole for the paſſage of the axis.

Fig. 5. is a ſpindle or axis itſelf; it is a ſquare bar of iron about 16 inches long, and more than half an inch thick; round at the bottom, and alſo towards the top, where it fits into the croſs piece I, fig. 7. and B, fig. 1. and 4.; in theſe pieces it turns round, and by them it is kept in its place. It muſt be ſquare at its upper extremity, that it may have a handle, about nine inches long, fixed to it, by means of which the conical grater is turned round. At G, (fig. 5.), a ſmall hole is made through the axis, to receive a pin H, by means of which the conical grater is kept at its proper height within the cylindrical one.

Fig. 6. is a bird's eye view, in which the mill is repreſented placed in an oval tub, like a bathing-tub. I is the fore-mentioned triangular iron croſs, fixed with ſcrews to the ſide of the tub; the centre of it has a round hole, for the axis of the mill to move in when it is uſed.

Fig. 7. repreſents the mill in the oval tub; it is placed

REAPING SCYTHES PLATE XLII.

Fig. 3.

Fig. 1

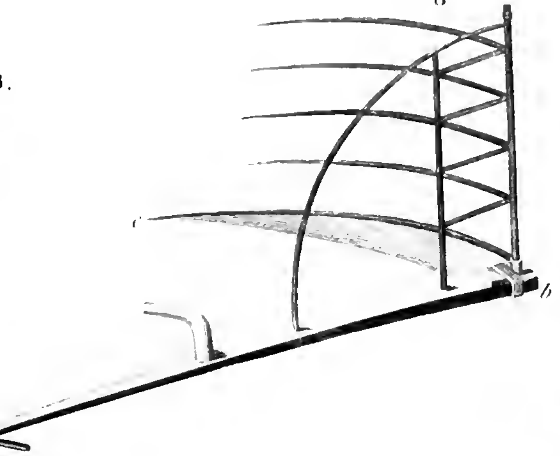
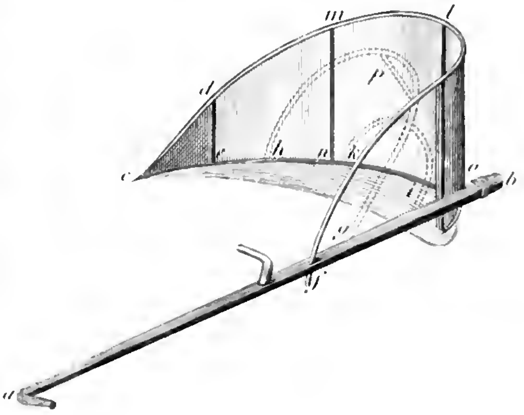


Fig. 2.



STARCH

Fig. 1.

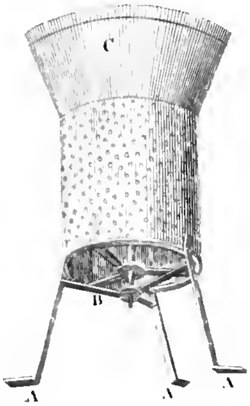


Fig. 2.

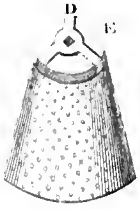


Fig. 3.

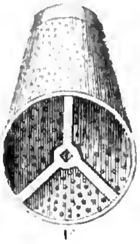


Fig. 4

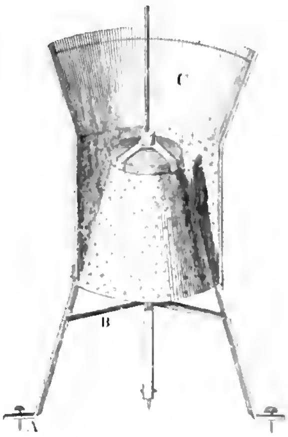


Fig. 5.

Fig. 7

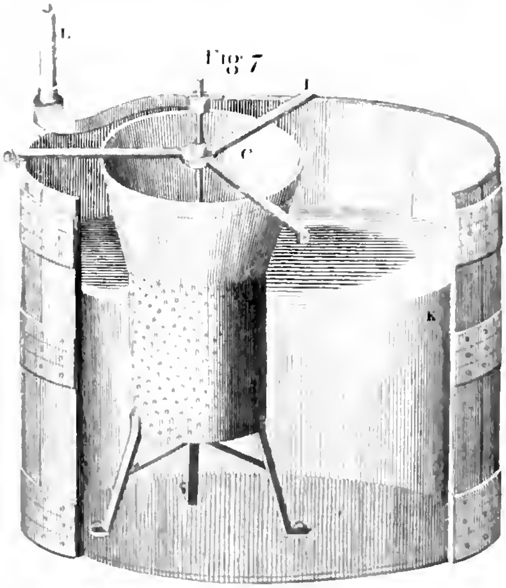
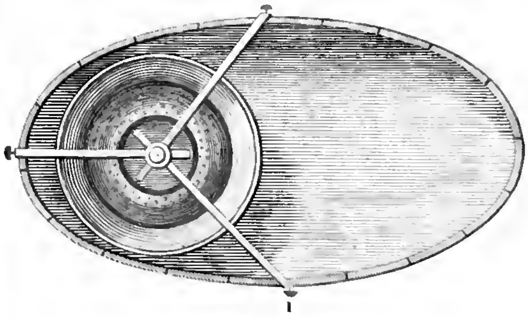


Fig. 6



placed at one end of it, that the other end may be left free for any operation to be performed in it which may be neceſſary. A part of the tub is cut off, that the inſide of it, and the manner of fixing the mill, may be ſeen. That the bottom of the tub may not be worn by the ſcrews which paſs through the feet of the mill, a deal board, about an inch thick, and properly ſhaped, is placed under the mill.

When we wiſh to make uſe of this mill, it is to be fixed by the feet, in the manner already deſcribed; it is alſo fixed at the top, by means of the croſs piece I, fig. 6. and 7. The tub is then to have water poured into it as high as K, and the top of the mill is to be filled with potatoes, properly waſhed and cut; the handle L is to be turned round, and the potatoes, after being ground between the two graters, go out gradually at the lower part, being aſſiſted by the motion produced in the water by the action of the mill.

It is not neceſſary, in the conſtruction of ſuch a mill, to be very particular with reſpect to its proportions; but, in order to make known thoſe which experience has proved to be good ones, a ſcale is given with the figures, to which recourſe may be had. With a mill of this ſize, 100 pounds of potatoes may be ground in the ſpace of two hours.

We are perſuaded that this mill will anſwer perfectly well for grinding horſe-cheſnuts; and we hope, that where they can be had they will be uſed in preference to potatoes. We ſhall, however, give M. Baumé's method of extracting ſtarch from the ground potatoes, not only becauſe it will be acceptable to thoſe who have not horſe-cheſnuts, but alſo becauſe thoſe who have may, by following it, be able, perhaps, to make ſtarch of them, without encroaching upon Lord William Murray's patent.

In order to prepare ſtarch from potatoes, ſays M. Baumé, any quantity of theſe roots may be taken, and ſoaked in a tub of water for about an hour; they are afterwards to have their fibres and ſhoots taken off, and then to be rubbed with a pretty ſtrong bruſh, that the earth, which is apt to lodge in the inequalities of their ſurface, may be entirely removed; as this is done, they are to be waſhed, and thrown into another tub full of clean water. When the quantity which we mean to make uſe of has been thus treated, thoſe which are too large are to be cut into pieces about the ſize of eggs, and thrown into the mill; that being already fixed in the oval tub, with the proper quantity of water; the handle is then turned round, and as the potatoes are grated they paſs out at the bottom of the mill. The pulp which collects about the mill muſt be taken off from time to time with a wooden ſpoon, and put aſide in water.

When all the potatoes are ground, the whole of the pulp is to be collected in a tub, and mixed up with a great quantity of clean water. At the ſame time, another tub, very clean, is to be prepared, on the brim of which are to be placed two wooden rails, to ſupport a hair ſieve, which muſt not be too fine. The pulp and water are to be thrown into the ſieve; the flour paſſes through with the water, and freſh quantities of water are ſucceſſively to be poured on the remaining pulp, till the water runs through as clear as it is poured in. In this way we are to proceed till all the potatoes that were ground are uſed.

The pulp is commonly thrown away as uſeleſs; but it ſhould be boiled in water, and uſed as food for animals; for it is very nouriſhing, and is about $\frac{7}{8}$ths of the whole quantity of potatoes uſed.

To return from this ſhort digreſſion. The liquor which has paſſed through the ſieve is turbid, and of a browniſh colour, on account of the extractive matter which is diſſolved in it; it depoſits, in the ſpace of five or ſix hours, the flour which was ſuſpended in it. When all the flour is ſettled to the bottom, the liquor is to be poured off and thrown away, being uſeleſs; a great quantity of very clean water is then to be poured upon the flour remaining at the bottom of the tub, which is to be ſtirred up in the water, that it may be waſhed, and the whole is to ſtand quiet till the day following. The flour will then be found to have ſettled at the bottom of the tub; the water is again to be poured off as uſeleſs, the flour waſhed in a freſh quantity of pure water, and the mixture paſſed through a ſilk ſieve pretty fine, which will retain any ſmall quantity of pulp which may have paſſed through the hair ſieve. The whole muſt once more be ſuffered to ſtand quiet till the flour is entirely ſettled; if the water above it is perfectly clear and colourleſs, the flour has been ſufficiently waſhed; but if the water has any ſenſible appearance either of colour or of taſte, the flour muſt be again waſhed, as it is abſolutely neceſſary that none of the extractive matter be ſuffered to remain.

When the flour is ſufficiently waſhed, it may be taken out of the tub with a wooden ſpoon; it is to be placed upon wicker frames covered with paper, and dried, properly defended from duſt. When it is thoroughly dry, it is to be paſſed through a ſilk ſieve, that if any clotted lumps ſhould have been formed they may be divided. It is to be kept in glaſs veſſels ſtopped with paper only. See *Vegetable Substances*, Suppl.

N. B. Almoſt all the flour of potatoes that is to be bought contains a ſmall quantity of ſand, which is perceived between the teeth; it is owing to the potatoes not having been properly waſhed; for the ſand which lodges in the knobs and wrinkles of theſe roots, is not always eaſy to get out.

STARKS, a plantation in Lincoln county, Maine, ſituated on the W. ſide of Kennebeck river, near Norridgewalk.—*Morse.*

STARKSBOROUGH, a townſhip in Addiſon county, Vermont, 12 miles E. of Ferriſburg. It contains 40 inhabitants.—*ib.*

STARLINGS, or Sterlings, the name given to the ſtrong pieces of timber which were driven into the bed of the river to protect the piles, on the top of which were laid the flat beams upon which were built the baſes of the ſtone piers that ſupport the arches of London bridge. In general, ſtarlings are large piles placed on the outſide of the foundation of the piers of bridges, to break the force of the water, and to protect the ſtone work from injury by floating ice. They are otherwiſe called Jettes, which ſee in this *Supplement;* and their place is often ſupplied by large ſtones thrown at random round the piers of bridges, as may be ſeen at Stirling bridge when the river is low; and as was done by Mr Smeaton's direction round the piers of the centre arch of London bridge, when it was thought in danger of being undermined by the current. See Smeaton, *Encycl.*

STATIONARY, in aſtronomy, the ſtate of a planet when, to an obſerver on the earth, it appears for ſome time to ſtand ſtill, or remain immoveable in the ſame place in the heavens. For as the planets, to ſuch an obſerver, have ſometimes a progreſſive motion, and ſometimes a retrograde one, there muſt be ſome point between the two where they muſt appear ſtationary.

STATEN *Iſland*, lies 9 miles S. W. of the city of New-York, and conſtitutes Richmond county. The iſland is about 18 miles in length, and at a medium 6 or 7 in breadth, and contains 3,835 inhabitants. On the ſouth ſide, is a conſiderable tract of level, good land; but the iſland in general, is rough and the hills high. Richmond is the only town of any note, and that is an inconſiderable place. The inhabitants are chiefly deſcendants of the Dutch and French; and are noted for their hoſpitality to ſtrangers, and love of their native ſpot.—*Morſe.*

STATEN *Land*, an iſland at the extremity of South-America, about 30 miles in length and 12 in breadth. It lies to the eaſtward of the E. point of Terra del Fuego, and from which it is ſeparated by Strait le Maire. The centre of the iſland is in lat. about 54 30 S. and long. 64 30 W.—*ib.*

STATESBURG, a poſt-town of S. Carolina, and the capital of Clermont county, ſituated on the E. ſide of Beech Creek, which unites with Shanks Creek, and empties into the Wateree, a few miles below the town. It contains 10 or 12 houſes, a court-houſe and gaol. It is 20 miles S. by E. of Camden, 100 N. by W. of Charleſton, and 663 S. W. of Philadelphia.—*ib.*

STAUNTON, a poſt-town of Virginia, and the capital of Auguſta county. It is ſituated on the S. E. ſide of Middle river, a water of Patowmack, a little to the N. of Maddiſon's Cave. It contains about 160 houſes, moſtly built of ſtone, a court-houſe and gaol. It is 93 miles from the Sweet Springs, 100 miles S. W. by S. of Wincheſter, 126 W. N. W. of Richmond, and 287 from Philadelphia.—*ib.*

STAUNTON, a ſmall river of Virginia, which riſes on the W. ſide of the Blue Ridge, and breaks through that mountain in lat. about 37 8 N. and uniting with Dan river forms the Roanoke, above the Occoneachy Iſlands, about 100 miles from its ſource. It is alſo called Smith's river.—*ib.*

STAUSEE, *Fort*, juſt above the Falls of Niagara, and 8 miles above Queens-Town.—*ib.*

STEADMAN's *Creek*, in the ſtate of New-York. The main fork of this creek empties into Niagara river, above Fort Schloſſer.—*ib.*

STEAM, STEAM-ENGINE. The few following corrections of theſe articles in the *Encycl.* were communicated by the author.

Page 745. col. 1.—It was not at the York Building waterworks in London that the boiler burſt, but in the country in an engine erected by Dr Deſaguilliers. See his *Experimental Philoſophy*, Vol. II. p. 489.

Page 746. col. 2.—The condenſation requires more cold water than is here allowed, as will appear by and bye; and we alſo ſuſpect that the rapidity is overrated with which a great volume of ſteam is condenſed by the cold ſurface of a veſſel. We are well informed that Mr Watt was much diſappointed in his expectations from a conſtruction in which this mode of condenſation was adopted. The condenſer employed by Mr Cartwright (ſee *Phil. Mag.*) was one of the very firſt thought of and tried for this purpoſe, and was given up, as well as all others on the ſame principle; and the immediate contact of cold water was preferred as incomparably more effective. The great ſuperiority of the capacity of water for heat is now well known. It is true, that when we employ an extenſive cold ſurface of the condenſer, this ſurface is kept cold by the water round it; and therefore we ſtill avail ourſelves of this great avidity of water for heat. But this water muſt act through the intervention of the veſſel; and the ſubſtance of the veſſel does not convey heat to the ſurrounding water in an inſtant.

Page 749. col. 2.—No diſtinct experiment ſhews ſo great an expanſion of water, when converted into ſteam at the temperature 212°; and under the preſſure of the air Mr Watt never found it more than 1800 times rarer than water.

Page 753. col. 1.—The heat expended in boiling off a cubic foot of water is about ſix times as much as would bring it to a boiling heat from the medium temperature (55°) in this climate.

Page 758. col. 2.—The quantity of water neceſſary for injection may be determined on principle, at leaſt for an engine having a ſeparate condenſer. Every cubic foot of common ſteam produces about an inch of water when condenſed, and contains about as much latent heat as would raiſe 1100 inches of water one degree. This ſteam muſt not only be condenſed, but muſt be cooled to the temperature of the hot well; therefore as many inches of cold water muſt be employed as will require all this heat to raiſe it to the temperature of the hot well. Therefore let x be the cubic feet of ſteam, or capacity of the cylinder, and let y be the inches of cold water expended in condenſing it. Let a be the difference between 212° and the temperature of the hot well, and b the difference between the temperature of the well and the injection ciſtern. We have $y\,b = x \times \overline{1100 + a}$, or $y = \frac{\overline{1100 + a} \times x}{b}$.

Thus, if the temperature of the hot well be 100° (and it ſhould never be higher, if we would have a tolerable vacuum in the cylinder), and that of the injection ciſtern be 50°, we have $a = 112$, and $b = 50$, and $y = \frac{1212}{50}x, = 24{,}24\,x$, or $24\frac{1}{4}\,x$; that is, every foot of the capacity of the cylinder, or every inch of water evaporated from the boiler, requires more than 24 inches of water to condenſe the ſteam. A wine pint for every inch of water boiled off, or every cubic foot of capacity of the cylinder, may be kept in mind, as a large allowance. Or, more exactly, if the engine be in good order, and the injection water as low as 50°, and the hot well not above 100°, we may allow 25 gallons of injection for one gallon of water boiled off. This greatly exceeds the quantity mentioned in the caſe of a good Newcomen's engine, the cylinder of which contained almoſt 30 cubic feet of ſteam. And this circumſtance ſhews the ſuperiority of the engine with a ſeparate condenſer. The injection of Newcomen's engine had been adjuſted by experience, ſo as to make the beſt compenſation for the unavoidable waſte in the cylinder. We preſume that this machine was not loaded above eight pounds per inch, more likely with ſeven; whereas

Steam,
‖
Steel.

as Watt's engine, working in the condition now deſcribed, bears a load not much below twelve, making at leaſt twelve ſtrokes per minute.

This is not a matter of mere curioſity; it affords a very exact rule for judging of the good working order of the engine. We can meaſure with accuracy the water admitted into the boiler during an hour, without allowing its ſurface to riſe or fall, and the water employed for injection. If the laſt be below the proportion now given (adapted to the temperatures 50° and 100°), we are certain that ſteam is waſted by leaks, or by condenſation in ſome improper place. The rule is not ſtrictly conformable to the latent heat of ſteam which balances the atmoſphere, 1100° being ſomewhat too great a value. It is accommodated to the actual performance of Watt's engines, when in their beſt working condition.

It is evident that it is of great importance to have the temperature of the hot well as low as poſſible; becauſe there always remains a ſteam in the cylinder, of the ſame, or rather higher temperature, poſſeſſing, an elaſticity which balances part of the preſſure on the other ſide of the piſton, and thus diminiſhes the power of the engine. This is clearly ſeen by the barometer, which Mr Watt applies to many of his beſt engines, and is a moſt uſeful addition for the proprietor. It ſhews him, in every moment, the ſtate of the vacuum, and the real power of his engine, and tells him when there are leaks by which air gets in.

Page 762. cols. 1. 2.—Mr Watt's firſt experiment was not exactly as here related; but much more analogous to the preſent form of his engine. The condenſer was a cylinder of tinplate, fitted with a piſton, which was drawn up from the bottom to the top, before the eduction cock was opened. Without this previous rarefaction in the condenſer, there was no inducement for the ſteam to take this courſe, unleſs it were made much ſtronger than that of ordinary boiling water.

The deſcription of the firſt form of the engine is alſo faulty, by the omiſſion of a valve immediately below the eduction pipe. This valve is ſhut along with the valve I, to prevent the ſteam, which ſhould then go into the lower part of the cylinder, from alſo going down into the condenſer. This is not abſolutely neceſſary, but its advantage is evident.

Page 766. col. 1.—This form of the engine was very early put in practice by Mr Watt—about the year 1775. The ſmall engine at Mr Boulton's works at Soho was erected in 1776; and the engine at Shadwell waterworks, one of the beſt yet erected, had been working ſome time when we ſaw it in 1778. We mention this, becauſe we have been told that Mr Hornblower puts in ſome claim to priority in this invention. We do not think that Mr Hornblower erected any of his engines before 1782; and as Mr Hornblower was, we believe, working with Boulton and Watt before that time, we think it fully more probable that he has in this reſpect profited by the inſtruction of ſuch intelligent employers. We may alſo obſerve, that Mr Watt employed the ſame contrivance which we have deſcribed with much approbation in p. 772. *Encycl.* for keeping the collar round the piſton rods ſteam and air tight. He found them effectual, but that they required more attention for keeping them in fit condition than the uſual mode of packing. He made a ſimilar packing for the piſton, and with a ſimilar reſult.

Page 769. cols. 1. 2.—Mr Boulton eſtimates the performance of the engines in the following manner. Seeing that the great expence of the engine is the conſumption of fuel, he makes this the ſtandard of computation, and eſtimates the performance by the work which he *engages* to perform by the conſumption of one buſhel of good Newcaſtle coal, London meaſure, or containing 84lbs without regard to the time in which this buſhel is expended. This depends on the ſize of the engine.

The burning one buſhel of coal will,

1. Raiſe 30 million pounds one foot high.
2. It will grind and dreſs 11 buſhels of wheat.
3. It will ſlit and draw into nail rods 5 cwt. of iron.
4. It will drive 1000 cotton ſpindles, with all the preparation machinery, with the proper velocity.
5. It is equivalent to the work of ten horſes.

The general performance of the double ſtroke expanſive engines is ſomewhat beyond this; and their performance in cotton ſpinning, or as compared with horſe work, is much under rated. The firſt eſtimation is without ambiguity. Suppoſe the engine of ſuch a ſize as to conſume a buſhel of coals per hour. This will be found equivalent to raiſing 97 wine hogſheads of water ten feet high in a minute, which ten ſtout draught horſes cannot do for a quarter of an hour together. They can raiſe 60 in that time, and work at this rate eight or perhaps ten hours from day to day.

Mr Watt finds, that, with the moſt judiciouſly conſtructed furnaces, it requires eight feet of ſurface of the boiler to be expoſed to the action of fire and flame to boil off a cubic foot of water in an hour, and that a buſhel of coals ſo applied will boil off from eight to twelve cubic feet.

Boulton and Watt now make ſteam-engines equivalent in power to one or two horſes. The cylinder and whole machinery does not occupy more room than a fine lady's working table, ſtanding in a ſquare of about 2½ feet, and about 5 feet high.

STEEL (ſee that article *Encycl.* and CHEMISTRY, n° 114. *Suppl.*) is compoſed of iron and carbon. In addition to the old proofs which we had of this fact, it occurred to *Morveau*, alias *Guyton*, to attempt to convert ſoft iron into ſteel, by uſing the diamond inſtead of charcoal in the proceſs of cementation. This expenſive experiment, which was ſuggeſted by M. Clouet, was made, by incloſing within a ſmall crucible of very ſoft iron a diamond, and ſhutting up the crucible by a ſtopper well adjuſted. This crucible of iron, with its contents, was placed, without the addition of any ſurrounding matter, in a very ſmall Heſſian crucible, and the latter in a ſecond crucible of the ſame earth; but the ſpace between the two latter crucibles was filled with ſiliceous ſand, free from all ferruginous particles. In the laſt place, the large crucible was luted with earth ariſing from pounded crucibles and unbaked clay, and the whole was expoſed about an hour to a three blaſt forge fire. When the whole was cooled, the iron was found in the interior Heſſian crucible converted into a ſolid ingot of caſt ſteel. Thus the diamond diſappeared by the affinity which iron exerciſed on it by the help of the high temperature to which they were both expoſed, in the ſame manner as a metal diſappears in the alloy of another metal. The diamond therefore furniſhed here the ſame principle as carbon, ſince the product of the union has the ſame properties.

The converſion into ſteel could not be doubted. The ingot having been poliſhed on a lapidary's wheel, a drop of weak nitrous acid immediately produced a dark-grey ſpot, abſolutely like that exhibited on Engliſh caſt ſteel, and on caſt ſteel produced by the proceſs of C. Clouet. Thoſe who have often tried ſteel by this kind of proof, long ago pointed out by Rinmann, had occaſion to remark, that the ſpot of caſt ſteel, tho' very ſenſible, is, however, leſs black than that of ſteel made by cementation, which depends perhaps on the different degree of oxydation of the carbon which they have taken in.

The proceſs of M. Clouet here mentioned, for producing caſt ſteel, conſiſts in nothing more than throwing a quantity of glaſs into the maſs of iron and charcoal during the formation of the former into ſteel. The ſame chemiſt has aſcertained that iron, during its converſion into ſteel, abſorbs 0.2013 of its weight of carbon; and that the affinity of iron for carbon is ſo ſtrong, that, at a white heat, it is capable of decompoſing carbonic acid gas. This he proved by the following experiment.

If ſix parts of iron be mixed with four parts of a mixture compoſed of equal quantities of carbonat of lime and clay, and kept in a crucible at a white heat for an hour or longer, according to the quantity, the iron will be converted into ſteel. The decompoſition of carbonic acid is evidently the conſequence of a compound affinity; part of the iron combining with the carbon, and another part with the oxygen of the carbonic acid gas. Accordingly the commiſſioners, who were appointed to examine the proceſs, remark, that a quantity of oxyd of iron was always mixed with the melted earthy ſubſtance, which was ſeparated from the ſteel.

STEEP ROCK, a curious ledge of perpendicular ſhelly rocks, which form the W. bank of Hudſon's river, with ſome interruptions, for 12 or 13 miles from the Tappan Sea, to within 11 miles of New-York city. Some of theſe ledges are from 150 to 200 feet high. As you paſs down the river from the Tappan Sea, by theſe rocks, the proſpect on every ſide is enchanting. On the N. the Tappan Sea, a fine broad bay opens to view, ſkirted with high hills; on the S. the river lies under the eye as far as it diſtinguiſhes objects; on the W. are the Steep Rocks, before deſcribed; and on the E. a fine cultivated country.—*Morſe.*

STEEVENS (George), the moſt ſucceſsful of all the editors and commentators of Shakeſpeare, was born 1735. Of his parents we know nothing, but that they ſeem to have been in circumſtances which may be deemed affluent. George received the rudiments of his claſſical education at Kingſton-upon-Thames, under the tuition of Dr Woodeſon and his aſſiſtants; and had for a companion at that ſchool Gibbon the hiſtorian. From Kingſton he went to Eton, whence, after ſome years, he was admitted a fellow-commoner of King's College, Cambridge; but with the courſe of his ſtudies in the univerſity we are not acquainted. If we might hazard a conjecture, from the manner in which he employed his riper years, we ſhould ſuppoſe that he had little reliſh for thoſe mathematical ſpeculations which in Cambridge lead to academical honours. After he left the univerſity, he accepted a commiſſion in the Eſſex militia on its firſt eſtabliſhment: and he ſpent the latter years of his life at Hampſtead in almoſt total ſecluſion from the world; ſeldom mixing with ſociety but in the ſhops of bookſellers, in the Shakeſpeare Gallery, or in the morning *converſations* of Sir Joſeph Banks. He died January 1800.

This is a very meagre account of the incidents which muſt have taken place in the life of a man ſo conſpicuous in the republic of letters; but we have had no opportunity of improving it. His character, as drawn in the Monthly Magazine, believing it to be juſt, we ſhall adopt, as it will ſupply in ſome degree the defects of our narrative.

Though Mr Steevens is known rather as a commentator than as an original writer; yet, when the works which he illuſtrated, the learning, ſagacity, taſte, and general knowledge which he brought to the taſk, and the ſucceſs which crowned his labours, are conſidered, it would be an act of injuſtice to refuſe him a place among the firſt literary characters of the age. Adorned by a verſatility of talents, he was indeed eminent both by his pen and his pencil. With the one there was nothing which he could not compoſe, and with the other there was nothing which he could not imitate ſo cloſely, as to leave a doubt which was the original and which the copy. But his chief excellence lay in his critical knowledge of an author's text; and the beſt ſpecimen of his great abilities is his edition of Shakeſpeare, in which he has left every competitor far behind him. He had, in ſhort, ſtudied the age of Shakeſpeare, and had employed his perſevering induſtry in becoming acquainted with the writings, manners, and laws of that period, as well as the provincial peculiarities, whether of language or cuſtom, which prevailed in different parts of the kingdom, but more particularly in thoſe where Shakeſpeare paſſed the early years of his life. This ſtore of knowledge he was continually increaſing, by the acquiſition of the rare and obſolete publications of a former age, which he ſpared no expence to obtain; while his critical ſagacity and acute obſervation were employed inceſſantly in calling forth the hidden meanings of the great dramatic bard, from their covert, and conſequently enlarging the diſplay of his beauties. This advantage is evident from his laſt edition of Shakeſpeare, which contains ſo large a portion of new, intereſting, and accumulated illuſtration. In the preparation of it for the preſs, he gave an inſtance of editorial activity and perſeverance which is without example. To this work he devoted ſolely, and excluſively of all other attentions, a period of 18 months; and during that time he left his houſe every morning at one o'clock with the Hampſtead patrole, and proceeded, without any conſideration of the weather or the ſeaſon, to his friend Mr Iſaac Read's chambers, in Barnard's Inn, where he was allowed to admit himſelf, and found a room prepared to receive him, with a ſheet of the Shakeſpeare letter preſs ready for correction. There was every book which he might wiſh to conſult; and to Mr Read he could apply, on any doubt or ſudden ſuggeſtion, as to a man whoſe knowledge of Engliſh literature was perhaps equal to his own. This nocturnal

nal toil greatly accelerated the printing of the work ; as while the printers ſlept the editor was awake ; and thus, in leſs than twenty months, he completed his laſt ſplendid edition of Shakeſpeare, in fifteen large octavo volumes ; an almoſt incredible labour, which proved the aſtoniſhing energy and perſevering powers of his mind.

That Mr Steevens contented himſelf with being a commentator, aroſe probably from the habits of his life, and his devotion to the name, with which his own will deſcend to the lateſt poſterity. It is probable that many of his *jeux d'eſprit* might be collected: there is a poem of his in Dodſley's Annual Regiſter, under the title of *The Frantic Lover*, which is ſuperior to any ſimilar production in the Engliſh language. Mr Steevens was a claſſical ſcholar of the firſt order. He was equally acquainted with the belles lettres of Europe. He had ſtudied hiſtory, ancient and modern, but particularly that of his own country. He poſſeſſed a ſtrong original genius, and an abundant wit ; his imagination was of every colour, and his ſentiments were enlivened with the moſt brilliant expreſſions. His colloquial powers ſurpaſſed thoſe of other men. In argument he was uncommonly eloquent ; and his eloquence was equally logical and animated. His deſcriptions were ſo true to nature, his figures were ſo finely ſketched, of ſuch curious ſelection, and ſo happily grouped, that he might be conſidered as a ſpeaking Hogarth. He would frequently, in his ſportive and almoſt boyiſh humours, condeſcend to a degree of ribaldry but little above O'Keefe—with him, however, it loſt all its coarſeneſs, and aſſumed the air of claſſical vivacity. He was indeed too apt to catch the ridiculous, both in characters and things, and indulge an indiſcreet animation wherever he found it. He ſcattered his wit and his humour, his gibes and his jeers, too freely around him, and they were not loſt for want of gathering.

Mr Steevens poſſeſſed a very handſome fortune, which he managed with diſcretion, and was enabled by it to gratify his wiſhes, which he did without any regard to expence, in forming his diſtinguiſhed collections of claſſical learning, literary antiquity, and the arts connected with it. His generoſity alſo was equal to his fortune ; and though he was not ſeen to give eleemoſynary ſixpences to ſturdy beggars or ſweepers of the croſſings, few perſons diſtributed banknotes with more liberality ; and ſome of his acts of pecuniary kindneſs might be named, which could only proceed from a mind adorned with the nobleſt ſentiments of humanity. He poſſeſſed all the grace of exterior accompliſhment, acquired at a period when civility and politeneſs were characteriſtics of a gentleman.

He has bequeathed his valuable Shakeſpeare, illuſtrated with near 1500 prints, to Lord Spencer ; his Hogarth perfect, with the exception of one or two pieces, to Mr Windham ; and his corrected copy of Shakeſpeare, with 200 guineas, to his friend Mr Read.

STEPHENS, a cape, S. W. of Cape Denbigh, on the N. W. coaſt of North-America, and is at the S. E. part of Norton Sound. Stuart's Iſland is oppoſite to it. N. lat. 63 33, W. long. 162 19. Between this and Shoal Neſs is ſhoal water.—*Morſe*.

Stephens, a ſhort river of Vermont, which empties into Connecticut river, from the N. W. in the town of Barnet.—*ib*.

Stephens, *St*, a pariſh of Charleſton diſtrict, S. Carolina ; containing 2,733 inhabitants, of whom 226 are whites.—*ib*.

Stephentown, || Stereometer.

STEPHENTOWN, a townſhip of good land in New-York, in Renſſelaer county, between Lebanon and Scoodack. It is about 14 miles ſquare, and lies 20 miles E. of Albany. Of its inhabitants 624 are electors. The timber on the low land is pine, hemlock, beech, birch, aſh, maple. On the hills, pine, hemlock, black and white oak, walnut and poplar.—*ib*.

STEREOMETER, an inſtrument lately invented in France for meaſuring the volume of a body, however irregular, without plunging it in any liquid. If the capacity of a veſſel, or, which is the ſame thing, the volume of air contained in that veſſel, be meaſured, when the veſſel contains air only, and alſo when the veſſel contains a body whoſe volume is required to be known, the volume of air aſcertained by the firſt meaſurement, deducting the volume aſcertained by the ſecond, will be the volume of the body itſelf. Again, if it be admitted as a law, that the volume of any maſs of air be inverſely as the preſſure to which it is ſubjected, the temperature being ſuppoſed conſtant, it will be eaſy to deduce, from the mathematical relations of quantity, the whole bulk, provided the difference between the two bulks under two known preſſures be obtained by experiment.

Let it be ſuppoſed, for example, that the firſt preſſure is double the ſecond, or, which follows as a conſequence, that the ſecond volume of the air be double the firſt, and that the difference be fifty cubic inches, it is evident that the firſt volume of the air will likewiſe be fifty cubic inches. The ſtereometer is intended to aſcertain this difference at two known preſſures.

Plate XLIII.

The inſtrument is a kind of funnel A B (fig. 1.), compoſed of a capſule A, in which the body is placed, and a tube B as uniform in the bore as can be procured. The upper edge of the capſule is ground with emery, in order that it may be hermetically cloſed with a glaſs cover M ſlightly greaſed. A double ſcale is paſted on the tube, having two ſets of graduations ; one to indicate the length, and the other the capacities, as determined by experiment.

When this inſtrument is uſed, it muſt be plunged in a veſſel of mercury with the tube very upright, until the mercury riſes within and without to a point C of the ſcale. See fig. 2.

The capſule is then cloſed with the cover, which being greaſed will prevent all communication between the external air and that contained within the capſule and tube.

In this ſituation of the inſtrument, in which the mercury ſtands at the ſame height within and without the tube, the internal air is compreſſed by the weight of the atmoſphere, which is known and expreſſed by the length of the mercury in the tube of the common barometer.

The inſtrument is then to be elevated, taking care to keep the tube conſtantly in the vertical poſition. It is repreſented in this ſituation, fig. 2. ſecond poſition. The mercury deſcends in the tube, but not to the level of the external ſurface, and a column DE of mercury remains ſuſpended in the tube, the height of which is known by the ſcale. The interior air is therefore leſs compreſſed than before, the increaſe of its volume being equal to the whole capacity of the tube from C to D, which is indicated by the ſecond ſcale.

It is known therefore that the preſſures are in proportion to the barometrical column, and to the ſame column diminiſhed by the ſubtraction of DE. And the bulks of the air in theſe two ſtates are inverſely in the ſame proportion: and again the difference between theſe bulks is the abſolute quantity left void in the tube by the fall of the mercury; from which data, by an eaſy analytical proceſs, the following rule is deduced: Multiply the number which expreſſes the leſs preſſure by that which denotes the augmentation of capacity, and divide the product by the number which denotes the difference of the preſſures. The quotient will be the bulk of the air when ſubject to the greater preſſure.

To render this more eaſy by an example, ſuppoſe the height of the mercury in the barometer to be 78 centimetres, and the inſtrument being empty to be plunged in the mercury to the point C. It is then covered, and raiſed until the ſmall column of mercury DE is ſuſpended, for example, at the height of ſix centimetres. The internal air, which was at firſt compreſſed by a force repreſented by 78 centimetres, is now compreſſed only by a force repreſented by 78—6, or 72 centimetres.

Suppoſe it to be obſerved, at the ſame time, by means of the graduations of the ſecond ſcale, that the capacity of the part CD of the tube which the mercury has quitted is two cubic centimetres. Then by the rule $\frac{72}{6} \times 2$ give 24 cubical centimetres, which is the volume of the air included in the inſtrument when the mercury roſe as high as C in the tube.

The body of which the volume is to be aſcertained muſt then be placed in the capſule, and the operation repeated. Suppoſe, in this caſe, the column of mercury ſuſpended to be eight centimetres, when the capacity of the part CD of the tube is equal to two centimetres cube. Then the greateſt preſſure being denoted by 78 centimetres, as before, the leaſt will be 70 centimetres, the difference of the preſſures being 8, and the difference of the volumes two cubical centimetres. Hence $\frac{70}{8} \times 2$ gives the bulk of the included air under the greateſt preſſure 17,5 cubic centimetres. If therefore 17,5 centimetres be taken from 24 centimetres, or the capacity of the inſtrument when empty, the difference 6,5 cubic centimetres will expreſs the volume of the body which was introduced. And if the abſolute weight of the body be multiplied by its bulk in centimetres, and divided by the abſolute weight of one cubic centimetre of diſtilled water, the quotient will expreſs the ſpecific gravity of the body in the common form of the tables where diſtilled water is taken as unity, or the term of compariſon.

After this deſcription and explanation of the uſe of his inſtrument, the author proceeds with the candour and acuteneſs of a philoſopher to aſcertain the limits of error in the reſults; an object ſeldom ſufficiently attended to in the inveſtigation of natural phenomena. From his reſults it appears, that with the dimenſions he has aſſumed, and the method preſcribed for operating, the errors may affect the ſecond figure. He likewiſe gives the formulæ by means of which the inſtrument itſelf may be made to ſupply the want of a barometer in aſcertaining the greateſt preſſure. He likewiſe adverts to the errors which may be produced by change of temperature. To prevent theſe as much as poſſible, the actual form of the inſtrument and arrangements of its auxiliary parts are ſettled, as in fig. 3. by which means the approach of the hand near the veſſel and its tube is avoided. In this figure the vertical poſition of the tube is ſecured by the ſuſpenſion of the veſſel, and a perforation in the table through which the tube paſſes. The table itſelf ſupports the capſule in its firſt poſition, namely, that at which the cover is required to be put on.

Mr Nicholſon, from whoſe Journal this abſtract is immediately taken, ſuppoſes, with great probability, that the author of the invention had not finiſhed his meditations on the ſubject, when the memoir giving an account of it was publiſhed. If he had, ſays the ingenious journaliſt, it is likely that he would have determined his preſſures, as well as the meaſures of bulks by weight. For it may be eaſily underſtood, that if the whole inſtrument were ſet to its poſitions by ſuſpending it to one arm of a balance at H (fig. 3.), the quantity of counterpoiſe, when in equilibrio, might be applied to determine the preſſures to a degree of accuracy much greater than can be obtained by linear meaſurement.

STERLING, a plantation in Lincoln county, Diſtrict of Maine; N. W. of Hallowell, and at no great diſtance. It contains 166 inhabitants.—*Morſe.*

STERLING, in Worceſter county, Maſſachuſetts, was formerly a pariſh of Lancaſter, called *Chockſet*, incorporated in 1781; ſituated 12 miles N. E. of Worceſter, and 46 W. of Boſton, and contains 1,428 inhabitants. Near the neck of land which divides Waſhacum Ponds, on the S. ſide, was formerly an Indian fort, of which the veſtiges are nearly diſappeared. On this ſpot was the palace and royal ſeat of Sholan, ſachem of the Naſhaways, proprietor of Naſhawogg.—*ib.*

STEUBEN, a ſmall fort in the N. W. Territory, ſituated at the Rapids of the Ohio, a ſhort diſtance above Clarkſville.—*ib.*

STEUBEN, a new county of New-York, taken from that of Ontario; being that part of Ontario county, bounded by the Pennſylvania line on the S. by the N. bounds of the ſix range of townſhips on the N. by the pre-emption line on the E. and by the Indian line on the weſt.—*ib.*

STEUBEN, a townſhip of New-York, in Herkemer county; taken from Whiteſtown, and incorporated in 1792. In 1796, the towns of Floyd and Rome were taken off of this townſhip. Of its inhabitants 417 are electors. The N. weſtern branch of Mohawk river riſes here; and the centre of the town is about 12 miles N. E. of Fort Schuyler, and 32 N. W. of the mouth of Canada Creek.—*ib.*

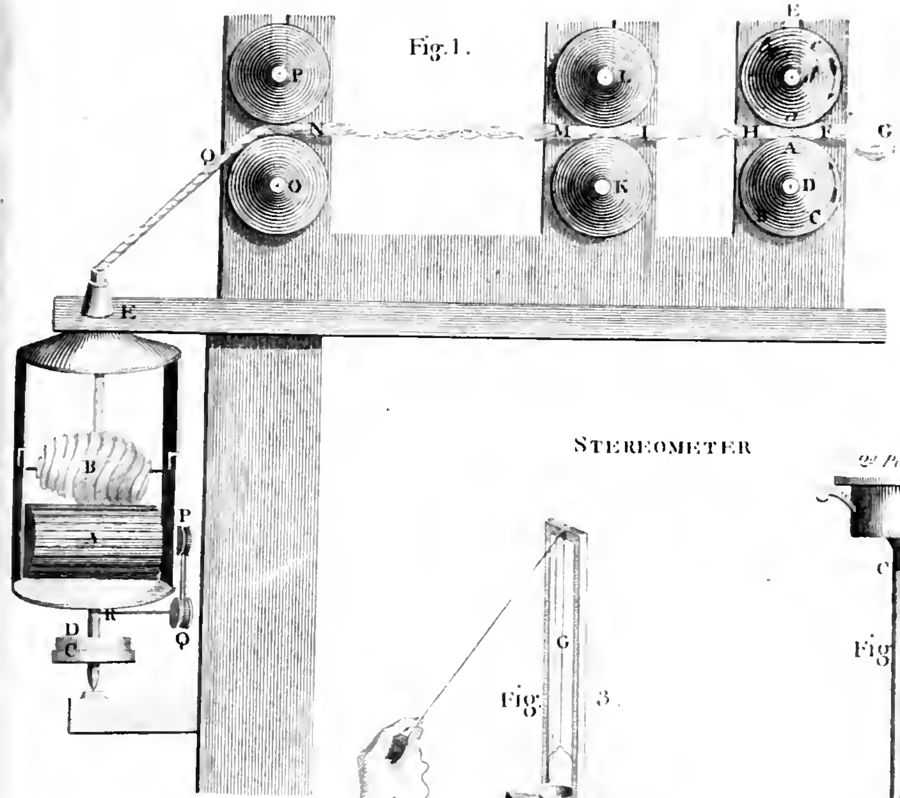
STEVENS, a ſhort navigable river of the Diſtrict of Maine. It riſes within a mile of Merry Meeting Bay, with which it is connected by a canal lately opened.—*ib.*

STEVENSBURG, a poſt-town of Virginia, ſituated on the road from Philadelphia to Staunton. It contains about 60 houſes; the inhabitants are moſtly of Dutch extraction. It is 10 miles N. by E. of Straſburg, 87 N. E. by N. of Staunton, 45 S. W. by S. of Williamſport, and 200 S. W. of Philadelphia.—*ib.*

STEVENTOWN, Weſt-Cheſter county, New-York, is bounded weſterly by York-Town, and northerly by Dutcheſs county. It contains 1,297 inhabitants, of whom 178 are electors.—*ib.*

SPINNING. PLATE XLIII

Fig. 1.



STEREOMETER

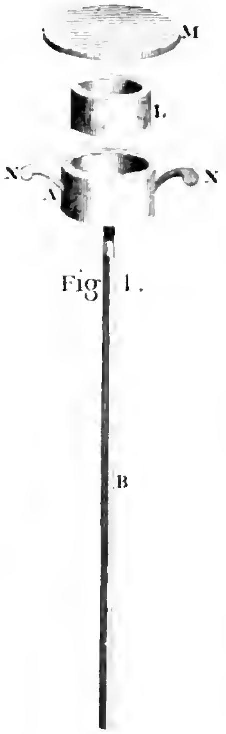


Fig. 1.

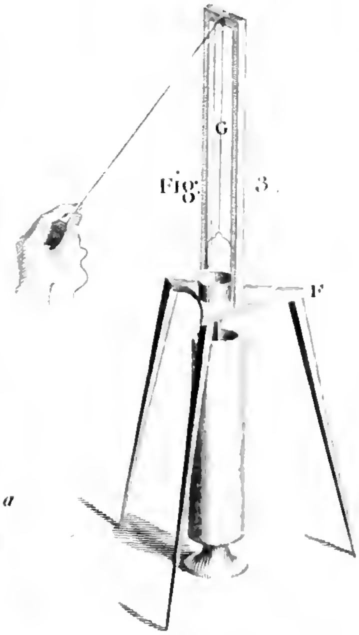


Fig. 3.

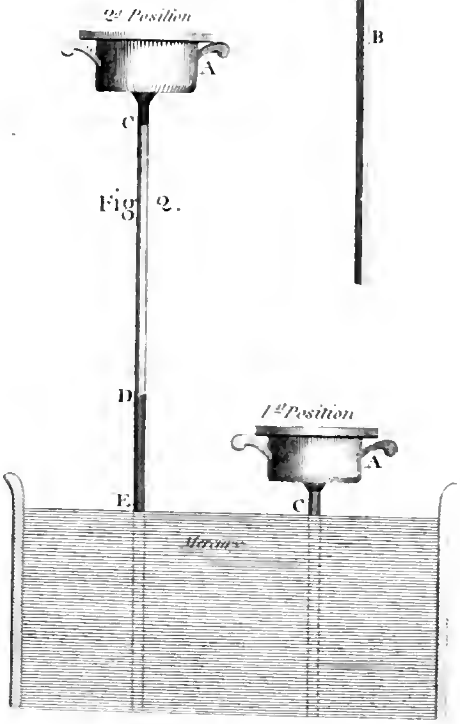


Fig. 2.

VEGETABLE SUBSTANCES

Fig. 1.

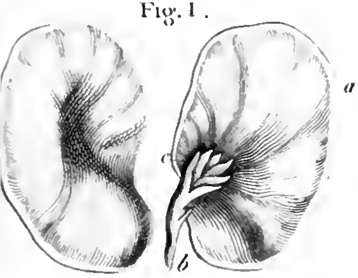
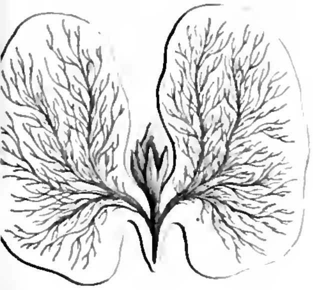


Fig. 2.



TEREBRATULA

Fig. 1.

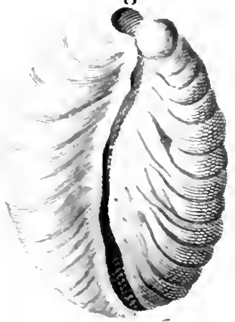
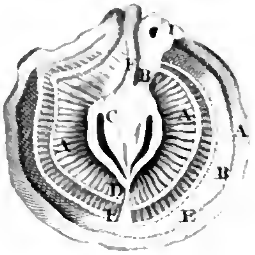


Fig. 2.



STEWART-Denham (Sir James) was born at Edinburgh on the 10th of October, O. S. in the year 1713. His father was Sir James Stewart of Goodtrees, Bart. Solicitor-general for Scotland; and his mother was Anne, daughter of Sir Hugh Dalrymple of North Berwick, Bart. preſident of the college of juſtice.

The firſt rudiments of his education he received at the grammar-ſchool of North-Berwick, which at the time of his father's death he quitted at the age of fourteen, with the reputation of being a good ſcholar, but without any extraordinary advancement in knowledge.

It is remarkable, that many men who have been ſingularly uſeful to ſociety have not ſhewn early ſymptoms of the greatneſs of their intellectual powers. A great underſtanding muſt be the offspring of happy organization in a healthy body, with co-operation of time, of circumſtance, and of inſtitution, without being forced into prematurity by exceſſive cultivation. This holds with reſpect to the growth and perfection of every creature; and the truth appears remarkable with reſpect to our own ſpecies, becauſe we are apt to miſtake the flimſy attainments of artificial education for the ſteady and permanent foundations of progreſſive knowledge.

From the ſchool of North-Berwick Sir James was ſent to the univerſity of Edinburgh, where he continued until the year 1735, when he paſſed advocate before the Court of Seſſion, and immediately afterwards went abroad to viſit foreign countries. He was then in the 23d year of his age, had made himſelf well acquainted with the Roman law and hiſtory, and the municipal law of Scotland. He had likewiſe maturely ſtudied the elements of juriſprudence; was verſed in the general, as well as the particular, politics of Europe; and was bent upon applying his knowledge to the inveſtigation of the ſtate of men and of manners in other nations, with a view to promote the benefit of his own, and to confirm himſelf in the love of a free conſtitution of government, by contemplating the baneful effects of unlimited monarchy in Germany, Italy, and Spain, and of extravagant attachment to a king and nobility, to war, and to pernicious ſplendour in France.

He travelled firſt, however, into Holland, with a view to ſtudy the conſtitution of the empire before he ſhould viſit Germany, and to attend ſome of the lectures of the moſt eminent profeſſors at Utrecht and Leyden, on public law and politics. From thence he paſſed into Germany, reſided about a year in France, travelled thro' ſome part of Spain, where he had a fever, that obliged him, for his perfect recovery from its effects, to go by the advice of his friends to the ſea-coaſt of the lovely province of Valencia; thence returning, he croſſed the Alps, and by Turin made the tour of Italy, where chiefly at Rome and Florence he reſided till the beginning of the year 1740; when, having ſpent five years on his travels, he returned to Scotland, and married the Lady Frances Wemyſs, eldeſt daughter of the Earl of Wemyſs, about two years after his return.

A few months after his marriage the repreſentation of the county of Mid-Lothian became vacant, by the member being made a lord of trade and plantation. The candidates were the late member and Sir John Baird of Newbyth. On the day of election Mr Dundas of Arniſton, one of the ſenators of the college of juſtice, was choſen preſes of the meeting; and ſome how or other omitted to cauſe the name of Sir James Stewart to be called on the roll of freeholders. For this illegal uſe of his temporary power, Sir James commenced a ſuit againſt the preſident; and reſuming the gown as an advocate, pleaded his own cauſe with great energy and eloquence, and with the applauſe of the bench, the bar, and the public. This called Lord Arniſton from the bench to plead in his own defence at the bar; and Sir James could not have been oppoſed to an antagoniſt better qualified to call forth all his powers; for that judge is talked of at this day in Edinburgh as the profoundeſt lawyer and the ableſt pleader that ever graced the Scottiſh bench or the Scottiſh bar.

With the iſſue of this conteſt we are not acquainted; but it drew upon Sir James Stewart very general attention, and convinced the public, that had he continued at the bar, he muſt have riſen rapidly to the head of his profeſſion. On his travels, however, he had contracted friendſhips with Lord Mariſchal, and other eminent men, attached to the pretenſions of the royal family of Stuart, and had received flattering attentions from the Pretender to the Britiſh throne; the impreſſion ariſing from which, added to the irritations of his controverſy with the powerful party in Scotland attached to the court, led him, unadviſedly, into connections with the movers of the rebellion in 1745.

As he was by far the ableſt man of their party, the Jacobites engaged him to write the Prince Regent's manifeſto, and to aſſiſt in his councils. Information having been given of his participation in theſe affairs, he thought it prudent, on the abortion of this unhappy attempt, to leave Britain; and by the zeal, it is ſaid, of Arniſton, he was excepted afterwards from the bill of indemnity, and rendered an exile from his country.

He choſe France for his reſidence during the ten firſt years of his baniſhment, and was chiefly at Angouleſme, where he ſuperintended the education of his ſon; from thence he went to Tubingen in Suabia, for the benefit of its univerſity, in proſecution of the ſame dutiful and laudable deſign; but in the end of the war 1756, having been ſuſpected by the court of Verſailles of communicating intelligence to the court of London, he was ſeized at Spa, and kept ſome time in confinement; from which being liberated, after the acceſſion of the preſent king of Great Britain, he came, by toleration, to England, and reſided at London, where he put the laſt hand to his Syſtem of Political Economy, the copy right of which he ſold to Andrew Millar; and being permitted to dedicate this work to the king, he applied for a *noli proſequi*, which, after ſome malicious objections, he obtained, and had the comfort of returning to his family eſtate in Scotland.

Having nothing profeſſional to do during his long reſidence in France, the active mind of Sir James was occupied in ſtudy. His book on the Principles of Political Economy contains moſt of the fruits of it. He turned himſelf, in the intervals of leiſure, to conſider the reſources of France, that he might the better compile that part of his great work which was to treat of revenue and expenditure. It was by ſtudying the language of the finances, without which nobody can aſk a proper queſtion concerning them, ſo as to be underſtood, that he attained his great purpoſe.

As ſoon as he could aſk queſtions properly, he applied in familiar converſation to the intendants and their ſubſtitutes in the provinces where he reſided, whom he found extremely deſirous to learn the ſtate of the Britiſh finances, under the branches of the land-tax, cuſtoms, exciſe, and other inland duties. This led him to compare the ſtate of the two nations. The information he gave was an equivalent for the information he received; curioſity balanced curioſity, each was ſatisfied and inſtructed. The department of the intendants in France was confined to the taxes which compoſed the *recettes generales*, namely, the *taille*, the *capitation*, and the *twentieths*, or *vingtiemes*. All the intendants had been *Maitres des Requetes*, bred at Paris, and could not fail to have much knowledge of the general *fermes* and other branches of the revenue. He carefully noted down at all times the anſwers he got; and when he came to reſide at Paris, he obtained more ample information, both from the gentlemen of the revenue, and from perſons of the parliament of Paris, who to the number of 25 had been for 15 months exiled in the province where he had ſo long reſided at Angouleſme.

With theſe advantages, with much ſtudy and attention to arrangement, he was enabled to compoſe the ſixth chapter of the fourth part of the fourth book of his Syſtem of Political Economy; a portion of that great work well worthy the attention of thoſe who wiſh to know the ſtate of France in reſpect of revenue under the old government.

Although Sir James Stewart's leiſure, during the firſt ten years of his exile, was chiefly employed in ſocial intercourſe with the moſt learned, elegant, and poliſhed characters in France, who delighted in the converſation and friendſhip of a man who poſſeſſed at once immenſe information, on almoſt every ſubject, important or agreeable to ſociety, and the talent of clearly and beautifully expreſſing his ſentiments in flowing and animated converſation; yet he did not allow the pleaſures of the circle and of the table to blunt the fine feelings of a man of genius and ſcience. The labour of collecting materials for his great political work was oppreſſive, and he relieved himſelf with various enquiries, ſuited to the exalted ambition of his cultivated underſtanding, while he turned the charms of converſation to the permanent delight of his aſſociates and of poſterity. The motto of Apelles, "*Nulla dies ſine linea*," was the emblem of his employment; and it is amazing what may be done by daily attention for improvement, without appearing to abſtract any extraordinary time from the common offices and rational pleaſures of ſociety.

In the beginning of the year 1755, Sir James wrote his Apology, or Defence of Sir Iſaac Newton's Chronology, which at that time he intended to publiſh, but was prevented by other engagements. It was communicated to ſeveral perſons of eminence in France and Germany in MS. and produced, in the month of December that year in the "*Mercure de France*," an anſwer from M. Deſhoulieres, to which Sir James ſoon after replied.

The great Newton, applying aſtronomical and ſtatiſtical principles to the ancient chronology of Greece, had chaſtiſed the vanity of nations, and arreſted the progreſs of infidelity in delineating the hiſtory of the world. Loſt in the confuſion of exceſſive pretenſions to an antiquity beyond all meaſure, and diſguſted by the ſuperſtitious aids that were aſſumed to ſupport theſe pretenſions among ancient nations, the revivers of learning in Europe, during the laſt and the preceding century, turmoiled themſelves with controverſies between the comparative merits of the ancients and moderns; and the abettors of the latter, entrenching themſelves behind the falſehoods of the ancients, on the ſcope of their remote hiſtory, gave the lie to all antiquity, and in deſpair plunged themſelves into the ocean of ſcepticiſm.

Happy had it been for ſociety if this ſcepticiſm had confined itſelf to the hiſtory of ancient nations in general; but the ſame ſpirit, taking diſguſt at the horrors of Chriſtian ambition and bigotry, and contemplating with deriſion the ridiculous legends of modern miracles, gave the lie to all religious ſcripture of the Jews and Chriſtians, and attempted to baniſh divine intelligence, the ſuperintending providence of Deity, and the true dignity of the human ſpecies, from the face of the earth!

It was a noble undertaking, therefore, in Sir James, to attempt to diſperſe this miſt of error, by diſpaſſionately and ſcientifically explaining and ſupporting the chronology of Sir Iſaac Newton. He has done it with great preciſion and effect; and it is a book well worth the peruſal of thoſe who wiſh to read ancient hiſtory with improvement, or to prevent themſelves from being bewildered in the mazes of modern conjecture. It was printed in 4to at Franckfort on the Maine, for John Bernard Eichemberg the Elder, in 1757.

In the year 1758, and the following, the Britiſh Houſe of Commons took up the conſideration of a ſtatute to regulate a general uniformity of weights and meaſures throughout the united kingdoms, which had been ſo often unſucceſsfully attempted.

This called the attention of Sir James, not only to the inveſtigation of the particular ſubject that engaged that of the Houſe of Commons, but to deviſe a method of rendering an uniformity of weights and meaſures univerſal. He thought the cauſe of former diſappointments in this uſeful purſuit had been the miſtaken notion that one or other of our preſent meaſures ſhould be adopted for the new ſtandard. After the plan had been relinquiſhed by the parliament of England, he digeſted his notes and obſervations on this important diſquiſition into the form of an epiſtolary diſſertation, which he tranſmitted to his friend Lord Barrington, and reſolved, if there had been a congreſs aſſembled, as was once propoſed, to adjuſt the preliminaries of the general peace in 1763, to have laid his plan before the miniſters of the different nations, who were to prepare that ſalutary pacification of the contending powers.

This epiſtolary diſſertation Sir James afterwards reduced at Coltneſs, in the year 1777, into a form more proper for the public eye, and ſent a corrected copy to a friend, reſerving another for the preſs, which was printed 1790 for Stockdale in Piccadilly.

In this tract the author ſhews, from the ineffectual attempts that have been made to alter partially, by innovation, the ſtandards of meaſures or weights, that the effectual plan to be adopted, is to depart entirely from every meaſure whatſoever now known, and to take, *ad libitum*, ſome new maſs inſtead of our pound, ſome new length inſtead of our ell, ſome new ſpace inſtead of our acre, and ſome new ſolid inſtead of our gallon and buſhel.

For this purpoſe Sir James propoſes as the unit a maſs to be verified with the greateſt poſſible accuracy, equal in weight to ten thouſand Troy grains. The pendulum, as it ſwings at London, to beat ſeconds of time, he propoſes to be the meaſure of length; and after having laid down his fundamental principles, he propoſes an ingenious plan for rendering their adoption univerſal through the whole world.

Having obtained his pardon, Sir James Stewart retired to Coltneſs, in the county of Lanark, the paternal eſtate of his family, where he turned his attention to the improvement of his neighbourhood by public works and police, and drew the firſt good plan for a turnpike bill, ſuited to the circumſtances of Scotland, which has been ſince generally adopted. He repaired his houſe, planted, improved, and decorated his eſtate, and in ſocial intercourſe rendered himſelf the delight of his neighbourhood and country.

Never was there a man who, with ſo much knowledge, and ſo much energy of expreſſion in converſation, rendered himſelf more delightful to his company, or was more regretted by his acquaintance when he died. Nor was the active mind of Sir James unemployed for the general benefit of his country during his retreat. He was engaged by the directiors of the Eaſt India Company of England to digeſt a code for the regulation of the current coin of Bengal; the plan for which important regulation he printed, and received from the court of directors a handſome diamond ring, as a mark of their approbation.

He prepared for the preſs, but never publiſhed, an antidote to the *Syſteme de la Nature* by Mirabeau, wherein the parallelogiſms and fooliſh reaſoning of that infidel work are examined, detected, and confuted. It is written in French; and were the work of Mirabeau worth refutation, might be printed with much advantage to Sir James's reputation as a controverſial writer.

This great and good man died in November 1780, and was buried at Cambuſnethan, in Lanarkſhire, on the 28th of the ſame month; the Duke of Hamilton and his neighbours performing the laſt offices to the remains of their highly valued friend, and bedewing his aſhes with their tears.

For this ſhort ſketch of the principal events in the life of Sir James Stewart-Denham, we are indebted to his nephew the Earl of Buchan, who, juſtly proud of his relation to ſuch a man, cannot be ſuppoſed to view all his projects, or even all his reaſonings, with the cool impartiality of ſtrangers. His plan, for inſtance, of a univerſal ſtandard of weights and meaſures for the *whole world*, though certainly a grand conception, we cannot help conſidering as romantic and impracticable. The author indeed was ſenſible, that time would be requiſite for its execution; and ſo large a portion of time, that, compared with it, a thouſand years are but as one day, when compared with the ordinary life of man: but ſchemes of this magnitude are not for creatures ſo blind and weak as we are, who, when we wander to a diſtance beyond the limits of our narrow ſphere, with the ambitious view of benefiting poſterity, are almoſt certain to injure ourſelves, without a probability of ſerving thoſe for whom we dream that we are exerting our abilities. Sir James's Political Economy, however, is a very great work, which has not received half the praiſes to which it is entitled, and which, we ſuſpect, provoked the envy of another great writer on ſimilar ſubjects, who exerted himſelf privately to leſſen its fame. The defence of Newton's chronology is likewiſe very valuable, though we certainly do not think that part of the ſyſtem invulnerable, in which the great aſtronomer attempts to prove, that *Oſiris*, *Seſoſtris*, and *Seſac*, are three names of the ſame Egyptian king. This, however, is a very trifling miſtake; and the modern ſcioliſt, who can lay hold of it to reject the whole, has certainly never read, or, if he has read, does not underſtand the defence of the ſyſtem by Sir James Stewart.

STEWART's *Iſlands*, in the South Pacific Ocean, a cluſter of 5 iſlands diſcovered by Capt. Hunter, in 1791; and ſo named in honour of Admiral Keith Stewart. S. lat. 8 26, W. long. 163 18.—*Morſe*.

STEY *Point*, on the Labrador coaſt, and N. Atlantic Ocean. N. lat. 58, W. long. 61 40.—*ib*.

STILL WATER, a townſhip of New-York, Albany county, bounded eaſterly by Cambridge, and ſoutherly by Schahtekoke and Anthony's Kill. It contains 3,071 inhabitants; of whom 459 are electors, and 61 ſlaves. The village of *Stillwater*, in this townſhip, is ſituated on the W. bank of Hudſon's river; 12 miles from Cohoez Bridge, 12 from Saratoga, 25 N. of Albany, and 12 from Ballſtown Springs. A canal is begun at this place to lead the water of the Hudſon to the mouth of the Mohawk, 14 miles below.—*ib*.

STINKING *Iſlands*, on the eaſt coaſt of Newfoundland Iſland. N. lat. 49 28, weſt long. 52 50.—*ib*.

STISSIK *Mountain*, lies between the State of Connecticut and Hudſon's river, and near it the Mahikander Indians formerly reſided.—*ib*.

STOCKBRIDGE, a poſt-town of Maſſachuſetts, Berkſhire county, 44 miles W. by N. of Springfield, 141 weſt of Boſton, 249 north-eaſt of Philadelphia, and 25 miles eaſt-by-ſouth of Kinderhook, in New-York. The townſhip is the chief of the county; was incorporated in 1739, and contains 1,336 inhabitants.—*ib*.

STOCKBRIDGE, a townſhip in Windſor county, Vermont, on White river, and contains 100 inhabitants. —*ib*.

STOCKBRIDGE, *New*, a tract of land 6 miles ſquare, lying in the ſouth-eaſt part of the Oneida Reſervation, in the State of New-York, inhabited by the Indians, 300 in number, who, ſome years ſince, removed from Stockbridge, Maſſachuſetts, and from this circumſtance are called the *Stockbridge Indians*. This tract was given to theſe Indians by the Oneidas, as an inducement to them to ſettle in their neighbourhood; and is 7 miles ſouth-eaſt of Kahnonwolohale, the principal village of the Oneidas. Theſe Indians are under the paſtoral care of a miſſionary, the Rev. Mr Sarjeant, whoſe pious labours have been attended with conſiderable ſucceſs. They are generally induſtrious, eſpecially the women, and employ themſelves in agriculture, and breeding of cattle and ſwine. Their farms are generally incloſed with pretty good fences, and under tolerable cultivation. In the fall of 1796, almoſt every family ſowed wheat; and there was a ſingle inſtance this year, of one of the Indian women, named *Eſther*, who wove 16 yards of woollen cloth; who is here mentioned as an example of induſtry, and as having led the way to improvements of this kind. There is little doubt but her example will be followed by others. Their dividend of monies from the United States, amounting to about 300 dollars, has hitherto been expended in erecting a ſaw-mill, and ſupporting an Engliſh ſchool.—*ib*.

STOCK *Creek*, a branch of Peleſon river.—*ib*.

STOCKPORT, a village in Northampton county, Pennſylvania,

Pennſylvania, on the weſt ſide of the Popaxtunk branch of Delaware river. From this place is a portage of about 18 miles to Harmony, on the eaſt branch of the river Suſquehannah.—*ib.*

STODDARD, a townſhip of New-Hampſhire, Cheſhire county, about 15 or 18 miles eaſt of Walpole on Connecticut river. It was incorporated in 1774, and contains 701 inhabitants.—*ib.*

STODHART *Bay*, near the north-weſt point of the iſland of Jamaica, is to the eaſt of Sandy Bay, and between it and Lucea harbour.—*ib.*

STOKES, a county of Saliſbury diſtrict, North-Carolina; bounded eaſt by Rockingham, and weſt by Surry, and contains 8,528 inhabitants, including 787 ſlaves. Iron ore is found here in conſiderable quantities, and works have been erected on Iron Creek, which manufacture conſiderable quantities. Chief town Germantown.—*ib.*

Stokes, the chief town of Montgomery county, N. Carolina, near Yadkin river. It contains a court-houſe, gaol, and about 20 houſes.—*ib.*

STONE *Arabia*, a village and fine tract of country ſo called in Montgomery county, New-York, on the north ſide of Mohawk river, between 50 and 60 miles weſtward of Albany. This ſettlement was begun by the Germans in 1709. The land from the river riſes on a beautiful and gradual aſcent for 4 miles, and the principal ſettlement is on a wide ſpreading hill, at that diſtance from the river. The ſoil is excellent, and the people induſtrious and thriving. It ſuffered much from the Indians in the late war, peculiarly in 1780.—*ib.*

STONEHAM, a townſhip of Maſſachuſetts, in Middleſex county, which was incorporated in 1725, and contains 381 inhabitants. It is about 10 miles north of Boſton.—*ib.*

STONE *Indians*, inhabit ſouth of Fire Fort, on Aſſenebayne river, N. America.—*ib.*

Stone *Mountain*, between the States of Tenneſſee and Virginia. The Virginia line interſects it in lat. 36 30 N. from thence to the place where Watauga river breaks through it.—*ib.*

Stone *Iſland*, on the eaſt coaſt of Newfoundland, is near Cape Broyle, and is one of the 3 iſlands which lie off Caplin Bay.—*ib.*

STONES, is a boatable water of Tenneſſee, which runs north-weſterly into Cumberland river, 6 miles north-eaſt of Naſhville.—*ib.*

Stones *Fort Gut*, on the ſouth-weſt ſide of the iſland of St Chriſtopher's; eaſtward of Old Road Bay, and between that and Bloody Point. There is a fort on a point of land, on the weſt ſide.—*ib.*

STONEY *Hill*, in Baltimore county, Maryland, is 5 or 6 miles north-weſterly of Whetſtone Fort, at the mouth of Baltimore harbour, and 2 miles ſouth-eaſt of Hooks-Town.—*ib.*

Stoney *Point*, in Orange county, New-York, a ſmall peninſula, projecting in a conſiderable bluff from the weſt bank of Hudſon's river into Haverſtraw bay; about 40 miles north of New-York city, juſt at the ſouthern entrance of the high lands. In the capture of this fortreſs, the brave Gen. Wayne diſtinguiſhed himſelf.—*ib.*

Stoney *Mountains*, in the north-weſt part of N. America, extend from the ſouthward to the northward, and in a north-weſtern direction, from lat. 48 to 68 north. The northern part of this range is called the Mountains of Bright Stones.—*ib.*

Stoney *River*, called by the French *Bayouk Pierre*, empties into the Miſſiſſippi 4 miles from Petit Goufre, and 10 from Louiſa Chitto. From the mouth of what is called the fork of this river, is computed to be 21 miles. In this diſtance there are ſeveral quarries of ſtone, and the land has a clayey ſoil, with gravel on the ſurface of the ground. On the north ſide of this river the land, in general, is low and rich; that on the ſouth ſide is much higher, but broken into hills and vales; but here the low lands are not often overflowed: both ſides are ſhaded with a variety of uſeful timber.—*ib.*

STONINGTON, a poſt-town and port in New-London county, Connecticut; 14 miles eaſt by ſouth of New-London city, and 251 N. E. of Philadelphia. The harbour ſets up from the Sound, oppoſite to Fiſher's Iſland. The town is ſeparated from Rhode-Iſland by the E. line of the ſtate; and was ſettled in 1658. Here are 6 places of public worſhip; and the number of inhabitants, in 1790, was 5,648.—*ib.*

STONO *Inlet*, on the coaſt of South Carolina, is to the ſouthward of the channel of Charleſton, at the N. E. corner of John's Iſland, which is bounded by Stono river on the weſtward. It is 6 miles from the S. channel of Charleſton, and from this inlet to that of North Ediſto, the courſe is ſouth-weſt by weſt ½ weſt, diſtant 11 miles.—*ib.*

STORM *Cape*, in the ſtraits of Northumberland, is the northern limit of the mouth of Bay Verte, and forms the ſouth eaſt corner of the province of New-Brunſwick.—*ib.*

STOUENUCK, a townſhip in Cumberland county, New-Jerſey.—*ib.*

STOUGHTON, called by the Indians, *Pakemitt*, or *Pontipog*, or *Punkapaug*, (that is *taken from a ſpring that ariſeth out of red earth*) a townſhip in Norfolk county, Maſſachuſetts, incorporated in 1726. It is bounded E. by Braintree, W. by Sharon, and is 15 miles ſouthwardly of Boſton. It contains 16,000 acres of land, and 1,994 inhabitants. Iron ore is found here of an excellent quality, and there is a rolling and ſlitting mill, which manufacture conſiderable quantities of ſteel and iron. Great quantities of charcoal, baſkets and brooms, are ſent from thence to Boſton. Early in the war a large quantity of gun powder, of an excellent quality, was made in this town, for the American army, from ſalt-petre, the produce of the towns in its vicinity.—*ib.*

STOW, a townſhip of Maſſachuſetts, Middleſex county, incorporated in 1683, and contains 801 inhabitants, and is 25 miles N. W. of Boſton.—*ib.*

Stow, a townſhip of Vermont, Chittenden county, about 25 or 30 miles eaſt of Burlington.—*ib.*

STRABANE, two townſhips of Pennſylvania; the one in York county, the other in that of Waſhington.—*ib.*

STRAFFORD, a townſhip in Orange county, Vermont, weſt of Thetford, adjoining, having 845 inhabitants.—*ib.*

Strafford, a county of New-Hampſhire, bounded N. and N. W. by Grafton; S. E. by Rockingham, and eaſt by the Diſtrict of Maine. It contains 25 townſhips, almoſt wholly agricultural, and has no ſea-port. The branches of the Piſcataqua and Merrimack, and other ſtreams water this county; beſides the lakes Winnipiſeogee and Oſſipee. It contains 23,601 inhabitants,

bitants, of whom 22 are ſlaves. Chief towns, Dover and Durham.—*ib.*

STRAITS *of Beering*, or *Bhering*, ſeparate the N. W. part of N. America from the N. E. coaſt of Aſia. Beering's Iſland lies in lat. 55 N. and long. 164 35 E.—*ib.*

STRASBURG, a poſt-town of Virginia, Shenandoah county, on the north-weſt branch of the north fork of Shenandoah river, and contains a handſome German Lutheran church, and about 60 or 70 houſes. It is 77 miles N. E. by N. of Staunton, 18 ſouth-ſouth-weſt of Wincheſter, and 210 ſouth-weſt of Philadelphia.—*ib.*

STRASBURG, a town of Lancaſter county, Pennſylvania; ſituated on an eminence, and in the centre of a fertile and well cultivated country, and contains about 60 houſes, ſeveral of which are built of brick. It is about 7 miles weſt from Straſburg Gap, where the road leads through the mountains, 8 miles eaſt of Lancaſter, and 58 weſt of Philadelphia.—*ib.*

STRASBURG, a ſettlement in Kentucky, near the Bullit Lick.—*ib.*

STRATFORD, a townſhip in Grafton county, New-Hampſhire; ſituated on the eaſt bank of Connecticut river, between Cockburn townſhip N. and Northumberland on the mouth of the Upper Amonooſuck on the ſouth. It was incorporated in 1773, and contains 146 inhabitants. It is 58 miles above Hanover.—*ib.*

STRATFORD, a pleaſant poſt-town of Connecticut, in Fairfield county, on the W. ſide of Stratford river, which contains 2 places for public worſhip, and ſeveral neat and commodious houſes. It is 14 miles ſouth-weſt of New-Haven, 20 N. E. of Norwalk, and 169 N. E. of Philadelphia. The townſhip of Stratford, the *Cupheag* of the Indians, was ſettled in 1638, principally from Maſſachuſetts.—*ib.*

STRATHAM or *Streatham*, a townſhip of New-Hampſhire; ſituated in Rockingham county. Incorporated in 1693, and contains 882 inhabitants. It lies on the road from Portſmouth to Exeter; 10 miles weſt of the former, and 4 eaſt of the latter.—*ib.*

STRATTON, a townſhip of Vermont, Windham county, about 15 miles N. E. of Bennington, having 95 inhabitants.—*ib.*

STRAWBERRY *Gap*, a paſs in the mountains on the road from Philadelphia to Lancaſter; 42 miles weſt of the former, and 16 ſouth-eaſt of the latter.—*ib.*

STRAWBERRY *River*, falls into Lake Ontario; and is thus named from the great quantity of large fruit of that name growing on its banks.—*ib.*

STROUDS, a ſtage on the new road from Lexington in Kentucky, to Virginia. It is 17 miles N. E. of Lexington, and 9 from Holden.—*ib.*

STUART's *Iſland*, on the N. W. coaſt of North-America, is about 6 or 7 leagues in circuit, about 17 leagues from Cape Denbigh on the continent. N. lat. 63 35.—*ib.*

STUART TOWN, in Grafton county, New-Hampſhire, is ſituated on the eaſtern bank of Connecticut river, between Colebrook on the ſouth, and a tract of 2,000 acres on the north, belonging to Dartmouth college.—*ib.*

STUMPSTOWN, a ſmall town of Pennſylvania, Dauphin county, on a branch of Little Swatara. It contains about 20 houſes, and a German Lutheran and Calviniſt church united. It is 24 miles E. N. E. of Harriſburg, and 89 N. W. by W. of Philadelphia.—*ib.*

STURBRIDGE, a townſhip in the S. W. corner of Worceſter county, Maſſachuſetts, containing 28,929 acres, divided from Woodſtock and Union on the ſouth, in Connecticut by the ſtate line, and on the north by Brookfield. It was incorporated in 1738, and contains 1704 inhabitants. The butter and cheeſe made here have obtained high credit in the markets. It is 70 miles ſouth-weſt by weſt of Boſton, and 22 ſouth-weſt of Worceſter.—*ib.*

STYX, a ſmall branch of Patowmac river, where it is called Cohongoronto. It riſes in the Laurel Thickets, in the Alleghany Mountains; runs north, and empties oppoſite to Laurel Creek.—*ib.*

SUBCONTRARY POSITION, in geometry, is when two equiangular triangles are ſo placed, as to have one common angle at the vertex, and yet their baſes not parallel; conſequently the angles at the baſes are equal, but on the contrary ſides.

SUBDUCTION, in arithmetic, the ſame as *Subtraction*.

ANIMAL AND VEGETABLE SUBSTANCES.

THE reader will recollect, that the article CHEMISTRY, in this *Supplement*, was divided into four parts; of which only the firſt three, comprehending the elements of the ſcience, were given under the word CHEMISTRY. The *fourth part*, which was entitled an examination of bodies as they are preſented to us by nature in the mineral, vegetable, and animal kingdoms, naturally ſubdivides itſelf into three parts, comprehending reſpectively, 1. Minerals; 2. Vegetables; 3. Animals.

The firſt of theſe ſubdiviſions, which has been diſtinguiſhed by the name of MINERALOGY, we have treated of already in a former part of this work. As the other two ſubdiviſions have not hitherto received any appropriate name, we have ſatisfied ourſelves with the word SUBSTANCE, by which chemiſts have agreed to denote the objects which belong to theſe ſubdiviſions. This name, it muſt be acknowledged, is not unexceptionable; but we did not conſider ourſelves as at liberty to invent a new one.

2 Diviſion of it.

The preſent article, then, ſeems to divide itſelf into two parts: the firſt part comprehending *vegetable*; the ſecond *animal* ſubſtances. But there are certain animal and vegetable ſubſtances diſtinguiſhed from all others by being uſed as articles of clothing. It is uſual to tinge theſe of various colours, by combining with them different colouring matters for which they have an affinity. This proceſs, well known by the name of DYEING, is purely chemical; and as it belongs excluſively to animal and vegetable ſubſtances, it comes naturally to be examined here. We ſhall therefore add a *third part*, in which we ſhall give a view of the preſent ſtate of DYEING, as far, at leaſt, as is conſiſtent with the nature of a ſupplementary article.

Part I. Of Vegetable SUBSTANCES.

Sugar.

VEGETABLES, or plants, as they are alſo called, are too well known to require any definition. Their number is prodigious, and their variety, regularity, and beauty, are wonderful. But it is not our intention in this place either to enumerate, to deſcribe, or to claſſify plants. Theſe taſks belong to the botaniſt, and have been ſucceſsfully accompliſhed by the zeal, the ſingular addreſs, and the indefatigable labour of Linnæus and his followers.

3 Chemical examination of vegetables. It is the buſineſs of the chemiſt to analyſe vegetables, to diſcover the ſubſtances of which they are compoſed, to examine the nature of theſe ſubſtances, to inveſtigate the manner in which they are combined, to detect the proceſſes by which they are formed, and to aſcertain the chemical changes to which plants, after they have ceaſed to vegetate, are ſubject. Hence it is evident, that a chemical inveſtigation of plants comprehends three particulars:

1. An account of the *ſubſtances* of which plants are compoſed.

2. An account of the *vegetation* of plants, as far as it can be illuſtrated by chemiſtry.

3. An account of the *changes* which plants undergo after they ceaſe to vegetate.

We therefore divide this part into three chapters, aſſigning a chapter to each of theſe particulars.

Chap. I. Of the Ingredients of Plants.

The ſubſtances hitherto found in the vegetable kingdom, all of them at leaſt which have been examined with any degree of accuracy, may be reduced to the following heads:

1. Sugar,
2. Starch,
3. Gluten,
4. Albumen,
5. Gum,
6. Jelly,
7. Extract,
8. Tan,
9. Oils,
10. Camphor,
11. Reſins,
12. Caoutchouc,
13. Wax,
14. Wood,
15. Acids,
16. Alkalies,
17. Earths,
18. Metals.

Theſe ſhall form the ſubject of the following ſections:

Sect. I. *Of Sugar.*

Sugar, which at preſent forms ſo important an article in our food, ſeems to have been known at a very early period to the inhabitants of India and China.

4 Diſcovery of ſugar. But Europe probably owes its acquaintance with it to the conqueſts of Alexander the Great. For ages after its introduction into the weſt, it was uſed only as a medicine; but its conſumption gradually increaſed, and during the time of the Cruſades, the Venetians, who brought it from the eaſt, and diſtributed it to the northern parts of Europe, carried on a lucrative commerce with ſugar. It was not till after the diſcovery of America, and the extenſive cultivation of ſugar in the Weſt Indies, that its uſe in Europe, as an article of food, became general.*

Suga

5 How o tained. Sugar is obtained from the *arundo ſaccharifera*, or *ſugar cane*. The juice of this plant is preſſed out and boiled in as low a temperature as poſſible, till the ſugar precipitates in the form of confuſed cryſtals. Theſe cryſtals, known by the name of *raw ſugar*, are again diſſolved in water, the ſolution is clarified, and purer cryſtals are obtained by a ſubſequent evaporation. But for the particulars of the art of manufacturing ſugar, we refer the reader to the article Sugar in the *Encyclopædia*.

6 Its pro ties. Sugar, after it has been purified, or *refined* as the manufacturers term it, is uſually ſold in Europe in the form of a white opake maſs, well known by the name of *loaf ſugar*. Sometimes alſo it is cryſtallized, and then it is called *ſugar candy*.

Sugar has a very ſtrong ſweet taſte; when pure it has no ſmell; its colour is white, and when cryſtallized it is ſomewhat tranſparent. It has often a conſiderable degree of hardneſs; but it is always ſo brittle that it can be reduced without difficulty to a very fine powder. It is not altered by expoſure to the atmoſphere.

7 Solubil in wate It is exceedingly ſoluble in water. At the temperature of 48°, water, according to Mr Wenzel, diſſolves its own weight of ſugar. The ſolvent power of water increaſes with its temperature; when nearly at the boiling point, it is capable of diſſolving any quantity of ſugar whatever. Water thus ſaturated with ſugar is known by the name of *ſyrup*.

8 Its cry Syrup is thick, ropy, and very adheſive; when ſpread thin upon paper, it ſoon dries, and forms a kind of varniſh, which is eaſily removed by water. Its ſpecific caloric, according to the experiments of Dr Crawford, is 1.086. When ſyrup is ſufficiently concentrated, the ſugar which it contains precipitates in cryſtals. The primitive form of theſe cryſtals is a four-ſided priſm, whoſe baſe is a rhomb, the length of which is to its breadth as 10 to 7; and whoſe height is a mean proportion between the length and breadth of the baſe. The cryſtals are uſually four or ſix-ſided priſms terminated by two-ſided, and ſometimes by three-ſided ſummits.†

9 Solubi in alc Sugar is ſoluble in alcohol, but not in ſo large a proportion as in water. According to Wenzel, four parts of boiling alcohol diſſolve one of ſugar.§ It unites readily with oils, and renders them miſcible with water. A moderate quantity of it prevents, or at leaſt retards, the coagulation of milk; but Scheele diſcovered that a very large quantity of ſugar cauſes milk to coagulate.‖

Sugar abſorbs muriatic acid gas ſlowly, and aſſumes a brown colour and very ſtrong ſmell.‡

1 Actio acids. Sulphuric acid, when concentrated, readily decompoſes ſugar; water is formed, and perhaps alſo acetous acid; while charcoal is evolved in great abundance, and gives the mixture a black colour, and a conſiderable degree of conſiſtency. The charcoal may be eaſily ſeparated by dilution and filtration. When heat is applied the ſulphuric acid is rapidly converted into ſulphurous acid.

1 Of p When ſugar is mixed with potaſs, the mixture acquires a bitter and aſtringent taſte, and is inſoluble in alcohol, though each of the ingredients is very ſoluble in that liquid. When the alkali is ſaturated with ſulphuric

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* See *Falconer's Hiſtory of Sugar, Mancheſter Memoirs*, iv. 291. and *Mozeley's Hiſtory of Sugar.*

† *Gillo Ann. d Chim.* 317.

§ *Enc. Meth.* i. 271

‖ *Sche* 52. D tranſl

‡ *Prie* ii. 29

gar.

ick- Rollo abates, 2.

ric acid, and precipitated by means of alcohol, the ſweet taſte of the ſugar is reſtored; a proof that it had undergone no decompoſition from the action of the potaſs, but had combined with it in the ſtate of ſugar.*

2 ne.

Lime boiled with ſugar produces nearly the ſame effect as potaſs; when an alkali is added to the compound, a ſubſtance precipitates in white flakes. This ſubſtance is ſugar combined with lime.† Sugar and chalk compoſe, as Leonardi informs us, a kind of cement ‡

ſ. yc. Chim :.

3 at.

Sugar, when thrown upon a hot iron, melts, ſwells, becomes browniſh black, emits air bubbles, and exhales a peculiar ſmell, known in French by the name of *caromel.* At a red heat it inſtantly burſts into flames with a kind of exploſion. The colour of the flame is white with blue edges.

4 lation

When ſugar is diſtilled in a retort, there comes over a fluid which, at firſt, ſcarcely differs from pure water; by and bye it is mixed with pyromucous acid, afterwards ſome empyreumatic oil makes its appearance; and a bulky charcoal remains in the retort. This charcoal very frequently contains lime, becauſe lime is uſed in refining ſugar; but if the ſugar, before being ſubmitted to diſtillation, be diſſolved in water, and made to cryſtallize by evaporation in a temperature ſcarcely higher than that of the atmoſphere, no lime whatever, nor any thing elſe, except pure charcoal, will be found in the retort. During the diſtillation, there comes over a conſiderable quantity of carbonic acid, and carbonated hydrogen gas.* Sugar therefore is decompoſed by the action of heat; and the following compounds are formed from it: Water, pyromucous acid, oil, charcoal, carbonic acid, carbonated hydrogen gas. The quantity of oil is inconſiderable; by far the moſt abundant product is pyromucous acid. Sugar indeed is very readily converted into pyromucous acid; for it makes its appearance always whenever ſyrup is raiſed to the boiling temperature. Hence the ſmell of caromel, which ſyrup at that temperature emits. Hence alſo the reaſon that, when we attempt to cryſtallize ſyrup by heat, there always remains behind a quantity of incryſtallizable matter, known by the name of *molaſſes*; whereas if the ſyrup be cryſtallized without artificial heat, every particle of ſugar may be obtained from it in a cryſtalline form.† Hence we ſee the importance of properly regulating the fire during the cryſtallization of ſugar, and the immenſe ſaving that would reſult from conducting the operation at a low heat.

boli Mor- Enc. Chim. ?.

rveau, Meth. i.

5 ompo- i.

It follows from theſe facts, and from various other methods of decompoſing ſugar, that it is compoſed of oxygen, hydrogen, and carbon; for all the ſubſtances obtained from ſugar by diſtillation may be reſolved into theſe elements. Lavoiſier has made it probable, by a ſeries of very delicate experiments, that theſe ſubſtances enter into the compoſition of ſugar in the following proportions:

64	oxygen,
28	carbon,
8	hydrogen.
100	

Of the way in which theſe ingredients are combined in ſugar, we are ſtill entirely ignorant. Lavoiſier's concluſions can only be conſidered as approximations to the truth.

Starch.

16 Plants containing it.

Sugar is conſidered as a very nouriſhing article of food. It is found moſt abundantly in the juice of the ſugar cane, but many other plants alſo contain it. The juice of the acer ſaccharinum, or *ſugar maple*, contains ſo much of it, that in North America ſugar is often extracted from that tree.* Sugar is alſo found in the roots of carrot, parſnip, beet, &c. Mr Achard has lately pointed out a method of increaſing the quantity of ſugar in beet ſo much, that, according to his own account, it is at preſent cultivated in large quantities in Pruſſia, and ſugar extracted from it with advantage.† Parmentier has alſo aſcertained that the grains of wheat, barley, &c. and all the other ſimilar ſeeds which are uſed as food, contain at firſt a large quantity of ſugar, which gradually diſappears as they approach to a ſtate of maturity. This is the caſe alſo with peas and beans, and all leguminous ſeeds, and is one reaſon why the flavour of young peas is ſo much ſuperior to that of old ones.

* *Ruſh. Tranſ. Philad.* iii. 64.

† *Ann. de Chim.* xxxii. 163.

SECT. II. *Of STARCH.*

17 Method of obtaining ſtarch.

WHEN a quantity of wheat flour is formed into a paſte, and water poured upon it till it runs off colourleſs, this water ſoon depoſits a very fine whitiſh powder; which, when properly waſhed and dried, is known by the name of *ſtarch*. When firſt prepared, it is of a grey colour; but the ſtarchmakers render it white by ſteeping it in water ſlightly acidulated. The acid ſeems to diſſolve and carry off the impurities.

Starch was well known to the ancients. Pliny informs us, that the method of obtaining it was firſt invented by the inhabitants of the iſland of Chio.†

† *Lib.* xviii. c. 7.

18 Its properties.

Starch has a fine white colour, and is uſually concreted in longiſh maſſes; it has ſcarcely any ſmell, and very little taſte. When kept dry, it continues for a long time uninjured though expoſed to the air.

19 How acted on by water,

Starch does not diſſolve in cold water, but very ſoon falls to powder. It combines with boiling water, and forms with it a thick paſte. Linen dipt into this paſte, and afterwards dried ſuddenly, acquires, as is well known, a great degree of ſtiffneſs. When this paſte is left expoſed to damp air it ſoon loſes its conſiſtency, acquires an acid taſte, and its ſurface is covered with mould.

20 Alcohol,

Starch is ſo far from diſſolving in alcohol, even when aſſiſted by heat, that it does not even fall to powder.

21 Acids,

When ſtarch is thrown into any of the mineral acids, at firſt no apparent change is viſible. But if an attempt is made to break the larger pieces while in acids to powder, they reſiſt it, and feel exceedingly tough and adheſive. Sulphuric acid diſſolves it ſlowly, and at the ſame time a ſmell of ſulphurous acid is emitted, and ſuch a quantity of charcoal is evolved, that the diſh containing the mixture may be inverted without ſpilling any of it. Indeed if the quantity of ſtarch be ſufficient, the mixture becomes perfectly ſolid. The charcoal may be ſeparated by dilution and filtration. In muriatic acid ſtarch diſſolves ſtill more ſlowly. The ſolution reſembles mucilage of gum arabic, and ſtill retains the peculiar odour of muriatic acid. When allowed to ſtand for ſome time, the ſolution gradually ſeparates into two parts; a perfectly tranſparent ſtraw-coloured liquid below, and a thick, muddy, oily, or rather mucilaginous ſubſtance, above. When water is poured in, the muriatic ſmell inſtantly diſappears, and a ſtrong ſmell is exhaled, preciſely ſimilar to that which is felt in corn-mills. Ammonia occaſions a ſlight precipitate, but too ſmall to be examined.

Nitric acid diſſolves ſtarch more rapidly than the other two acids; it acquires a green colour, and emits nitrous gas. The ſolution is never complete, nor do any cryſtals of oxalic acid appear unleſs heat be applied. In this reſpect ſtarch differs from ſugar, which yields oxalic acid with nitric acid, even at the temperature of the atmoſphere. When heat is applied to the ſolution of ſtarch in nitric acid, both oxalic and malic acid is formed, but the undiſſolved ſubſtance ſtill remains. When ſeparated by filtration, and afterwards edulcorated, this ſubſtance has the appearance of a thick oil, not unlike tallow; but it diſſolves readily in alcohol. When diſtilled, it yields acetous acid, and an oil having the ſmell and the conſiſtence of tallow.*

22 Heat. When ſtarch is thrown upon a hot iron, it melts, blackens, froths, ſwells, and burns with a bright flame like ſugar, emitting, at the ſame time, a great deal of ſmoke; but it does not explode, nor has it the caramel ſmell which diſtinguiſhes burning ſugar. When diſtilled, it yields water impregnated with an acid, ſuppoſed to be the pyromucous, and mixed with a little empyreumatic oil. The charcoal which remains is eaſily diſſipated when ſet on fire in the open air; a proof that it contains very little earth.

23 Its compoſition. Barley grain conſiſts almoſt entirely of ſtarch, not however in a ſtate of perfect purity. In the proceſs of malting, which is nothing elſe than cauſing the barley to begin to vegetate, a great part of the ſtarch is converted into ſugar. During this proceſs oxygen gas is abſorbed, and carbonic acid gas is emitted. Water, too, is abſolutely neceſſary; hence it is probable, that it is decompoſed, and its hydrogen retained.† Starch, then, ſeems to be converted into ſugar by diminiſhing the proportion of its carbon, and encreaſing that of its hydrogen and oxygen. Its diſtillation ſhews us that it contains no other ingredients than theſe three.

24 Subſtances containing it. Starch is contained in a great variety of vegetable ſubſtances; moſt commonly in their ſeeds or bulbous roots; but ſometimes alſo in other parts. Mr Parmentier, whoſe experiments have greatly contributed towards an accurate knowledge of ſtarch, has given us the following liſt of the plants from the roots of which it may be extracted.

Arctium lappa,
Atropa belladonna,
Polygonum biſtorta,
Bryonia alba,
Colchicum autumnale,
Spiræ filipendula,
Ranunculus bulboſus,
Scrophularia nodoſa,
Sambucus ebulus,
———— nigra,
Orchis morio,
Imperatoria oſtrutheum,
Hyoſcyamus niger,
Rumex obtuſifolius,
———— acutus,
———— aquaticus,
Arum maculatum,
Orchis maſcula,
Iris pſeudacorus,
—— fœtidiſſima,
Orobus tuberoſus,
Bunium bulbocaſtanum.

It is found alſo nearly pure in the following ſeeds:

Oats,
Rice,
Maiz,
Millet,
Cheſnut,
Horſecheſnut,
Peas,
Beans,
Acorn,
And alſo in
Salop,
Sago.

Sect. III. Of Gluten.

25 Gluten, how obtained. When wheat flour is waſhed in the manner deſcribed in the laſt ſection, in order to obtain ſtarch from it, the ſubſtance which remains, after every thing has been waſhed away which cold water can ſeparate, is called *gluten*. It was diſcovered by Beccaria an Italian philoſopher, to whom we are indebted for the firſt analyſis of wheat flour.†

26 Its propeties. Gluten, when thus obtained, is of a grey colour, exceedingly tenacious, ductile, and elaſtic, and may be extended to twenty times its original length. When very thin, it is of a whitiſh colour, and has a good deal of reſemblance to animal tendon or membrane. In this ſtate it adheres very tenaciouſly to other bodies, and has often been uſed to cement together broken pieces of porcelain. Its ſmell is agreeable. It has ſcarce any taſte, and does not loſe its tenacity in the mouth.

27 Action air. When expoſed to the air, it gradually dries; and, when completely dry, it is pretty hard, brittle, ſlightly tranſparent, of a dark brown colour, and has ſome reſemblance to *glue*. It breaks like a piece of glaſs, and the edges of the fracture reſemble in ſmoothneſs thoſe of broken glaſs; that is to ſay, it breaks with a *vitreous* fracture.

28 Water. When expoſed to the air, and kept moiſt, it ſoon putrefies; but when dry, it may be kept any length of time without alteration. It is inſoluble in water; though it imbibes and retains a certain quantity of it with great obſtinacy. To this water it owes its elaſticity and tenacity. When boiled in water, it loſes both theſe properties. It is ſoluble in alcohol, as Mr Vauquelin informs us;‡ and precipitated again, as Mr Fourcroy has obſerved, by pouring into the alcohol two parts of water.§

29 Acids. Gluten is ſoluble in the three mineral acids. When nitric acid is poured on it, and heat applied, there is a quantity of azotic gas emitted, as Berthollet diſcovered; and, by continuing the heat, a quantity of oxalic acid is formed.‖

30 Alkalies. Alkalies diſſolve gluten when they are aſſiſted by heat. The ſolution is never perfectly tranſparent. Acids precipitate the gluten from alkalies, but it is deſtitute of its elaſticity.¶

31 Heat. When moiſt gluten is ſuddenly dried, it ſwells amazingly. Dry gluten, when expoſed to heat, cracks, ſwells, melts, blackens, exhales a fetid odour, and burns preciſely like feathers or horn. When diſtilled, there comes over water impregnated with ammonia and an empyreumatic oil; the charcoal which remains is with difficulty reduced to aſhes. 32 Its compſition. From theſe phenomena, it is evident that gluten is compoſed of carbon, hydrogen, azot, and oxygen; perhaps alſo it contains a little lime. In what manner theſe ſubſtances are combined is unknown.

33 Subſtanc containi it. The only vegetable ſubſtance which has been hitherto found to contain it abundantly, is wheat flour. Vauquelin alſo found it in the fruit of the *caſſia fiſtularis*,* and Fourcroy in the bark of a ſpecies of quinquina from St Domingo.† It probably exiſts in many other plants.

Sect. IV. Of Albumen.

If the water in which wheat flour has been waſhed in order to obtain ſtarch and gluten, according to the directions laid down in the two laſt ſections, be filtrated, and afterwards boiled, a ſubſtance precipitates in white flakes; to which Mr Fourcroy, who firſt pointed it

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* Scheele, Crell's Journ. ii. 14. Engliſh tranſlation.

† Cruickſhank, Rollo on Diabetes.

† Collect. Acad. x.

‡ Ann. de Chim. vi. 278.

§ Ibid. v 135.

‖ Vauque Ibid. vi. 278.

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* Ibid.

† Ibid. vi 135.

it out, has given the name of *albumen* (A), on account of its reſemblance to the *white* of an egg.‡

It is evident, from the method of obtaining it, that albumen, in its natural ſtate, is ſoluble in water, and that heat precipitates it from that fluid in a concrete ſtate. While diſſolved in water, it has ſcarcely any taſte; but it has the property of changing vegetable blues, eſpecially that which is obtained from the flowers of the mallow (*malva ſylveſtris*), into a green.§ When allowed to remain diſſolved in water, it putrefies without becoming previouſly acid.||

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After it has been precipitated from water in a concrete ſtate by boiling, it is no longer ſoluble in water as before. Alcohol alſo precipitates it from water preciſely in the ſame ſtate as when it is precipitated by heat.

When concrete albumen is dried it becomes ſomewhat tranſparent, and very like glue. In that ſtate it is ſoluble in alkalies, eſpecially ammonia.*

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When diſtilled it gives out carbonat of ammonia, a red fetid oil, and carbonated hydrogen gas; and a ſpongy charcoal remains behind.† From this, it is evident that albumen, like gluten, is compoſed of carbon, azot, hydrogen, and oxygen; but the proportions and combinations of theſe ſubſtances are altogether unknown.

Mr Fourcroy found albumen in the expreſſed juice of ſcurvy graſs, creſſes, cabbage, and almoſt all cruciform plants. He found it too, in a great many young and ſucculent plants; but never a particle in thoſe parts of vegetables which contain an acid. He obſerved alſo that the quantity decreaſed conſtantly with the age of the plant.

SECT. V. *Of Jelly.*

IF we preſs out the juice of ripe blackberries, currants, and many other fruits, and allow it to remain for ſome time in a ſtate of reſt, it partly coagulates into a tremulous ſoft ſubſtance, well known by the name of *jelly*. If we pour off the uncoagulated part, and waſh the coagulum with a ſmall quantity of water, we obtain *jelly* approaching to a ſtate of purity.

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In this ſtate it is nearly colourleſs, unleſs tinged by the peculiar colouring matter of the fruit; it has a pleaſant taſte, and a tremulous conſiſtency. It is ſcarcely ſoluble in cold water, but very ſoluble in hot water; and, when the ſolution cools, it again coagulates into the form of a jelly.† When long boiled, it loſes the property of gelatiniſing by cooling, and becomes analogous to mucilage.‡ This is the reaſon that in making currant jelly or any other jelly, when the quantity of ſugar added is not ſufficient to abſorb all the watery parts of the fruit, and conſequently it is neceſſary to concentrate the liquid by long boiling, the mixture often loſes the property of coagulating, and the jelly, of courſe, is ſpoiled.§

Jelly combines readily with alkalies; nitric acid converts it into oxalic acid, without ſeparating any azotic gas.|| When dried it becomes tranſparent.¶ When diſtilled it affords a great deal of pyromucous acid, a ſmall quantity of oil, and ſcarcely any ammonia.†

Jelly exiſts in all acid fruits, as oranges, lemons, gooſeberries, &c. and no albumen is ever found in thoſe parts of vegetables which contain an acid. This circumſtance has induced Fourcroy to ſuppoſe that jelly is albumen combined with an acid:* but this conjecture has not been verified by experiment: nor indeed is it probable that it ever ſhall; as albumen evidently contains a quantity of azot, and jelly ſcarcely any. The products of jelly by diſtillation ſhew that it approaches nearer than any other vegetable ſubſtance to the nature of ſugar.

SECT. VI. *Of Gum.*

THERE is a thick tranſparent taſteleſs fluid which ſometimes exſudes from certain ſpecies of trees. It is very adheſive, and gradually hardens without loſing its tranſparency; but eaſily ſoftens again when moiſtened with water. This exſudation is known by the name of *gum*. The gum moſt commonly uſed is that which exſudes from different ſpecies of the *mimoſa*, particularly the *nilotica*.† It is known by the name of *gum arabic*. Gum likewiſe exſudes abundantly from the *prunus avium*, or common wild cherry tree of this country.

37
Gum how obtained.

Gum is uſually obtained in ſmall pieces like tears, moderately hard, and ſomewhat brittle while cold, ſo that it can be reduced by pounding to a fine powder. Its colour is uſually yellowiſh, and it is not deſtitute of luſtre. It has no ſmell; its taſte is inſipid.

38
Action of water.

Gum undergoes no change from being expoſed to the atmoſphere; but the light of the ſun makes it aſſume a white colour. Water diſſolves it in large quantities. The ſolution which is known by the name of *mucilage* (B), is thick and adheſive: it is often uſed as a paſte, and to give ſtiffneſs and luſtre to linen. When ſpread out thin it ſoon dries, and has the appearance of a varniſh; but it readily attracts moiſture, and becomes glutinous. Water waſhes it away entirely. When mucilage is evaporated the gum is obtained unaltered.

39
Alcohol.

Gum is inſoluble in alcohol. When alcohol is poured into mucilage, the gum immediately precipitates; becauſe the affinity between water and alcohol is greater than that between water and gum.

The action of alkalies and earths upon gum has not been

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§ *Ann. de Chim.* v. 102

|| *Ibid.* vi. 282.

¶ *Ibid.* v. 100.

† *Ibid.* vi. 286.

* *Ibid.* iii. 261.

† *Schouſboe, Philoſ. Mag.* v. 241.

(A) The exiſtence of albumen in vegetables was known to Scheele. He mentions it particularly in his paper on Milk, firſt publiſhed in the year 1780. See *Scheele's Works*, II. 55. Dijon edition.

(B) Hermſtadt uſes this word in a different ſenſe. He makes a diſtinction between *gum* and *mucilage*. The ſolution of *gum* in water is tranſparent and glutinous, and can be drawn out into threads; whereas that of *mucilage* is opake, does not feel glutinous, but ſlippery, and cannot be drawn into threads. Gum may be ſeparated from mucilage by the following proceſs:

Let the gum which is ſuppoſed to be mixed with mucilage, previouſly reduced to a dry maſs, be diſſolved in as ſmall a quantity of water as poſſible, and into the ſolution drop at intervals diluted ſulphuric acid. The mucilage coagulates while the gum remains diſſolved. When no more coagulation takes place, let the mixture remain at reſt for ſome time, and the mucilage will precipitate to the bottom, and aſſume the conſiſtence of jelly. Decant off the liquid part, and evaporate the mucilage to dryneſs by a gentle heat till it acquires the conſiſtence of horn. *Med. and Phyſ. Jour.* iii. 370.

been examined. Acids do not precipitate it from mucilage.‡ The concentrated mineral acids deſtroy it. Concentrated ſulphuric acid decompoſes it; water is formed, and perhaps alſo acetous acid; while charcoal is precipitated. Nitric acid converts it into oxalic acid; oxy-muriatic acid, on the contrary, into citric acid.*

40
Of heat.

When gum is expoſed to heat it ſoftens and ſwells, but does not melt; it emits air bubbles, blackens, and at laſt, when nearly reduced to charcoal, emits a low blue flame. This flame appears ſooner if a flaming ſubſtance be held juſt above the gum. After the gum is conſumed, there remains a ſmall quantity of white aſhes, compoſed chiefly of the carbonats of lime and potaſs.

When gum is diſtilled in a retort, the products are water impregnated with a conſiderable quantity of pyromucous acid, a little empyreumatic oil, carbonic acid gas, and carbonated hydrogen gas. When the pyromucous acid obtained by this proceſs is ſaturated with lime, a quantity of ammonia is diſengaged with which that acid had been combined. The charcoal which remained in the retort leaves behind it, after incineration, a little lime, and phoſphat of lime.§

41
Its compoſition.

Theſe experiments ſhow us that gum is compoſed of hydrogen, carbon, oxygen, azot, lime, and phoſphorus; but the proportions and combinations of theſe ſubſtances are unknown to us. Mr Cruickſhank has rendered it probable that the quantity of carbon is greater, and the quantity of oxygen leſs, in gum than in ſugar.||

Gum, or mucilage, exiſts moſt abundantly in young plants, and gradually diſappears as they arrive at perfection. It forms a great proportion of the leaves and roots of many eatable plants.

SECT. VII. *Of Extract.*

42
Extract, how obtained.

THE word *extract* was at firſt applied to all thoſe ſubſtances which were extracted from plants by means of water, and conſequently included gum, jelly, and ſeveral other bodies. But of late it has been confined, by thoſe chemiſts who have paid attention to the uſe of language, to a ſubſtance which exiſts in many plants, and which may be obtained by infuſing *ſaffron* in water for ſome time, filtrating the infuſion, and evaporating it to dryneſs. The reſiduum, after evaporation, is *extract* nearly pure.¶ It poſſeſſes the following properties:

43
Its properties.

Water diſſolves it in conſiderable quantities, eſpecially hot water. Alcohol alſo diſſolves it with facility. This property of being ſoluble both in water and alcohol has induced ſome chemiſts to give *extract* the name of *ſoap*. It is inſoluble in ſulphuric ether. Theſe three properties are ſufficient to diſtinguiſh it from every other vegetable ſubſtance.*

When the ſolution of extract in water is expoſed for ſome time in the open air, the extract precipitates, and is now no longer ſoluble in water. This change is ſuppoſed to proceed from the addition of a quantity of oxygen which it imbibes from the atmoſphere.†

When oxy-muriatic acid is poured into a watery ſolution of extract, that ſubſtance precipitates in yellow flakes. Theſe flakes are inſoluble in water; they are inſoluble alſo in alcohol at the temperature of 97°; but that liquid diſſolves them at the temperature of 120°. They are ſoluble alſo in alkalies, and in boiling hot water they melt into a yellow maſs.‡

Extract is ſoluble in acids. Heat ſoftens but does not melt it.§

It is found in a great variety of plants; but as no method of obtaining it perfectly pure has hitherto been diſcovered, the extracts of different plants differ ſomewhat from each other both in their colour and ſmell.

SECT. VIII. *Of Tan.*

44
Preparation of

IF a quantity of nut galls, coarſely powdered, be kept for ſome time infuſed in cold water, if the water be filtered, and a ſolution of muriat of tin be dropt into it, a copious white precipitate falls to the bottom. This precipitate is to be carefully waſhed and diffuſed (for it will not diſſolve) thro' a large quantity of water, and this water is to be ſaturated with ſulphurated hydrogen gas ſo completely that it will not abſorb any more. By this treatment the white precipitate will gradually diſappear, and a brown precipitate will take its place. This brown precipitate muſt be ſeparated by filtration; and the water, which has now acquired the colour and the taſte of the infuſion of nut galls, muſt be evaporated to dryneſs. A ſubſtance remains behind, known by the name of *tan* or *tannine*.

It was firſt diſcovered by Seguin, who pointed out ſome of its properties, and the method of detecting it in plants.|| The above method of obtaining it in a ſtate of purity was contrived by Mr Prouſt. Tan exiſts in the ſolution of nut galls combined with gallic acid. The oxyd of tin has a ſtrong affinity for it. When muriat of tin is poured in, the tan combines with the oxyd, and the compound being inſoluble, falls to the bottom. Sulphur has a ſtronger affinity for the oxyd than tan has. Hence when ſulphurated hydrogen gas is thrown upon this compound, the ſulphur leaves the gas and combines with the tin; and the compound, being inſoluble, falls to the bottom: The hydrogen gas eſcapes, and nothing remains in the water except the tan.

45
Its properties.

Tan is a brittle ſubſtance, of a brown colour. It breaks with a vitreous fracture, and does not attract moiſture from the air. Its taſte is exceedingly aſtringent. It is very ſoluble in water. The ſolution is of a deep brown colour, a very aſtringent and bitter taſte, and has the odour which diſtinguiſhes a ſolution of nut galls. It froths, when agitated, like a ſolution of ſoap; but does not feel unctuous. Acids precipitate the tan from this ſolution.

Tan is ſtill more ſoluble in alcohol than in water.

When the ſolution of tan is poured into a ſolution of the brown ſulphat of iron, a deep blue coloured precipitate immediately appears, conſiſting of the tan combined with the oxyd. This precipitate, when dried, aſſumes a black colour. It is decompoſed by acids. The green ſulphat of iron is not altered by tan.

When too great a proportion of brown ſulphat of iron is poured into a ſolution of tan, the ſulphuric acid, ſet at liberty by the combination of the iron and tan, is ſufficient to rediſſolve the precipitate as it appears; but the precipitate may eaſily be obtained by cautiouſly ſaturating this exceſs of acid with potaſs. When the experiment is performed in this manner, all the red ſulphat of iron which remains in the ſolution undecompoſed is converted into green ſulphat. Mr Prouſt, to whom we are indebted for almoſt every thing yet known concerning the properties of tan, ſuppoſes that this change is produced

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‡ *Vauquelin.*

* *Id. Ann. de Chim.* vi. 178.

§ *Cruickſhank Rollo on Diabetes.*

|| *Ibid.*

¶ *Hermſtadt.*

* *Hermſtadt.*

† *Fourcroy.*

§ *Fourcroy.*

§ *Id. Ann. de Chim.* viii.

|| *Nicholſon's Jo* i. 271.

produced by the tan abſorbing oxygen from the iron. This may very poſſibly be the caſe; but his experiments are inſufficient to prove that it is. The ſame change takes place if red oxyd be mixed with a conſiderable exceſs of ſulphuric acid, and diluted with water.

Tan combines readily with oxygen. When oxy-muriatic acid is poured upon it, its colour deepens, and it loſes all its peculiar characters.*

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Tan exiſts in almoſt all thoſe vegetable ſubſtances which have an aſtringent taſte. It is almoſt conſtantly combined with gallic acid. The following table, drawn up by Mr Biggin,† though the rule which the author followed in making his experiments precluded rigid accuracy, will ſerve to give ſome idea of the proportions of tan which exiſt in different plants:

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	Prop. of Tan.		Prop. of Tan.
Elm	2,1	Sallow	4,6
Oak cut in winter	2,1	Mountain aſh	4,7
Horſe cheſnut	2,2	Poplar	6,0
Beech	2,4	Hazel	6,3
Willow (boughs)	2 4	Aſh	6,6
Elder	3,0	Spaniſh cheſnut	9,0
Plum tree	4,0	Smooth oak	9,2
Willow (trunk)	4,0	Oak cut in ſpring	9,6
Sycamore	4,1	Huntingdon or Leiceſter willow	10,1
Birch	4,1		
Cherry tree	4,2	Sumach	16,2

SECT. IX. *Of OILS.*

THERE are two ſpecies of oils; namely, *fixed* and *volatile;* both of which are found abundantly in plants.

1. Fixed oil is found in the ſeeds of many plants, eſpecially of the olive, beech, flax, almond, rape, &c.

2. Volatile oil is obtained by diſtillation from the leaves, flowers, or roots of aromatic plants, as lavender, roſes, roſemary, &c.

As an account of the properties of oils has been given already in the article CHEMISTRY, *Suppl.* it would be ſuperfluous to repeat it here.

SECT. X. *Of CAMPHOR.*

THE laurus camphorata is a tree which grows in China, Japan, and ſeveral parts of India. When the roots of this tree are put into an iron pot furniſhed with a capital, and a ſufficient heat is applied, a particular ſubſtance ſublimes into the capital, which is known by the name of *camphor*. The Dutch afterwards purify this camphor by a ſecond ſublimation.

Camphor is a white brittle ſubſtance, having a peculiar aromatic odour and a ſtrong taſte.

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It is not altered by atmoſpheric air; but it is ſo volatile, that if it be expoſed during warm weather in an open veſſel, it evaporates completely. When ſublimed in cloſe veſſels it cryſtalliſes in hexagonal plates or pyramids.*

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It is inſoluble in water; but it communicates to that liquid a certain portion of its peculiar odour.

It diſſolves readily in alcohol, and is precipitated again by water. If the alcohol be diluted with water as much as poſſible, without cauſing the camphor to precipitate, ſmall cryſtals of camphor reſembling feathers gradually form.†

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Camphor is ſoluble alſo in hot oils, both fixed and volatile; but as the ſolution cools the camphor precipitates, and aſſumes the form of plumoſe, or feather-like cryſtals.‡

Camphor is not acted on by alkalies, either pure or in the ſtate of carbonats. Pure alkalies indeed ſeem to diſſolve a little camphor; but the quantity is too ſmall to be perceptible by any other quality than its odour.§ Neither is it acted upon by any of the neutral ſalts which have hitherto been tried.

Acids diſſolve camphor, but it is precipitated again, unaltered, by alkalies, and even by water. The ſolution of camphor in ſulphuric acid is red; that in the nitric acid is yellow. This laſt ſolution has obtained the abſurd name of *oil of camphor.* When nitric acid is diſtilled repeatedly off camphor, it converts it into camphoric acid.

Muriatic, ſulphurous, and fluoric acids, in the ſtate of gas, diſſolve camphor. When water is added, the camphor appears unaltered in flakes, which ſwim on the ſurface of the water §

When heat is applied to camphor it is volatilized. If the heat be ſudden and ſtrong, the camphor melts before it evaporates. It catches flame very readily, and emits a great deal of ſmoke as it burns, but it leaves no reſiduum. It is ſo inflammable that it continues to burn even on the ſurface of water. When camphor is ſet on fire in a large glaſs globe filled with oxygen gas, and containing a little water, it burns with a very bright flame, and produces a great deal of heat. The inner ſurface of the glaſs is ſoon covered with a black powder, which has all the properties of charcoal, a quantity of carbonic acid gas is evolved, the water in the globe acquires a ſtrong ſmell, and is impregnated with carbonic acid and camphoric acid.‖

48
Its analyſis.

If two parts of alumina and one of camphor be formed into a paſte with water, and diſtilled in a glaſs retort, there comes over into the receiver (which ſhould contain a little water, and communicate with a pneumatic apparatus) a volatile oil of a golden yellow colour, a little camphoric acid which diſſolves in the water, and a quantity of carbonic acid gas, and carbonated hydrogen gas, which may be collected by means of a pneumatic apparatus. There remains in the retort a ſubſtance of a deep black colour, compoſed of alumina and charcoal. By this proceſs, from 122.284 parts of camphor, Mr Bouillon la Grange, to whom we are indebted for the whole of the analyſis of camphor, obtained 45.856 parts of volatile oil, and 30.571 parts of charcoal. The proportion of the other products was not aſcertained.*

From this analyſis, Mr Bouillon la Grange concludes, that camphor is compoſed of volatile oil, and charcoal or carbon, combined together. We learn, from his experiments, that the ultimate ingredients of camphor are carbon and hydrogen; and that the proportion of carbon is much greater than in oils.

49
Plants containing it.

Camphor exiſts in a great many plants. Neumann, Geoffroy, and Cartheuſer, extracted it from the roots of zedoary, thyme, ſage, &c. and rendered it probable that it is contained in almoſt all the labiated plants. It has been ſuppoſed to exiſt in theſe plants combined with volatile oil. Prouſt has ſhewn how it may be extracted, in conſiderable quantity, from many volatile oils.†

Camphor, which was unknown to the ancient Greeks and Romans, was introduced into Europe by the Arabians.

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‡ Romieu, *Mem. Par.* 1756, p.41.

§ *Bouillon la Grange, Ann. de Chim.* xxiii. 154.

§ *Fourcroy.*

‖ *Bouillon la Grange, ibid*, p. 168.

* *Ibid*, p. 157.

† *Ann. de Chim.* iv. 179.

bians. Ætius is the firſt perſon who mentions it. It ſeems, however, to have been very early known to the eaſtern nations.

It is much uſed in medicine. It is a powerful ſtimulant; it is conſidered as peculiarly efficacious in diſeaſes of the urinary organs; it is often ſerviceable in mania, and procures ſleep when every other medicine fails.

SECT. XI. *Of RESINS.*

There is a yellowiſh white coloured ſubſtance which often exſudes from the *Abies Montana*, or *common Scotch fir*, and likewiſe from other fir trees. It is ſomewhat tranſparent, is hard and brittle, of a diſagreeable taſte, and may be collected in conſiderable quantities. This ſubſtance is known by the name of *reſin;* and the ſame name is alſo applied to all ſubſtances which poſſeſs nearly the ſame properties with it. Reſin may be diſtinguiſhed from every other ſubſtance by the following properties:

50 Properties of reſin. It is more or leſs concrete, and has an acrid and hot taſte.

It is totally inſoluble in water. By this property it may eaſily be ſeparated from gum, if they happen to be mixed together.

It is ſoluble in alcohol, and in ſulphuric ether.* By the firſt of theſe properties we may ſeparate it from gum, and by the laſt from extract; for extract is inſoluble in ſulphuric ether. When theſe ſolutions are evaporated the reſin is obtained unaltered. If the ſolution be ſpread thin upon any body, it ſoon dries by the evaporation of the alcohol; the reſin remains behind, and covers the body with a ſmooth ſhining tranſparent coat, which cannot be waſhed off by water. This proceſs is called *varniſhing*.

Reſin is ſoluble alſo in volatile oils; and theſe ſolutions are often uſed likewiſe in varniſhing.

Reſin is ſcarcely acted upon by acids. Alkalies combine with it, but the combination is not eaſily effected.

When reſin is heated it readily melts; and if the heat be increaſed it is volatilized, and burns with a white flame and ſtrong ſmell. When diſtilled it yields much volatile oil, but ſcarcely any acid.

When volatile oils are expoſed for ſome time to the action of the atmoſphere they acquire conſiſtency, and aſſume the properties of reſins. During this change they abſorb a quantity of oxygen from the air. Weſtrum put 30 grains of oil of turpentine into 40 cubic inches of oxy-muriatic acid gas. Heat was evolved, the oil gradually evaporated, and aſſumed the form of yellow reſin.† Theſe facts render it probable that reſin is merely volatile oil combined with a quantity of oxygen.

To know whether any vegetable ſubſtance contains reſin, we have only to pour ſome ſulphuric ether upon it in powder, and expoſe the infuſion to the light. If any reſin be preſent the ether will aſſume a brown colour.‡

51 Number of reſins. The number of reſins is conſiderable. They differ from each other chiefly in colour, taſte, ſmell, and conſiſtency. Whether theſe reſins be really different combinations, or, as is moſt likely, owe theſe differences to foreign ingredients, either combined with the reſin, or mechanically mixed with it, is not at preſent known. To deſcribe each reſin ſeparately would be to little purpoſe, as ſcarcely any thing is known of them except their general properties as reſins. The following is a liſt of the principal. The reader will find an account of the manner of obtaining them, and of their uſes, by conſulting the name of each in the *Encyclopædia*.

1. Common reſin,
2. Turpentine,
3. Pitch,
4. Galipot,
5. Elemi,
6. Maſtic,
7. Sandarac,
8. Guaiacum,
9. Labdanum,
10. Dragon's blood,
11. Copaiba.

52 Balſa There are three vegetable ſubſtances which have been denominated *balſams* by ſome of the later French writers. They appear to conſiſt of reſin, or volatile oil combined with benzoic acid. Theſe ſubſtances are, benzoin, balſam of Tolu, and ſtorax. For an account of them we refer to the *Encyclopædia*.

53 Gum r ſins. Many vegetable ſubſtances occur in medicine which conſiſt chiefly of a mixture of gum and reſin. Theſe ſubſtances, of courſe, have a number of the properties both of gums and reſins. For this reaſon they have been denominated *gum reſins*. The following are the moſt important of theſe ſubſtances:

Olibanum,
Galbanum,
Scammony,
Aſafœtida,
Aloes,
Myrrh,
Ammoniac,
Opium.

For an account of them we refer to the *Encyclopædia.*

SECT. XII. *Of CAOUTCHOUC.*

54 Diſcove of caou chouc. ABOUT the beginning of the 18th century a ſubſtance, called *caoutchouc*, was brought as a curioſity from America. It was ſoft, wonderfully elaſtic, and very combuſtible. The pieces of it that came to Europe were uſually in the ſhape of bottles, birds, &c. This ſubſtance is very much uſed in rubbing out the marks made upon paper by a black lead pencil; and therefore in this country it is often called *Indian rubber*. Nothing was known of its production, except that it was obtained from a tree, till the French academicians went to South America in 1735 to meaſure a degree of the meridian. Mr de la Condamine ſent an account of it to the French Academy in the year 1736. He told them, that there grew in the province of Eſmeraldas, in Brazil, a tree, called by the natives *Hhevé;* that from this tree there flowed a milky juice, which, when inſpiſſated, was *caoutchouc*. Don Pedro Maldonado, who accompanied the French academicians, found the ſame tree on the banks of the Maragnon; but he died ſoon after, and his papers were never publiſhed. Mr Freſnau, after a very laborious ſearch, diſcovered the ſame tree in Cayenne. His account of it was read to the French Academy in 1751.

55 Plants taining It is now known that there are at leaſt two trees in South America from which caoutchouc may be obtained, the Hævea Caoutchouc and the Jatropha Elaſtica; and it is exceedingly probable that it is extracted alſo from other ſpecies of Hævea and Jatropha. Several trees likewiſe which grow in the Eaſt Indies yield caoutchouc; the principal of theſe are, the Ficus Indica, the Artocarpus Integrifolia, and the Urceola Elaſtica; a plant diſcovered by Mr Howiſon, and firſt deſcribed and named by Dr Roxburgh.*

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* *Hermſtadt.*

† *Crell's Annals*, i. 1790.

‡ *Hermſtadt.*

* *Aſiati Reſearch* v. 167. Londo edition.

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When any of theſe plants is punctured, there exſudes from it a milky juice, which, when expoſed to the air, gradually lets fall a concrete ſubſtance, which is caoutchouc.

If oxy-muriatic acid be poured into the milky juice, the caoutchouc precipitates immediately, and, at the ſame time, the acid loſes it peculiar odour. This renders it probable that the formation of the caoutchouc is owing to its baſis abſorbing oxygen.* If the milky juice be confined in a glaſs veſſel containing common air, it gradually abſorbs oxygen, and a pellicle of caoutchouc appears on its ſurface.†

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Caoutchouc was no ſooner known than it drew the attention of philoſophers. Its ſingular properties promiſed that it would be exceedingly uſeful in the arts, provided any method could be fallen upon to mould it into the various inſtruments for which it ſeemed peculiarly adapted. Meſſrs de la Condamine and Freſnau had mentioned ſome of its properties; but Macquer was the firſt perſon who undertook to examine it with attention. His experiments were publiſhed in the memoirs of the French Academy for the year 1768. They threw a good deal of light on the ſubject; but Macquer fell into ſome miſtakes, which were pointed out by Mr Berniard, who publiſhed an admirable paper on caoutchouc in the 17th volume of the *Journal de Phyſique*. To this paper we are indebted for the greater number of facts at preſent known reſpecting caoutchouc. Mr Groſſart and Mr Fourcroy have likewiſe added conſiderably to our knowledge of this ſingular ſubſtance; both of their treatiſes have been publiſhed in the 11th volume of the *Annales de Chimie*.

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Caoutchouc, when pure, is of a white colour (c), and without either taſte or ſmell.‡ The blackiſh colour of the caoutchouc of commerce is owing to the method employed in drying it after it has been ſpread upon moulds. The uſual way is to ſpread a thin coat of the milky juice upon the mould, and then to dry it by expoſing it to ſmoke; afterwards another coat is ſpread on, which is dried in the ſame way. Thus the caoutchouc of commerce conſiſts of numerous layers of pure caoutchouc alternating with as many layers of ſoot.

Caoutchouc is ſoft and pliable like leather. It is exceedingly elaſtic and adheſive; ſo that it may be forcibly ſtretched out much beyond its uſual length, and inſtantly recover its former bulk when the force is withdrawn. It cannot be broken without very conſiderable force.

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It is not altered by expoſure to the air; it is perfectly inſoluble in water: but if boiled for ſome time its edges become ſomewhat tranſparent, owing undoubtedly to the water carrying off the ſoot; and ſo ſoft, that when two of them are preſſed and kept together for ſome time, they adhere as cloſely as if they formed one piece. By this contrivance pieces of caoutchouc may be ſoldered together, and thus made to aſſume whatever ſhape we pleaſe.§

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Caoutchouc is inſoluble in alcohol. This property was diſcovered very early, and fully confirmed by the experiments of Mr Macquer. The alcohol, however, renders it colourleſs.

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Caoutchouc is ſoluble in ether. This property was firſt pointed out by Macquer. Berniard, on the contrary, found that caoutchouc was ſcarcely ſoluble at all in ſulphuric ether, which was the ether uſed by Macquer, and that even nitric ether was but an imperfect ſolvent. The difference in the reſults of theſe two chemiſts was very ſingular; both were remarkable for their accuracy, and both were too well acquainted with the ſubject to be eaſily miſled. The matter was firſt cleared up by Mr Cavallo. He found that ether, when newly prepared, ſeldom or never diſſolved caoutchouc completely; but if the precaution was taken to waſh the ether previouſly in water, it afterwards diſſolved caoutchouc with facility. Mr Groſſart tried this experiment, and found it accurate.|| It is evident from this that theſe chemiſts had employed ether in different ſtates. The waſhing of ether has two effects. It deprives it of a little acid with which it is often impregnated, and it adds to it about one-tenth of water, which remains combined with it.

Caoutchouc.

|| Ann. de Chim. xi. 147.

When the ether is evaporated, the caoutchouc is obtained unaltered. Caoutchouc, therefore, diſſolved in ether, may be employed to make inſtruments of different kinds, juſt as the milky juice of the hævea; but this method would be a great deal too expenſive for common uſe.

60 Oils,

Caoutchouc is ſoluble in volatile oils;* but, in general, when theſe oils are evaporated, it remains ſomewhat glutinous, and therefore is ſcarcely proper for thoſe uſes to which, before its ſolution, it was ſo admirably adapted.

* Berniard.

61 Acids and alkalies,

It is inſoluble in alkalies.† The acids act upon it with more or leſs violence according to their nature. Sulphuric acid decompoſes it completely, charcoal precipitates, and part of the acid is converted into ſulphurous acid. Nitric acid converts it into a yellow ſubſtance, analogous to ſuberic acid. Muriatic acid does not affect it.‡ The other acids have not been tried.

† Id.

‡ Id.

Fabroni has diſcovered, that rectified petroleum diſſolves it, and leaves it unaltered when evaporated.¶

¶ Ibid. 195. & xii. 156.

62 Heat.

When expoſed to heat it readily melts; but it never afterwards recovers it properties, but continues always of the conſiſtence of tar. It burns very readily with a bright white flame, and diffuſes a fetid odour. In thoſe countries where it is produced, it is often uſed by way of candle.

When diſtilled, it gives out ammonia.§ It is evident from this, and from the effect of ſulphuric and nitric acid upon it, that it is compoſed of carbon, hydrogen, azot, and oxygen; but the manner in which they are combined is unknown.

§ Fourcroy, Ann. de Chim. xi. 232.

When treated with nitric acid, there came over azotic gas, carbonic acid gas, pruſſic acid gas; and oxalic acid was formed.||

|| Ibid.

63 How to ſeparate it from plants.

It ſeems to exiſt in a great variety of plants; but is uſually confounded with the other ingredients. It may be ſeparated from reſins by means of alcohol. It may be extracted from the different ſpecies of miſletoe by water, with which, in the fluid ſtate in which it exiſts in theſe plants, it readily combines. When mixed with gum or extract, it may be ſeparated by the following proceſs: Digeſt a part of the plant containing it firſt in water and then in alcohol, till all the ſubſtances ſo-

luble

(c) Mr De Fourcroy ſays, that blackiſh brown is the natural colour of caoutchouc. But we have ſeen ſome pieces of it from the Eaſt Indies, which had been allowed to inſpiſſate in the open air: They were white, with a ſlight caſt of yellow, and had very much the appearance and feel of white ſoap.

luble in theſe liquids be extracted. Dry the reſiduum, and digeſt it in five times its weight of rectified petroleum. Expreſs the liquid part by ſqueezing the ſubſtance in a linen cloth. Let this liquid remain ſeveral days to ſettle, then decant off the clear liquid part, mix it with a third part of water and diſtil, the caoutchouc remains behind.*

SECT. XIII. *Of Wax.*

THE upper ſurface of the leaves of many trees is covered with a varniſh of wax. This varniſh may be ſeparated and obtained in a ſtate of purity by the following proceſs.

64 Wax a vegetable production. Digeſt the bruiſed leaves, firſt in water and then in alcohol, till every part of them which is ſoluble in theſe liquids be extracted. Then mix the reſiduum with ſix times it weight of a ſolution of pure ammonia, and, after ſufficient maceration, decant off the ſolution, filter it, and drop into it, while it is inceſſantly ſtirred, diluted ſulphuric acid, till more be added than is ſufficient to ſaturate the alkali. The wax precipitates in the form of a yellow powder. It ſhould be carefully waſhed with water, and then melted over a gentle fire.†

Mr Tingry firſt diſcovered that this varniſh poſſeſſed all the properties of *bees wax*.‡ Wax then is a vegetable product. The bees extract it unaltered from the leaves of trees and other vegetable ſubſtances which contain it. They ſeem, however, to mix it with ſome of the pollen of flowers.

65 Its properties. Wax, when pure, is of a whitiſh colour, it is deſtitute of taſte, and has ſcarcely any ſmell. Bees wax indeed has a pretty ſtrong aromatic ſmell; but this ſeems chiefly owing to ſome ſubſtance with which it is mixed; for it diſappears almoſt completely by expoſing the wax, drawn out into thin ribands, for ſome time to the atmoſphere. By this proceſs alſo, which is called *bleaching*, the yellow colour of the wax diſappears, and it becomes very white. Bleached wax is not affected by the air.§

Wax is inſoluble in water and in alcohol. It combines readily with alkalies, and forms with them a ſoap which is ſoluble in water.‖

Punic wax, which the ancients employed in painting in encauſto, is a ſoap compoſed of twenty parts of wax and one of ſoda.* Its compoſition was aſcertained by Mr Lorgna †

Sulphuric and nitric acids decompoſe wax completely; oxy-muriatic acid bleaches it inſtantaneouſly.

Wax combines readily with oils, and forms with them a ſubſtance of greater or leſs conſiſtency according to the quantity of oil. This compoſition, which is known by the name of *cerate*, is much employed by ſurgeons.

When heat is applied to wax it becomes ſoft; and at the temperature of 142°, if unbleached, or of 155° if bleached,‡ it melts into a colourleſs tranſparent fluid, which concretes again, and reſumes its former appearance as the temperature diminiſhes. If the heat be ſtill farther increaſed, the wax boils and evaporates; and if a red heat be applied to the vapour, it takes fire and burns with a bright flame. It is this property which renders wax ſo uſeful for making candles.

66 Analyſis. Mr Lavoiſier, by means of the apparatus deſcribed in the article CHEMISTRY, *Suppl.* n° 353. contrived to burn wax in oxygen gas. The quantity of wax conſumed was 21.9 grains. The oxygen gas employed in conſuming that quantity amounted to 66.55 grains. Conſequently the ſubſtances conſumed amounted to 88.45 grains. After the combuſtion, there were found in the glaſs veſſel 62 58 grains of carbonic acid, and a quantity of water, which was ſuppoſed to amount to 25.87 grains. Theſe were the only products.

Now 62.58 grains of carbonic acid gas contain

44.56 of oxy. and 18 02 of carb.; and 25.87 gr. of water contain
21.99 of oxy. and 3.88 of hydro.

66.55 21.90

Conſequently 21.9 parts of wax are compoſed of 18 02 of carbon, and 3.88 of hydrogen. And 100 parts of wax are compoſed of

82.28	carbon,
17.72	hydrogen,
100.00.*	

If wax be diſtilled with a heat greater than 212°, there comes over a little water, ſome ſebacic acid, a little very fluid and odorous oil: the oil, as the diſtillation advances, becomes thicker and thicker, till at laſt it is of the conſiſtency of butter, and for this reaſon has been called *butter of wax*. There remains in the retort a ſmall quantity of coal, which is not eaſily reduced to aſhes. When the butter of wax is repeatedly diſtilled it becomes very fluid, and aſſumes the properties of volatile oil.†

SECT. XIV. *Of the WOODY FIBRE.*

ALL trees, and moſt other plants, contain a particular ſubſtance, well known by the name of *wood*. If a piece of wood be well dried, and digeſted, firſt in a ſufficient quantity of water, and then of alcohol, to extract from it all the ſubſtances ſoluble in theſe liquids, there remains behind only the *woody fibre*.

67 Proper of woo This ſubſtance, which conſtitutes the baſis of wood, is compoſed of longitudinal fibres, eaſily ſubdivided into a number of ſmaller fibres. It is ſomewhat tranſparent; is perfectly taſteleſs; has no ſmell; and is not altered by expoſure to the atmoſphere.

It is inſoluble in water and in alcohol; but ſoluble in alkalies. The mineral acids decompoſe it. When diſtilled it yields, in all probability, pyrolignous acid. When burnt with a ſmothered fire it leaves behind it a conſiderable quantity of charcoal.

It is precipitated from alkalies unaltered by acids.*

68 Its anal By nitric acid Fourcroy converted the reſiduum of quinquina, which does not ſeem to differ from the woody fibre, into oxalic acid; at the ſame time there was a little citric acid formed, and a very ſmall quantity of malic and acetous acids. Some azotic gas alſo was diſengaged. By this proceſs he obtained from 100 parts of woody fibre

56.250	oxalic acid,
3.905	citric acid,
0.388	malic acid,
0.486	acetous acid,
0.867	azotic gas,
8.330	carbonat of lime,
70.226	
32.031	reſiduum.
102.257	

There was likewiſe a quantity of carbonic acid gas diſengaged, the weight of which was unknown. This increaſe

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* Hermſtadt, Med. and Phyſ. Jour. iii. 372.

† Id. ibid. 373.

‡ Enc. Meth. Forets et Bois, i. 100.

§ Senelier, Ann. de Chim. xii. 60. and Jour. de Phyſ. xxxviii. 56.

‖ Chaptal, iii. 164.

* Plin. l. 21. c. 14.

† Jour. de Phyſ. Nov. 1785.

‡ Nicholſon's Journal, i. 71.

* Lav Jour. Phyſ. 59.

† Leme Mem. 1708. 53.

* Fourc Ann. d Chim. 149.

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increaſe of weight in the product was evidently owing to the oxygen derived from the nitric acid.[*]

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When diſtilled in a retort, 100 parts yield the following products:

26.62 of a yellow liquid, containing alcohol, and acid which had the ſmell of pyromucous.
6.977 of concrete oil, moſtly ſoluble in alcohol.
22.995 charcoal } in the retort.
3.567 carbonat of lime } in the retort.
———
60.159
39.841 gas, half carbonic acid, half carbonated hydrogen.
———
100.000[*].

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Theſe facts ſhew us, that the woody fibre is compoſed of oxygen, carbon, hydrogen, azot, and lime. Mr Chaptal ſuppoſes that mucilage differs from woody fibre merely in containing leſs oxygen. We are certain at leaſt that mucilage or gum is compoſed of the ſame ingredients; and Mr Chaptal has ſhewn, that the juices of plants are partly converted into woody fibre by oxy muriatic acid, which imparts to them oxygen.[†] Theſe juices contain both gum and reſin: after the formation of the woody fibre the reſin is ſtill unaltered. This gives a good deal of probability to his opinion.

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SECT. XV. *Of Acids.*

THE acids found ready formed in vegetables are the following:

1. Oxalic,	5. Gallic,
2. Tartarous,	6. Benzoic,
3. Citric,	7. Phoſphoric.
4. Malic,	

Sometimes alſo the ſulphuric, nitric, and muriatic acids occur in vegetables, combined with alkalies or earths, but never except in very minute quantities.

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c acid,

1. Oxalic acid is eaſily detected and diſtinguiſhed by the following properties: It decompoſes all calcareous ſalts, and forms with lime a ſalt inſoluble in water. It readily cryſtallizes. Its cryſtals are quadrilateral priſms. It is totally deſtroyed by heat.

Oxalic acid was firſt detected in vegetables by Mr Scheele. It has been diſcovered in the following plants:

The leaves of the oxalis acetoſella.[†]
oxalis corniculata.
The root of rhubarb.[‡]
The leaves of the geranium acidum.[§]

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7. Eng.
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2. Tartarous acid is known by the following properties: When a little potaſs is cautiouſly dropt into a ſolution containing it, common tartar is formed, and precipitates to the bottom. Tartarous acid does not decompoſe the ſulphat, nitrat, or muriat of lime. Tartrite of lime is ſoluble in water. Tartarous acid cryſtallizes. Its cryſtals are long ſlender priſms. It is deſtroyed by heat.

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Tartarous acid has been found in the following vegetable ſubſtances:

The pulp of the tamarind.[*]
The juice of grapes.
Mulberries.[†]
Rumex acetoſa, *ſorrel.*[†]
Rhus coriaria, *ſumach*[†]
Rheum rhaponticum.[||]
Agave Americana.[¶]
The roots of triticum repens.[†]
Leontodon taraxicum.[†]

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Acids.

71 Citric acid,

3. Citric acid is diſtinguiſhed by the following properties: It does not form tartar when potaſs is added to it. With lime it forms a ſalt inſoluble in water, which is decompoſed by ſulphuric, nitric, and muriatic acids. It readily cryſtallizes. It is deſtroyed by heat.

Citric acid has been found unmixed with other acids in the following vegetable ſubſtances:[*]

The juice of oranges and lemons.
The berries of vaccinium oxycoccos, *cranberry.*
——— vitis idæa, *red whortle berry.*
Prunus padus, *birdcherry.*
Solanum dulcamara, *nightſhade.*
Roſa canina, *hip.*

[*] Scheele, Crell's Jour. ii. 8. Eng. Tranſl.

It occurs mixed with other acids in many other fruits.

72 Malic acid,

4. Malic acid is known by the following properties: It forms with lime a ſalt ſoluble in water, which is decompoſed by citric acid. It does not form tartar with potaſs. It is incryſtallizable. Heat deſtroys it.

Malic acid has been found, by Scheele,[†] in the fruits of the following plants, which contain no other acid:

[†] Ibid.

Apples.
Berberis vulgaris, *barberry.*
Prunus domeſtica, *plum.*
——— ſpinoſa, *ſloe.*
Sambucus nigra, *elder.*
Sorbus aucuparia, *roan* or *ſervice.*

73 Malic and citric,

In the following fruits he found nearly an equal quantity of malic and citric acids.[‡]

[‡] Ibid.

Ribes groſſularia, *gooſeberry.*
——— rubrum, *currants.*
Vaccinium myrtillus, *bleaberry.*
Crategus aria, *beam.*
Prunus ceraſus, *cherry.*
Fragaria veſca, *ſtrawberry.*
Rubus chamæmorus, *cloudberries, evrocks.*
——— idæus, *raſpberry.*

Malic acid has alſo been found in the agave americana,[§] and in the pulp of tamarinds.[||] In the firſt of theſe it is mixed with tartarous acid; in the ſecond with tartarous and citric acids.

[§] Hoffman of Weimar.

[||] Vauquelin, Ann. de Chim. v. 92.

74 Gallic acid,

5. Gallic acid is known by the following properties: With the brown oxyd of iron it produces a black colour. It is cryſtallizable. Heat deſtroys it. It has been found in a great number of plants, chiefly in the bark.—The following table, drawn up by Mr Biggin,[*] will ſerve to ſhew the relative proportions of this acid in different plants:

[*] Nicholſon's Journal, iii. 394.

Elm - - -	7	Sallow - -	8
Oak cut in winter -	8	Mountain aſh -	8
Horſe cheſnut -	6	Poplar - -	8
Beech - -	7	Hazel - - -	9
Willow (boughs) -	8	Aſh - -	10
Elder - -	4	Spaniſh cheſnut -	10
Plum tree - -	8	Smooth oak -	10
Willow (trunk) -	9	Oak cut in ſpring -	10
Sycamore - -	6	Huntingdon or Leiceſter willow	10
Birch - -	4		
Cherry tree -	8	Sumach - -	14

75 Benzoic acid,

6. Benzoic acid is diſtinguiſhed by its aromatic odour, and its volatility on the application of a very moderate heat. It has been found hitherto only in three vegetable ſubſtances, to which the French chemiſts have confined the term *balſam.* Theſe three are, *benzoin, balſam of tolu,* and *ſtorax.* In theſe ſubſtances it ſeems to be combined with a reſin, or ſomething which has nearly the properties of a reſin.

Alkalies.

76 Phoſphoric acid. 7. Phoſphoric acid is eaſily diſtinguiſhed from the former ſix, for it is very fixed, and a violent heat does not deſtroy it as it does the others.

Phoſphoric acid has been found in different plants, but only in very ſmall quantities; it is almoſt conſtantly combined with lime. Meyer found it in the leaves of many trees;* Thuren found phoſphat of lime in the Aconitus Napellus;† and Bergman found it in all kinds of grain.‡

SECT. XVI. *Of ALKALIES.*

THE only alkalies found in plants are potaſs and ſoda. Ammonia may indeed be obtained by diſtilling many vegetable ſubſtances, but it is produced during the operation. One or other of theſe alkalies is found in every plant which has hitherto been examined. The quantity indeed is uſually very ſmall.

77 Proportion of potaſs in plants. 1. Potaſs is found in almoſt all plants which grow at a diſtance from the ſea. It may be extracted by burning the vegetable, waſhing the aſhes in water, filtrating the water, and evaporating it to dryneſs. It is in this manner that all the potaſh of commerce is procured.

The following table exhibits the quantity of aſhes and potaſs which may be extracted from 100 parts of various plants:

	Aſhes.	*Potaſs.*
Sallow	2.8	0.285*(c)
Elm	2.36727	0.39*
Oak	1.35185	0.15343
Poplar	1.23476	0.07481
Hornbeam	1.1283	0.1254
Beech	0.58432	0.14572
Fir	0.34133	
Vine branches	3.379	0.55*
Common nettle	10.67186	2 5033
Common thiſtle	4.04265	0.53734
Fern	5.00781	0.6259
Cow thiſtle	10.5	1.96603
Great river ruſh	3.85395	0.72234
Feathered ruſh	4.33593	0.50811
Stalks of turkey wheat	8.86	1.75*
Wormwood	9.744	7.3*
Fumitory	21.9	7.9*
Trifolium pratenſe		0.078*
Vetches		2.75*
Beans with their ſtalks		2.0*

In general, three times as much aſhes are obtained from ſhrubs, and five times as much from herbs, as from trees. Equal weights of the branches of trees produce more aſhes than the trunk, and the leaves more than the branches. Herbs arrived at maturity produce more aſhes than at any other time. Green vegetables produce more aſhes than dry.†

The ſalt which is obtained from plants does not conſiſt wholly of potaſs, there are other ſalts mixed with it; theſe uſually are ſulphat of potaſs, muriat of potaſs, ſulphat of lime, phoſphat of lime, &c.; but theſe bear, in general, but a ſmall proportion to the potaſs. The aſhes conſiſt of potaſs mixed with earths.

Some judgment may be formed of the quantity of potaſs which a plant contains from the quantity of aſhes which it yields: but the above table is ſufficient to ſhew us, that were we to truſt to that we would often be miſled.

Eart

7 Sod 2. Soda is found in almoſt all the plants which grow in the ſea, and in many of thoſe which grow on the ſhore. In general, the quantity of ſoda which plants contain bears a much greater proportion to their weight than the potaſs does which is found in inland vegetables. 100 parts of the *ſalſola ſoda*, for inſtance, yield 19.921 of aſhes; and theſe contain 1.992 parts of ſoda, ſome of which, however, is combined with muriatic acid.* The plants from which the greater part of the ſoda, or *barilha*, as it is called, which is imported from Spain, is extracted, are the *ſalſola ſativa*, and *vermiculata*.

SECT. XVII. *Of EARTHS.*

THE only earths hitherto found in plants are the four following; *lime, ſilica, magneſia, alumina.*

7 Lir 1. Lime is uſually the moſt abundant of the earths of plants, and the moſt generally diffuſed over the vegetable kingdom. Indeed, it is a very uncommon thing to find a plant entirely deſtitute of lime: ſalſola ſoda is almoſt the only one in which we know for certain that this earth does not exiſt.*

8 Sili 2. Silica exiſts alſo in many plants, particularly graſſes and equiſetums. Mr Davy has aſcertained, that it forms a part of the epidermis, or outermoſt bark of theſe plants; and that in ſome of them almoſt the whole epidermis is ſilica.

		Parts Silica.
100 parts of the epid. of	bonnet-cane yielded	90
	bamboo	71.4
(arundo phragm.)	common reed	48.1
	ſtalks of corn	6.5

The concretions which are ſometimes found in the bamboo cane have been aſcertained by Mr Macie to be compoſed of pure ſilica.

8 Magr 3. Magneſia does not exiſt ſo generally in the vegetable kingdom as the two preceding earths. It has been found, however, in conſiderable quantities in ſeveral ſea plants, eſpecially fuci.† But the ſalſola ſoda contains a greater proportion of magneſia than any plant hitherto examined. Mr Vauquelin found that 100 parts of it contained 17.929 of that earth.‡

8 Alum 4. Alumina has only been found in very ſmall quantities in plants.

8 Prop of ear plants The following table will ſhew the quantity of theſe four earths which exiſt in ſeveral vegetables.

100 parts of oak contain of earths	1.03*
Beech	0.453†
Fir	0.003†
Turkey wheat	7.11†
Sunflower	3.72†
Vine branches	2.85†
Box	2.6741†
Willow	2.515†
Elm	1.96†
Aſpin	1.146†
Fern	3.221‡
Wormwood	2 444§
Fumitory	14.000§

This

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* En. Meth. Phyſiol. Veget. i. 100.

† Ann. de Chim. ii. 308.

‡ Bergman, v. 96.

† Ann. de Chim. xix. 174.

* Vau Ann. Chim. 77.

* Id. i

† Id. 80. a 94.

‡ Ibid

* We

† Kir Iriſh iii. 3

‡ Ho

§ Wi

(c) Thoſe marked * are from *Kirwan, Iriſh Tranſ.* v. 164. The reſt from *Pertuis, Ann. de Chim.* 19. 178.

This table ſhews us, that the quantity of earth is greater in herbs than in trees.

Bergman found all the four earths in every kind of grain which he analyſed.*

Opuſc. v.
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Vauquelin found, that 100 parts of oat grain left 3.1591 of reſiduum. This reſiduum is compoſed of

60.7 ſilica,
39.3 phoſphat.

100.0†

Ann. de
im. xxix.
.

When the whole of the avena ſativa, however, ſtalk and ſeed together, are burnt, they leave a reſiduum compoſed of

55 ſilica,
15 phoſphat of lime,
20 potaſs,
5 carbonat of lime.

95, and a little oxyd of iron.‡

Ibid. 19.

This ſhews us that the ſtalk contains ſeveral ſubſtances not to be found in the grain.

SECT. XVIII. *Of Metals.*

SEVERAL metallic ſubſtances have alſo been found in vegetables, but their quantity is exceedingly ſmall; ſo ſmall, indeed, that without very delicate experiments their preſence cannot even be detected.

84
ree me-
s found
plants

The metals hitherto diſcovered are iron, which is by far the moſt common, manganeſe, and gold.

Scheele firſt detected manganeſe in vegetables.* Prouſt found it in the aſhes of the pine, calendula, vine, green oak, and fig-tree.† M. Sage has ſhewn, that gold exiſts in many plants. Iron exiſts in moſt plants. The aſhes of ſome ſpecies of ſalſola contain a conſiderable quantity of it.

Opuſc. i.
6.
Phil.
ag. v.
.

WE have now taken a ſurvey of all the ſubſtances which have hitherto been obtained from vegetables: by analyſing each of theſe, we come at laſt to thoſe bodies which we are at preſent obliged to conſider as ſimple, becauſe they have not yet been decompoſed, and of which accordingly we muſt ſuppoſe that vegetables are ultimately compoſed. Theſe bodies amount to 16, namely,

85
nple ſub-
nces con-
ned in
nts.

1. Oxygen,
2. Sulphur,
3 Phoſphorus,
4. Carbon,
5. Hydrogen,
6. Azot,
7. Iron,
8. Manganeſe,
9. Gold,
10. Lime,
11. Magneſia,
12. Silica,
13. Alumina,
14. Potaſs,
15. Soda,
16. Muriatic acid.

But of theſe ſubſtances there are twelve which compoſe but a very ſmall proportion indeed of vegetables. Almoſt the whole of vegetable ſubſtances are compoſed of four ingredients, namely,

Carbon, Oxygen,
Hydrogen, Azot.

Of theſe the laſt, namely azot, forms but a ſmall proportion even of thoſe vegetable ſubſtances of which it is a conſtituent part, while into many it does not enter at all: So that, upon the whole, by far the greater part of vegetable ſubſtances is compoſed of carbon, hydrogen, and oxygen. We do not mention caloric and light, concerning the nature of which too little is known to enable us to determine with certainty into what ſubſtances they enter.

The ſubſtances at preſent known to chemiſts, which they have not been hitherto able to decompoſe, amount (omitting caloric and light) to 40. Sixteen of theſe exiſt in plants; the other 24 belong excluſively to the mineral kingdom: for it is a fact, that no ſubſtance (we mean ſimple ſubſtance) has been hitherto found in the animal kingdom which does not exiſt alſo in vegetables.

On the contrary, all the ſimple ſubſtances at preſent known may be found in minerals. This indeed ought not to ſurpriſe us, if we recollect, that the ſpoils of animals and vegetables, after they have undergone decompoſition, are ultimately confounded with minerals, and conſequently arranged under the mineral kingdom. Beſides, as vegetables draw all their food from the mineral kingdom, it would be abſurd to ſuppoſe that they contain ſubſtances which they could not have procured from minerals. It muſt follow, therefore, of neceſſity, that minerals contain all the ſimple ſubſtances which exiſt in this globe of ours; and that plants owe their diverſity merely to different modifications of thoſe principles which they imbibe from the ſoil. But it is impoſſible to have any preciſe notions about a ſubject ſo intricate, without conſidering with ſome attention the ſtructure of vegetables, the food which they imbibe and the changes which they produce on that food. Theſe enquiries ſhall form the ſubject of the next chapter; in which we propoſe to take a view of thoſe phenomena of vegetation which are connected with chemiſtry, or which may be elucidated by the application of the principles of that ſcience.

CHAP. II. OF VEGETATION.

WE have now ſeen the different ſubſtances which are contained in plants; but we have ſtill to examine the manner in which theſe ſubſtances are produced, and to endeavour to trace the different proceſſes which conſtitute vegetation. We muſt warn our readers not to expect complete information in this chapter. The wonders of the vegetable kingdom are ſtill but very imperfectly explored; many of the organs of plants are too minute for our ſenſes; and ſcarcely a ſingle proceſs can be completely traced.

86
Phenomena of vegetation very numerous.

The multiplicity of operations continually going on in vegetables at the ſame time, and the variety of different, and even oppoſite ſubſtances, formed out of the ſame ingredients, and almoſt in the ſame place, aſtoniſh and confound us. The order, too, and the ſkill with which every thing is conducted, are no leſs ſurpriſing. No two operations claſh; there is no diſcord, no irregularity, no diſturbance; every object is gained, and every thing is ready for its intended purpoſe. This is too wonderful to eſcape our obſervation, and of too much importance not to claim our attention. Many philoſophers, accordingly, diſtinguiſhed equally by their induſtry and ſagacity, have dedicated a great part of their lives to the ſtudy of *vegetation*. But hitherto their ſucceſs has not been equal to their exertions. No perſon has been able to detect this *agent*, always ſo buſy, and performing ſuch wonders, or to diſcover him at his work; nor have philoſophers been much more fortunate in their attempts to aſcertain the inſtruments which he employs in his operations. A great variety, however, of curious and intereſting facts, have been diſcovered. Theſe we ſhall attempt in this chapter to collect and arrange, to point out their dependence on each other, and perhaps to deduce ſuch conſequences as obviouſly reſult from this mutual dependence.

87 Plants ariſe from ſeed. 1. Natural hiſtorians have proved, by a very complete induction of facts, that all plants ariſe from *ſeeds*. The pretended exceptions have diſappeared, one after another, as our knowledge of vegetables increaſed: and now there remains ſcarcely a ſingle objection entitled to the ſmalleſt regard. The late attempt of Girtanner* to revive the doctrine of equivocal generation, deſerves no attention whatever; becauſe his concluſions are abſolutely incompatible with the *experiments* of Mr Senebier upon the very ſubſtance on which his theory is founded.

88 Seeds compoſed of three parts. A SEED conſiſts of three parts; namely, the *cotyledons*, the *radicle*, and the *plumula*, which are uſually incloſed in a cover.

If we take a garden bean, we may perceive each of theſe three parts with great eaſe; for this ſeed is of ſo large a ſize, that all its organs are exceedingly diſtinct.

When we ſtrip off the external coats of the bean, which are two, and of different degrees of thickneſs in different parts, we find that it eaſily divides into two lobes, pretty nearly of the ſame ſize and figure. Each of theſe lobes is called a *cotyledon* (fig. 1. *a*.) The cotyledons of the bean, then, are two in number. Plate XLIII.

Near that part of the lobes which is contiguous to what is called the *eye* of the bean, there is a ſmall round white body (*b*), which comes out between the two lobes. This body is called the *radicle*.

Attached to the radicle, there is another ſmall round body (*c*), which lies between the cotyledons and wholly within them, ſo that it cannot be ſeen till they are ſeparated from each other. This body is called the *plumula*.

The appearance and ſhape of theſe three parts differ very much in different ſeeds, but there is no ſeed which wants them. The figure and ſize of the ſeed depend chiefly upon the cotyledons. This is evidently the caſe with the bean, and it is ſo with all other ſeeds. The number of cotyledons is different in different ſeeds. Some ſeeds have only one cotyledon, as the ſeeds of wheat, oats, barley, and the whole tribe of graſſes: ſome have three; others ſix, as the ſeeds of the garden graſs; but moſt ſeeds, like the bean, have two cotyledons.

89 Germination of ſeeds. 2. When a ſeed is placed in a ſituation favourable to vegetation, it very ſoon changes its appearance. The radicle is converted into a root, and ſinks into the earth; the plumula, on the other hand, riſes above the earth, and becomes the trunk or ſtem. When theſe changes take place, the ſeed is ſaid to *germinate*: the proceſs itſelf has been called *germination*. Seeds do not germinate equally and indifferently in all places and ſeaſons. Germination, therefore, is a proceſs which does not depend upon the ſeed alone; ſomething external muſt alſo affect it.

90 Requires moiſture, 3. It is a well known fact, that ſeeds will not germinate unleſs *moiſture* have acceſs to them; for ſeeds, if they are kept perfectly dry, never vegetate at all, and yet their power of vegetating is not deſtroyed. There are indeed ſome apparent objections to this: potatoes, for inſtance, and other bulbous bodies, germinate, tho' kept ever ſo dry. But the reaſon of this is, that theſe bodies (which are not ſeeds, though they reſemble them in ſome particulars) have a ſufficient quantity of water within themſelves to give a beginning to germination. We may conclude, then, that no ſeed will germinate unleſs water has acceſs to it. *Water*, then, is eſſential to germination. Too much water, however, is no leſs prejudicial to moſt ſeeds than none at all. The ſeeds of water plants, indeed, germinate and vegetate extremely well in water; but moſt other ſeeds, if they are kept in water beyond a certain time, are rotted and deſtroyed altogether.

91 Heat, 4. It is well known alſo, that ſeeds will not germinate, even though ſupplied with water, provided the temperature be below a certain degree. No ſeed, for inſtance, on which the experiment has been tried, can be made to vegetate at or below the freezing point: yet this degree of cold does not injure the vegetating power of ſeeds; for many ſeeds will vegetate as well as ever after having been frozen, or after having been kept in frozen water. We may conclude, then, that a certain degree of heat is neceſſary for the germination of ſeeds. And every ſpecies of plants ſeems to have a degree peculiar to itſelf, at which its ſeeds begin to germinate; for we find that almoſt every ſeed has a peculiar ſeaſon at which it begins to germinate, and this ſeaſon varies always according to the temperature of the air. Mr Adanſon found that ſeeds, when ſown at the ſame time in France and in Senegal, always appeared ſooner above ground in the latter country, where the climate is hotter, than in France.§

92 And oxygen gas 5. Seeds, although ſupplied with moiſture, and placed in a proper temperature, will not germinate, provided atmoſpherical air be completely excluded from them. Mr Ray found that grains of lettuce did not germinate in the vacuum of an air-pump, but they began to grow as ſoon as air was admitted to them.† Homberg made a number of experiments on the ſame ſubject, which were publiſhed in the Memoirs of the French Academy for the year 1693. He found, that the greater number of ſeeds which he tried refuſed to vegetate in the vacuum of an air-pump. Some, however, did germinate; but Boyle, Muſchenbroek, and Boerhaave, who made experiments on the ſame ſubject in ſucceſſion, proved beyond a doubt that no plant vegetates in the vacuum of an air-pump; and that in thoſe caſes in which Homberg's ſeeds germinated, the vacuum was far from perfect, a quantity of air ſtill remaining in the receiver. It follows, therefore, that no ſeed will germinate unleſs atmoſpherical air, or ſome air having the ſame properties, have acceſs to it. It is for this reaſon that ſeeds will not germinate at a certain depth below the ſurface of the earth.

Mr Scheele found that beans would not germinate except oxygen gas were preſent; Mr Achard afterwards proved, that oxygen gas is abſolutely neceſſary for the germination of all ſeeds, and that no ſeed will germinate in azotic gas, or hydrogen gas, or carbonic acid gas, unleſs theſe gaſes contain a mixture of oxygen gas. Theſe experiments have been confirmed by Mr

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* Ann. de Chim. xxxiv. 35.

§ Enc. M Phyſiol. gét. 124

† Phil. Tranſ. N° 53.

Mr Gough, Mr Cruickſhank, and many other philoſophers. It follows, therefore, that it is not the whole atmoſpheric air, but merely the oxygen gas which it contains, that is neceſſary for the germination of ſeeds.

93 ijured by e pre- nce of ght.

6. Seeds do not germinate equally well when they are expoſed to the light, and when they are kept in a dark place; light therefore has ſome effect on germination.

Mr Ingenhouſz found, that ſeeds always germinate faſter in the dark than when expoſed to the light.* His experiments were repeated by Mr Senebier with equal ſucceſs;† and it was concluded, in conſequence of their experiments, that light is injurious to germination. But the Abbé Bertholin, who diſtinguiſhed himſelf ſo much by his labours to demonſtrate the effect of electricity on vegetation, objected to the concluſions of theſe philoſophers, and affirmed, that the difference in the germination of ſeeds in the ſhade and in the light was owing, not to the light itſelf, but to the difference of the moiſture in the two ſituations; the moiſture evaporating much faſter from the ſeeds in the light than from thoſe in the ſhade; and he affirmed, that when precautions were taken to keep the ſeeds equally moiſt, thoſe in the ſun germinated ſooner than thoſe in the ſhade.‡ But when Mr Senebier repeated his former experiments, and employed every poſſible precaution to enſure the equality of moiſture in both ſituations, he conſtantly found the ſeeds in the ſhade germinate ſooner than thoſe in the light.§ We may conclude, therefore, that light is injurious to germination; and hence one reaſon for covering ſeeds with the ſoil in which they are to grow.

7. Thus we have ſeen that ſeeds will not germinate unleſs *moiſture*, *heat*, and *oxygen gas*, be preſent; and that they do not germinate well if they are expoſed to the action of *light*. Now, in what manner do theſe ſubſtances affect the ſeed? What are the changes which they produce?

94 ienome- of ger- nation.

We obſerved before, that all ſeeds have one or more cotyledons. Theſe cotyledons contain a quantity of farinaceous matter, laid up on purpoſe to ſupply the embryo plant with food as ſoon as it begins to require it. This food, however, muſt undergo ſome previous preparation, before it can be applied by the plant to the formation or completion of its organs. Now all the phenomena of germination which we can perceive conſiſt in the chemical changes which are produced in that food, and the conſequent developement of the organs of the plant.

95 ıc coty- lons pre- re food,

When a ſeed is placed in favourable circumſtances, it gradually imbibes moiſture, and very ſoon after emits a quantity of carbonic acid gas, even though no oxygen gas be preſent.* This ſeems to prove, as Mr Cruickſhank has ſuppoſed, that ſome of the water imbibed by the ſeed is decompoſed, that its oxygen combines with part of the carbon of the farina, and goes off in the form of carbonic acid gas, while the hydrogen remains behind, and combines with the ingredients contained in the cotyledon. The firſt part of germination, then, conſiſts in diminiſhing the quantity of carbon, and increaſing the hydrogen of the farina. If no oxygen gas be preſent, the proceſs ſtops here, and no germination takes place.

But if oxygen gas be preſent, it is gradually abſorbed and retained by the ſeed; and at the ſame time, the farina of the cotyledons aſſumes a ſweet taſte reſembling ſugar: it is therefore converted into ſugar, or ſome ſubſtance analogous to it.† Farina, then, is changed into ſugar, by diminiſhing its carbon, and augmenting the proportion of its hydrogen and oxygen. This is preciſely the proceſs of malting, or of converting grain into malt; during which it is well known that there is a conſiderable heat evolved; ſo much indeed, that in certain circumſtances grain improperly kept has even taken fire. We may conclude from this, that during the germination of ſeeds in the earth there is alſo an evolution of a conſiderable portion of heat. This indeed might have been expected, as it uſually happens when oxygen gas is abſorbed.

So far ſeems to be the work of chemiſtry alone; at leaſt we have no right to conclude that any other agent interferes; ſince *hay*, when it happens to imbibe moiſture, exhibits nearly the ſame proceſſes. Carbonic acid gas is evolved, oxygen gas is abſorbed, heat is produced ſo abundantly, that the hay often takes fire: at the ſame time a quantity of ſugar is formed. It is owing to a partial change of the ſame kind that old hay generally taſtes much ſweeter than new hay. Now we have no reaſon to ſuppoſe that any agents peculiar to the vegetable kingdom reſide in hay; as all vegetation, and all power of vegetating, are evidently deſtroyed.

96 Which paſſes into the radicle,

But when the farina in the ſeeds of vegetables is converted into ſugar, a number of veſſels make their appearance in the cotyledon. The reader will have a pretty diſtinct notion of their diſtribution, by inſpecting fig. 2. Theſe veſſels may indeed be detected in many ſeeds before germination commences, but they become much more diſtinct after it has made ſome progreſs. Branches from them have been demonſtrated by Grew, Malpighi, and Hedwig, paſſing into the radicle, and diſtributed through every part of it. Theſe evidently carry the nouriſhment prepared in the cotyledons to the radicle; for if the cotyledons be cut off even after the proceſſes above deſcribed are completed, germination, as Bonnet and Senebier aſcertained by experiment, immediately ſtops. The food therefore is conveyed from the cotyledons into the radicle, the radicle increaſes in ſize, aſſumes the form of a *root*, ſinks down into the earth, and ſoon becomes capable of extracting the nouriſhment neceſſary for the future growth of the plant. Even at this period, after the radicle has become a perfect root, the plant, as Senebier aſcertained by experiment, ceaſes to vegetate if the *cotyledons* be cut off. They are ſtill then abſolutely neceſſary for the vegetation of the plant.

97 And converts it into a root.

98 Cotyledons become ſeminal leaves,

The cotyledons now aſſume the appearance of leaves, and appear above the ground, forming what are called the *ſeminal leaves* of the plant. After this the *plumula* gradually increaſes in ſize, riſes out of the earth, and expands itſelf into branches and leaves. The ſeminal leaves, ſoon after this, decay and drop off, and the plant carries on all the proceſſes of vegetation without their aſſiſtance.

Mr Eller attempted to ſhew, that there is a veſſel in ſeeds which paſſes from the cotyledons to the plumula; but later anatomiſts have not been able to perceive any ſuch veſſel. Even Mr Hedwig, one of the moſt patient, acute, and ſucceſsful philoſophers that ever turned their attention to the ſtructure of vegetables, could

never

Experi- ce ſur les egetaux, ii.

Mem. byſico- imique, iii. 1I.

Jour. de byſ. 1789, ecemb.

Enc. Meth. byſiol. Ve- . 126.

Gougb, ancb. em. iv. 5, *Cruick- nk, Rollo Diabetes*, 452.

† *Ibid.*

never diſcover any ſuch veſſel, although he traced the veſſels of the cotyledons even through the radicle. As it does not appear, then, that there is any communication between the cotyledons and the plumula, it muſt follow that the nouriſhment paſſes into the plumula from the radicle: and accordingly we ſee, that the plumula does not begin to vegetate till the radicle has made ſome progreſs. Since the plant ceaſes to vegetate, even after the radicle has been converted into a root, if the cotyledons be removed before the plumula is developed, it follows, that the radicle is inſufficient of itſelf to carry on the proceſſes of vegetation, and that the cotyledons ſtill continue to perform a part. Now we have ſeen already what that part is: they prepare *food* for the nouriſhment of the plant. The root, then, is of itſelf inſufficient for this purpoſe. When the cotyledons aſſume the form of ſeminal leaves, it is evident that the nouriſhment which was originally laid up in them for the ſupport of the embryo plant is exhauſted, yet they ſtill continue as neceſſary as ever. They muſt therefore receive the nouriſhment which is imbibed by the root: they muſt produce ſome changes on it, render it ſuitable for the purpoſes of vegetation, and then ſend it back again to be tranſmitted to the plumula.

99 Which prepare the food ſent from the root.

After the plumula has acquired a certain ſize, which muſt be at leaſt a *line*, if the cotyledons be cut off, the plant, as Mr Bonnet aſcertained by a number of experiments, afterwards repeated with equal ſucceſs by Mr Senebier, does not ceaſe to vegetate, but it continues always a mere pigmy: its ſize, when compared with that of a plant whoſe cotyledons are allowed to remain, being only as 2 to 7.*

100 Plumula forms the ſtem and leaves.

When the plumula has expanded completely into leaves, the cotyledons may be removed without injuring the plant, and they very ſoon decay of themſelves. It appears, then, that this new office of the cotyledons is afterwards performed by that part of the plant which is above ground.

Thus we have traced the phenomena of germination as far as they have been detected. The facts are obvious; but the *manner* in which they are produced is a profound ſecret. We can neither explain how the food enters into the veſſels, how it is conveyed to the different parts of the plant, how it is depoſited in every organ, nor how it is employed to increaſe the ſize of the old parts, or to form new parts. Theſe phenomena are analogous to nothing in mechanics or chemiſtry. He that attempts to explain them on the principles of theſe ſciences, merely ſubſtitutes new meanings of words inſtead of old ones, and gives us no aſſiſtance whatever in conceiving the proceſſes themſelves. As the ſubſtances employed in vegetation are all material, it is evident that they poſſeſs the properties of matter, and that they are arranged in the plant according to theſe laws. It follows, therefore, that all the changes which take place in the plant are produced according to the known laws of mechanics and chemiſtry. This cannot be diſputed: but it explains nothing; for what we want to know is the *agent* that brings every particle of matter to its proper place, and enables the laws of chemiſtry and mechanics to act only in order to accompliſh a certain end. Who is the agent that acts according to this end? To ſay that it is chemiſtry or mechanics is to pervert the uſe of words. For what are the laws of chemiſtry and mechanics? Are they not certain fixed and unalterable properties of matter? Now, to ſay that a property of matter has an end in view, or that it acts in order to accompliſh ſome deſign, is a downright abſurdity. There muſt therefore be ſome agent in all caſes of germination, which regulates and directs the mechanical and chemical proceſſes, and which therefore is neither a mechanical nor chemical property.

8. When the proceſs of germination is accompliſhed, the plant is complete in all its parts, and capable of vegetating in a proper ſoil, for a time and with a vigour proportional to its nature.

101 Plants co poſed of bark, wo and pith

Plants, as every body knows, are very various, and of courſe the ſtructure of each ſpecies muſt have many peculiarities. Trees have principally engaged the attention of anatomiſts, on account of their ſize and the diſtinctneſs which they expected to find in their parts. We ſhall therefore take a tree as an inſtance of the ſtructure of plants; and we ſhall do it the more readily, as the greater number of vegetables are provided with analogous organs, dedicated to ſimilar uſes.

A TREE is compoſed of a *root*, a *trunk*, and *branches*; the ſtructure of each of which is ſo ſimilar, that a general deſcription of their component parts will be ſufficient. Each of them conſiſts of three parts, the *bark*, the *wood*, and the *pith*.

102 Bark

The BARK is the outermoſt part of the tree. It covers the whole plant from the extremity of the roots to the extremity of the branches. It is uſually of a green colour, if a branch of a tree be cut acroſs, the bark is eaſily diſtinguiſhed from the reſt of the branch by this colour. If we inſpect ſuch a horizontal ſection with attention, we ſhall perceive that the bark itſelf is compoſed of three diſtinct bodies, which, with a little care, may be ſeparated from each other. The outermoſt of theſe bodies is called the *epidermis*, the middlemoſt is called the *parenchyma*, and the innermoſt, or that next the wood, is called the *cortical layers*.

103 Compoſ of epide mis,

The *epidermis* is a thin tranſparent membrane, which covers all the outſide of the bark. It is pretty tough. When inſpected with a microſcope, it appears to be compoſed of a number of ſlender fibres croſſing each other, and forming a kind of network. It ſeems even to conſiſt of different thin retiform membranes, adhering cloſely together. This, at leaſt, is the caſe with the epidermis of the birch, which Mr Duhamel ſeparated into ſix layers. The epidermis, when rubbed off, is reproduced. In old trees it cracks and decays, and new epidermes are ſucceſſively formed. This is the reaſon that the trunks of many old trees have a rough ſurface.

104 Parench ma,

The *parenchyma* lies immediately below the epidermis; it is of a deep green colour, very tender, and ſucculent. When viewed with a microſcope, it ſeems to be compoſed of fibres which croſs each other in every direction, like the fibres which compoſe a hat. Both in it and the epidermis there are numberleſs interſtices, which have been compared to ſo many ſmall bladders.

105 And co cal laye

The *cortical layers* form the innermoſt part of the bark, or that which is next to the wood. They conſiſt of ſeveral thin membranes, lying the one above the other; and their number appears to increaſe with the age of the plant. Each of theſe layers is compoſed of longitudinal fibres, which ſeparate and approach each other alternately, ſo as to form a kind of network. The meſhes of this network correſpond in each of the layers;

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* Enc. Meth. Phyſiol. Veget. 42.

ers; and they become ſmaller and ſmaller in every layer as it approaches the wood. Theſe meſhes are filled with a green coloured cellular ſubſtance, which has been compared by anatomiſts to a number of bladders adhering together, and communicating with each other.

106 'oodcom- ſed of The WOOD lies immediately under the bark, and forms by far the greateſt part of the trunk and large branches of trees. It conſiſts of concentric layers, the number of which increaſes with the age of the part. Each of theſe layers, as Mr Du Hamel aſcertained, may be ſeparated into ſeveral thinner layers, and theſe are compoſed chiefly of longitudinal fibres. Hence the reaſon that wood may be much more eaſily ſplit aſunder than cut acroſs.

The *wood*, when we inſpect it with attention, is not, through its whole extent, the ſame; the part of it next the bark is much ſofter and whiter, and more juicy than the reſt, and has for that reaſon obtained a particular name: it has been called the *alburnum* or *aubier*. 107 burnum d perfect ood. The *perfect wood* is browner, and harder, and denſer, than the alburnum, and the layers increaſe in denſity the nearer they are to the centre. Sir John Hill gave to the innermoſt layer of wood the name of *corona*, or rather he gave this name to a thin zone which, according to him, lies between the wood and the pith.

108 th. The PITH occupies the centre of the wood. It is a very ſpongy body, containing a prodigious number of cells, which anatomiſts have compared to bladders. In young ſhoots it is very ſucculent; but it becomes dry as the plant advances, and at laſt in the large trunks of many trees diſappears altogether.

109 aves. The LEAVES are attached to the branches of plants by ſhort footſtalks. From theſe footſtalks a number of fibres iſſue, which ramify and communicate with each other in every part of the leaf, and form a very curious network. Theſe fibres may be obtained ſeparately, by keeping the leaf long in moiſture. Every other part of it putrefies, and falls off, or may eaſily be rubbed off, and only the fibres remain, conſtituting a ſkeleton of the leaf. In every leaf there are two layers of theſe fibres, forming two diſtinct ſkeletons, which had conſtituted the upper and under ſurface of the leaf.

The whole leaf is covered with the epidermis of the plant; and this epidermis, as Sauſſure has ſhewn, contains in it a great number of glands. The other parts of the bark may alſo be traced on many leaves; at leaſt Sauſſure has ſhewn, that the *bark* of leaves is compoſed of two different layers. The interſtices between the fibres of the leaf are filled up by a pulpy-like ſubſtance, to which the green colour of the leaf is owing.

Such is a ſhort deſcription of the moſt conſpicuous parts of plants. A more minute account would have been foreign to the ſubject of the preſent article.

110 nts increaſe in :. 9. Plants, after they have germinated, do not remain ſtationary, but are continually increaſing in ſize. A tree, for inſtance, every ſeaſon, adds conſiderably to its former bulk. The root ſends forth new ſhoots, and the old ones become larger and thicker. The ſame increment takes place in the branches and the trunk. When we examine this increaſe more minutely, we find that a new layer of wood, or rather of alburnum, has been added to the tree in every part, and this addition has been made juſt under the bark. We find, too, that a layer of alburnum has aſſumed the appearance of perfect wood. Beſides this addition of vegetable fibre, a great number of leaves have been produced; and the tree puts forth flowers, and forms ſeeds.

It is evident from all this, that a great deal of new matter is continually making its appearance in plants. 111 Therefore require food. Hence, ſince it would be abſurd to ſuppoſe that they *create* new matter, it muſt follow that they receive it by ſome channel or other. Plants, then, require food as well as animals. Now, what is this food, and whence do they derive it? Theſe queſtions can only be anſwered by an attentive ſurvey of the ſubſtances which are contained in vegetables, and an examination of thoſe ſubſtances which are neceſſary for their vegetation. If we could ſucceed completely, it would throw a great deal of light upon the nature of ſoils and of manures, and on ſome of the moſt important queſtions in agriculture. But we are far indeed at preſent from being able to examine the ſubject to the bottom.

10. In the firſt place, it is certain that plants will not vegetate without water; for whenever they are deprived of it, they wither and die. 112 Water neceſſary. Hence the well known uſe of rains and dews, and the artificial watering of ground. We may conclude, then, that water is at leaſt an eſſential part of the food of plants.

But many plants grow in pure water; and therefore it may be queſtioned whether water is not the only food of plants. This opinion was adopted very long ago, and numerous experiments have been made in order to demonſtrate it. Indeed, it was the general opinion of the 17th century; and ſome of the moſt ſucceſsful improvers of the phyſiology of plants, in the 18th century, have embraced it. The moſt zealous advocates for it were, Van Helmont, Boyle, Bonnet, Duhamel, and Tillet.

113 Suppoſed the whole food of plants; Van Helmont planted a willow which weighed five pounds, in an earthen veſſel filled with ſoil previouſly dried in an oven, and moiſtened with rain water. This veſſel he ſunk into the earth, and he watered his willow, ſometimes with rain, and ſometimes with diſtilled water. After five years it weighed 169¼lbs. and the earth in which it was planted, when again dried, was found to have loſt only two ounces of its original weight. Here, it has been ſaid, was an increaſe of 164lb. and yet the only food of the willow was pure water; therefore it follows that pure water is ſufficient to afford nouriſhment to plants. The inſufficiency of this experiment to decide the queſtion was firſt pointed out by Bergman in 1773.[*] He ſhewed, from the experiments of Margraff that the rain water employed by Van Helmont contained in it as much earth as could exiſt in the willow at the end of five years. For, according to the experiments of Margraff, 1 lb. of rain water contains 1 gr. of earth.[†] The growth of the willow, therefore, by no means proves that the earth which plants contain has been formed out of water. Beſides, as Mr Kirwan has remarked,[‡] the earthen veſſel muſt have often abſorbed moiſture, from the ſurrounding earth, impregnated with whatever ſubſtance that earth contained; for unglazed earthen veſſels, as Hales[*] and Tillet[†] have ſhewn, readily tranſmit moiſture.

Hence it is evident that no concluſion whatever can be drawn from this experiment; for all the ſubſtances which the willow contained, except water, may have been derived from the rain water, the earth in the pot, and the moiſture imbibed from the ſurrounding ſoil. 114 But without reaſon.

The

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[*] *Opuſc.* v. 92.

[†] *Opuſc.* ii. 15 and 19.

[‡] *Iriſh Tranſ.* v. 150.

[*] *Veget. Stat.* i. 5.

[†] *Mem. Par.* 1772. 298.

The experiments of Duhamel and Tillet are equally inconcluſive: ſo that it is impoſſible from them to decide the queſtion, Whether water be the ſole nouriſhment of plants or not? We owe the ſolution of this difficulty to the experiments of Mr Haſſenfratz, who pointed out the fallacy of thoſe juſt mentioned.

He analyſed the bulbous roots of hyacinths, in order to diſcover the quantity of water, carbon, and hydrogen, which they contained; and by repeating the analyſis on a number of bulbs, he diſcovered how much of theſe ingredients was contained in a given weight of the bulb. He analyſed alſo kidney beans and creſs ſeeds in the ſame manner. Then he made a number of each of theſe vegetate in pure water, taking the precaution to weigh them beforehand, in order to aſcertain the preciſe quantity of carbon which they contained. The plants being then placed, ſome within doors, and others in the open air, grew and flowered, but produced no ſeed. He afterwards dried them, collecting with care all their leaves and every other part which had dropt off during the courſe of the vegetation. On ſubmitting each plant to a chemical analyſis, he found that the quantity of carbon, which it contained, was ſomewhat leſs than the quantity which exiſted in the bulb or the ſeed from which the plant had ſprung.*

Hence it follows irreſiſtibly, that plants growing in pure water do not receive any increaſe of *carbon*; that the water merely ſerves as a vehicle for the carbonaceous matter already preſent, and diffuſes it thro' the plant. Water, then, is not the ſole food of plants; for all plants during vegetation receive an increaſe of carbonaceous matter, without which they cannot produce perfect ſeeds, nor even continue to vegetate beyond a certain time; and that time ſeems to be limited by the quantity of carbonaceous matter contained in the bulb or the ſeed from which they grow. For Duhamel found, that an oak which he had raiſed by water from an acorn, made leſs and leſs progreſs every year. We ſee, too, that thoſe bulbous roots, ſuch as hyacinths, tulips, &c. which are made to grow in water, unleſs they be planted in the earth every other year, refuſe at laſt to flower, and even to vegetate; eſpecially if they produce new bulbous roots annually, and the old ones decay.

115
A certain portion only proper.

So far, indeed, is water from being the ſole food of plants, that in general only a certain proportion of it is ſerviceable, too much being equally prejudicial to them as too little. Some plants, it is true, grow conſtantly in water, and will not vegetate in any other ſituation; but the reſt are entirely deſtroyed when kept immerſed in that fluid beyond a certain time. Moſt plants require a certain degree of moiſture, in order to vegetate well. This is one reaſon why different ſoils are required for different plants. Rice, for inſtance, requires a very wet ſoil: were we to ſow it in the ground on which wheat grows luxuriantly, it would not ſucceed: and wheat, on the contrary, would rot in the rice ground.

We ſhould, therefore, in chooſing a ſoil proper for the plants which we mean to raiſe, conſider the quantity of moiſture which is beſt adapted for them, and chooſe our ſoil accordingly. Now, the dryneſs or moiſture of a ſoil depends upon two things; the nature and proportions of the earths which compoſe it, and the quantity of rain which falls upon it. Every ſoil contains at leaſt three earths, ſilica, lime, and alumina, and ſometimes alſo magneſia. The ſilica is always in the ſtate of ſand. Now ſoils retain moiſture longer or ſhorter according to the proportions of theſe earths. Thoſe which contain the greateſt quantity of ſand retain it the ſhorteſt, and thoſe which contain the greateſt quantity of alumina retain it longeſt. The firſt is a dry, the ſecond a wet ſoil. Lime and magneſia are intermediate between theſe two extremes: they render a ſandy ſoil more retentive of moiſture, and diminiſh the wetneſs of a clayey ſoil. It is evident, therefore, that, by mixing together proper proportions of theſe four earths, we may form a ſoil of any degree of dryneſs and moiſture that we pleaſe.

But whatever be the nature of the ſoil, its moiſture muſt depend in general upon the quantity of rain which falls. If no rain at all fell, a ſoil, however retentive of moiſture it be, muſt remain dry; and if rain were very frequently falling, the ſoil muſt be open indeed, if it be not conſtantly wet. The proportion of the different earths in a ſoil, therefore, muſt depend upon the quantity of rain which falls. In a rainy country, the ſoil ought to be open; in a dry country, it ought to be retentive of moiſture. In the firſt, there ought to be a greater proportion of ſand; in the ſecond, of clay.

116
Earth neceſſary;

11. Almoſt all plants grow in the earth, and every ſoil contains at leaſt ſilica, lime, alumina, and often magneſia. We have ſeen already, that one uſe of theſe earths is to adminiſter the proper quantity of water to the vegetables which grow in the ſoil. But as all plants contain earths as a part of their ingredients, is it not probable that earths alſo ſerve as a food for plants? It has not yet indeed been ſhewn, that thoſe plants which vegetate in pure water do not contain the uſual quantity of earth; but as earths are abſolutely neceſſary for the perfect vegetation of plants, as they are contained in all plants, and are even found in their juices, we can ſcarcely doubt that they are actually imbibed, though only in ſmall quantities.(D)

117
And ſalt

12. We have ſeen in the laſt chapter, that all plants contain various ſaline ſubſtances; and if we analyſe the moſt fertile ſoils, and the richeſt manures, we never find them deſtitute of theſe ſubſtances. Hence it is probable that different ſalts enter as ingredients into the food of plants. It is probable alſo, that every plant abſorbs particular kinds of ſalts. Thus ſea plants yield ſoda by analyſis, while inland plants furniſh potaſs. The potaſs contained in plants has indeed been ſuppoſed to be the produce of vegetation; but this has not been proved in a ſatisfactory manner. We find potaſs in the very juices of plants, even more abundantly than in the vegetable fibres themſelves. But this ſubject is ſtill buried in obſcurity; and indeed it is extremely difficult

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* *Ann. de Chim.* xiii. 188.

(D) Mr Tennant has aſcertained, that magneſia, when uncombined with carbonic acid gas, is injurious to corn when employed in a manure; and that lime, which contains a mixture of magneſia, likewiſe injures corn.—See *Phil. Tranſ.* 1799, p. 2. This important fact demonſtrates, that earths are not mere vehicles for conveying water to plants.

ficult to make deciſive experiments, on account of the very ſmall quantity of potaſs which moſt plants contain.

The phoſphorus, too, and the iron, and other metals which are found in plants, are no doubt abſorbed by them as a part of their food. We may ſuppoſe alſo, that the ſulphuric and muriatic acids, and perhaps even the nitric acid, when found in plants, are imbibed by them along with the reſt of their aliment.

Nothing is at preſent known concerning thoſe ſaline ſubſtances which form an eſſential part of the food of plants; though it has been long remarked that certain ſalts are uſeful as manures.

118
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13. Water, then, and earths, and perhaps alſo ſalts, form a part of the food of plants. But plants contain carbon, which cannot be derived from any of theſe ſubſtances; conſequently ſome ſubſtance or other beſides, which contains carbon, muſt conſtitute a part of the food of plants.

Mr Giobert mixed together the four earths, ſilica, alumina, lime, magneſia, in the proper proportions, to conſtitute a fertile ſoil; and after moiſtening them with water, planted ſeveral vegetables in them; but none of his plants grew well, till he moiſtened his artificial ſoil with water from a dunghill.* Now it is certain, from the experiments of Haſſenfratz, that this water contains carbon; for when evaporated, it conſtantly left behind it a reſiduum of charcoal.† We know likewiſe, from a great variety of experiments, that all fertile ſoils contain a conſiderable quantity of carbonaceous matter; for all of them, when expoſed to heat, are ſuſceptible of partial combuſtion, during which a quantity of carbonic acid gas eſcapes. Thus Fourcroy and Haſſenfratz found, that 9216 parts of fertile ſoil contained 305 parts of carbon, beſides 279 parts of oil; which, from the analyſis of Lavoiſier, we may ſuppoſe to contain about 220 parts of carbon. It follows, therefore, from the experiments of theſe chemiſts,‡ that 9216 parts of ſoil contain 525 parts of carbon. But theſe 9216 parts of ſoil contained 806 parts of roots of vegetables which were excluded from the analyſis; conſequently a fertile ſoil contains (excluſive of the roots of vegetables) about one-ſixteenth of its weight of carbon.

119
hich
uſt be in
particu-
ſtate;

But the carbon muſt exiſt in the ſoil in a particular ſtate of combination, otherwiſe it does not anſwer as food for plants: For inſtance, powdered pitcoal, mixed with earths, is not found to act, at leaſt immediately, as a manure; yet pitcoal contains a very great quantity of carbon. Farther, it appears, from the experiments of Mr Haſſenfratz, that ſubſtances employed as manures produce effects in times proportioned to their degree of putrefaction; thoſe ſubſtances which are moſt putrid producing the moſt ſpeedy effects, and of courſe ſooneſt loſing their efficacy. Having manured two pieces of the ſame kind of ſoil, the one with a mixture of dung and ſtraw highly putrefied, the other with the ſame mixture newly made, and the ſtraw almoſt freſh, he obſerved that, during the firſt year, the plants which grew on the land manured with the putrefied dung produced a much better crop than the other: but the ſecond year (no new dung being added), the ground which had been manured with the unputrefied dung produced the beſt crop; the ſame thing took place the third year; after which, both ſeemed to be equally exhauſted.* Here it is evident that the putrefied dung acted ſooneſt, and was ſooneſt exhauſted. It follows from this, that carbon only acts as a manure when in a particular ſtate of combination; and this ſtate, whatever it may be, is evidently produced by putrefaction. Another experiment of the ſame chemiſt renders this truth ſtill more evident. He allowed ſhavings of wood to remain for about ten months in a moiſt place till they began to putrefy, and then ſpread them over a piece of ground by way of manure. The firſt two years this piece of ground produced nothing more than others which had not been manured at all; the third year it was better, the fourth year ſtill better, the fifth year it reached its maximum of fertility; after which it declined conſtantly till the ninth, when it was quite exhauſted.† Here the effect of the manure evidently depended upon its progreſs in putrefaction.

120
And ſoluble in
water.

Now what is the particular ſtate into which carbon muſt be reduced before it be fit for the food of plants? This ſubject has never been examined with attention; the different combinations of carbon having been in a great meaſure overlooked. And yet it is evident, that it is only by an accurate examination of theſe combinations, and a thorough analyſis of manures, in order to diſcover what particular combinations of carbon exiſt in them, and in what the moſt efficacious manures differ from the reſt, that we can expect to throw complete light upon the nature and uſe of manures, one of the moſt important ſubjects to which the farmer can direct his attention. We know, from the experiments of Mr Haſſenfratz, that all thoſe manures which act with efficacy and celerity contain carbon in ſuch a ſtate of combination, that it is ſoluble in water; and that the efficacy of the manure is proportional to the quantity of carbon ſo ſoluble. He found that all efficacious manures gave a brown colour to water, and that the water ſo coloured, when evaporated, left a reſiduum, which conſiſted in a great meaſure of carbon.* He obſerved, too, that the ſoil which gives the deepeſt colour to water, or which contains the greateſt quantity of carbon ſoluble in water, is, other things being the ſame, the moſt fertile.

This is not, however, to be underſtood without limitation; for it is well known that if we employ exceſſive quantities of manure, we injure vegetation inſtead of promoting it. This is the reaſon that plants will not, as Mr Duhamel found by experiment, vegetate in ſaturated ſolutions of dung.†

121
This ſtate
not carbonic acid
gas;

One of the combinations of carbon which is ſoluble in water, and with which we are beſt acquainted, is carbonic acid gas. It has been ſuppoſed by many philoſophers, particularly by Mr Senebier, that this gas, diſſolved in water, ſupplies plants with a great part of their carbon. But Mr Haſſenfratz, on making the experiment, found, that the plants which he raiſed in water, impregnated with carbonic acid gas, differed in no reſpect from thoſe which grew in pure water, and did not contain a particle of carbon which had not exiſted in the ſeeds from which they ſprung.‡ This experiment proves, that carbonic acid gas, diſſolved in water, does not ſerve as food for plants. It appears, however, from the experiments of Ruckert, that when plants growing in ſoil are watered daily with water impregnated with carbonic acid gas, they vegetate faſter than when this watering is omitted. He planted two beans in

122
Though
that gas
is uſeful.

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[*] ncyc. eth. Phyſ. get. p. 5.

[†] Ann. de im. xiv.

[‡] Encyc. eth. Phyſ. get. p. 7.

[*] Ann. de Chim. xiv. 57.

[†] Ibid. p. 58.

[*] Ibid. p. 56.

[†] Mem. Par. 1748.

[‡] Ann. de Chim. xiii. 320.

in pots of equal dimenſions, filled with garden mould. One of theſe was watered almoſt daily with diſtilled water, the other with water, every ounce of which was impregnated with half a cubic inch of carbonic acid gas. Both were placed in the open air, but in a ſituation where they were ſecure from rain. The bean treated with the water impregnated with carbonic acid gas appeared above ground nine days before the other, and produced 25 beans; whereas the other produced only 15. The ſame experiment was tried on other plants with equal ſucceſs.† This ſhews us that carbonic acid gas is ſomehow or other uſeful to plants when they vegetate in mould; but it gives us no information about its mode of acting. Some ſoils, we know, are capable of decompoſing it; for ſome ſoils contain the green oxyd of iron: and Gadolin has proved, that ſuch ſoils have the property of decompoſing carbonic acid gas.* Indeed almoſt all ſoils contain iron, either in the ſtate of the brown or the green oxyd; and Beaumé has ſhewn, that oils convert the brown oxyd of iron into the green.† Now dung contains a quantity of oily ſubſtance; and this is the caſe alſo with rich ſoils. One uſe of manures, therefore, may be, to reduce the brown oxyd of iron to the green, that it may be capable of decompoſing carbonic acid gas; and the carbon, thus precipitated, doubtleſs enters into ſome new combination, in which ſtate it ſerves as food for plants.

Mr Humbolt has lately proved, that ſoils have the property of abſorbing oxygen. It can ſcarcely be doubted that this abſorption has an influence on vegetation, eſpecially as watering plants with weak ſolutions of oxy-muriatic acid accelerates vegetation.* But we know too little of the ſubject at preſent to be able to ſpecify preciſely what that influence is.

123
Food abſorbed by the roots.

14. Since the only part of plants which is contiguous to the ſoil is the root, and ſince the plant periſhes when the root is pulled out of the ground, it is evident that the food of plants muſt be imbibed by the roots.

When we examine the roots, we do not find them to contain any large opening. The paſſages by which the food enters are two ſmall for the naked eye. This ſhews us, that the food can enter plants only in a fluid ſtate; and that conſequently every thing which can be rendered uſeful as food for plants muſt be previouſly in a ſtate of ſolution,

It ſeems moſt probable, that the whole, or the greateſt part of the food, enters at the extremities of the roots; for Duhamel obſerved, that the portion of the ſoil which is ſooneſt exhauſted, is preciſely that part in which the greateſt number of the extremities of roots lies.‡ This ſhews us the reaſon why the roots of plants are continually increaſing in length. By this means they are enabled, in ſome meaſure, to go in queſt of nouriſhment. The extremities of the roots ſeem to have a peculiar ſtructure adapted for the imbibing of moiſture. If we cut off the extremity of a root, it never increaſes any more in length: therefore its uſe as a root has been in a great meaſure deſtroyed. But it ſends out fibres from its ſides which act the part of roots, and imbibe food by their extremity. Nay, in ſome caſes, when the extremity of a root is cut off, the whole decays, and a new one is formed in its place. This, as Dr Bell informs us, is the caſe with the hyacinth.†

124
Diſſolve
in water.

Since the food of plants muſt be in a fluid ſtate, and ſince no plant will live if it be deprived of moiſture, we may conclude that all its food is previouſly diſſolved in water. As for the carbon, we know, that in all active manures it is in ſuch a ſtate of combination, that it is ſoluble in water. We know, too that all the ſalts which we can ſuppoſe to make a part of the food of plants, are more or leſs ſoluble in water. Lime alſo is ſoluble in water, whether it be pure or in the ſtate of a ſalt; magneſia and alumina may be rendered ſo by means of carbonic acid gas; and Bergman, Macie, and Klaproth, have ſhewn, that even ſilica may be diſſolved in water. We can ſee, therefore, in general, though we have no preciſe notions of the very combinations which are immediately imbibed by plants, that all the ſubſtances which form eſſential parts of that food *may* be diſſolved in water.

125
Therefor
fluid.

15. Since the food of plants is imbibed by their roots in a fluid ſtate, it muſt exiſt in plants in a fluid ſtate; and unleſs it undergoes alterations in its compoſition juſt when imbibed, we may expect to find it in the plant unaltered. If there were any method of obtaining this fluid food from plants before it has been altered by them, we might analyſe it, and obtain by that means a much more accurate knowledge of the food of plants than we can by any other method. This plan indeed muſt fail, provided the food undergoes alteration juſt when it is abſorbed by the roots: but if we conſider, that when one ſpecies of tree is grafted upon another, each bears its own peculiar fruit, and produces its own peculiar ſubſtances, we can ſcarcely avoid thinking that the *great* changes, at leaſt which the food undergoes after abſorption, are produced, not in the roots, but in other parts of the plant.

126
Sap of plants.

If this concluſion be juſt, the food of plants, after being imbibed by the roots, muſt go directly to thoſe organs where it is to receive new modifications, and to be rendered fit for being aſſimilated to the different parts of the plant. There ought therefore to be certain juices continually aſcending from the roots of plants; and theſe juices, if we could get them pure and unmixed with the other juices or fluids which the plant muſt contain, and which have been ſecreted and formed from theſe primary juices, would be, very nearly at leaſt, the food as it was imbibed by the plant. Now during the vegetation of plants, there actually is a *juice* continually aſcending from their roots. This juice has been called the *ſap*, the *ſuccus communis*, the *lymph* of plants. We ſhall adopt the firſt of theſe names, becauſe it has been moſt generally received.

The firſt ſtep towards an accurate knowledge of the food, and of the changes which take place during vegetation, is an analyſis of the ſap. The ſap is moſt abundant during the ſpring. At that ſeaſon, if a cut be made through the bark and part of the wood of ſome trees, the ſap flows out very profuſely. The trees are then ſaid to *bleed*. By this contrivance any quantity of ſap we think proper may be collected. It is not probable, indeed, that by this method we obtain the aſcending ſap in all its purity: it is no doubt mixed with the peculiar juices of the plant; but the leſs progreſs vegetation has made, the purer we may expect to find it; both becauſe the peculiar juices muſt be in much ſmaller quantity, and becauſe its quantity may

† *Crell's Annals*, 1783. ii. 399.

* *Ibid.* 1791. i. 53.

† *Kirwan, Iriſh. Tranſ.* v. 156.

* *Ingenhouſz.*

‡ *Phyſique des Arbres*, ii. 239.

† *Manch. Mem.* ii. 412.

may be ſuppoſed to be greater. We ſhould therefore examine the ſap as early in the ſeaſon as poſſible, and at all events before the leaves have expanded.

127 nalyſed. For the moſt complete ſet of experiments hitherto made upon the ſap, we are indebted to Mr Vauquelin. An account of his experiments has been publiſhed in the 31ſt volume of the *Annales de Chimie*. He has neglected to inform us of the ſtate of the tree when the ſap which he analyſed was taken from it; ſo that we are left in a ſtate of uncertainty with reſpect to the purity of the ſap: but from the compariſon which he has put it in our power to draw between the ſtate of the ſap at different ſucceſſive periods, we may in ſome meaſure obviate this uncertainty.

He found that 1039 parts of the ſap of the ulmus campeſtris, or common elm, were compoſed of

1027.567	water and volatile matter,
9.553	acetite of potaſs,
1.062	vegetable matter,
0.818	carbonat of lime,

Beſides ſome ſlight traces of ſulphuric and muriatic acids.

On analyſing the ſame ſap ſomewhat later in the ſeaſon, Mr Vauquelin found the quantity of vegetable matter a little increaſed, and that of the carbonat of lime and acetite of potaſs diminiſhed. Still later in the ſeaſon the vegetable matter was farther increaſed, and the other two ingredients farther diminiſhed. The acetite of potaſs, in 1039 parts of this third ſap, amounted to 8.615 parts.*

Ann. de *him.* xxxi.

If theſe experiments warrant any conſequence to be drawn from them, they would induce us to ſuppoſe that the carbonat of lime and acetite of potaſs were contained in the pure aſcending ſap, and that part at leaſt of the vegetable matter was derived from the peculiar juices altered by the ſecreting organs of the plant; for the two ſalts diminiſhed in quantity, and the vegetable matter increaſed as the vegetation of the tree advanced. Now this is preciſely what ought to have taken place, on the ſuppoſition that the ſap became more and more mixed with the peculiar juices of the tree, as we are ſuppoſing it to do. If theſe concluſions have any ſolidity, it follows from them, that carbonat of lime and acetite of potaſs are abſorbed by plants as a part of their food. Now theſe ſalts, before they are abſorbed, muſt be diſſolved in water. But the carbonat of lime may be diſſolved in water by the help of carbonic acid. This ſhews us how water ſaturated with carbonic acid may be uſeful to plants vegetating in a proper ſoil, while it is uſeleſs to thoſe that vegetate in pure water. In the pure water there is no carbonat of lime to be diſſolved; and therefore carbonic acid gas cannot enter into a combination which renders it proper for becoming the food of plants. Part of the vegetable matter was precipitated from the ſap by alcohol. This part ſeems to have been gummy. Now gums we know are produced by vegetation.

The ſap of the fagus ſylvatica, or beech, contained the following ingredients.

Water,
Acetite of lime with exceſs of acid,
Acetite of potaſs,
Gallic acid,
Tan,
A mucous and extractive matter,
Acetite of alumina.

Although Mr Vauquelin made two different analyſes of this ſap at different ſeaſons, it is impoſſible to draw any ſatisfactory concluſions from them, as he has not given us the proportions of the ingredients. It ſeems clear that the gallic acid and tan were combined together; for the ſap taſted like the infuſion of oak bark. The quantity of each of theſe ingredients increaſed as vegetation advanced; for the colour of the ſecond ſap collected later was much deeper than that of the firſt. This ſhews us that theſe ingredients were produced by vegetation, and that they did not form a part of the aſcending ſap. Probably they were derived from the bark of the tree. The preſence of alumina, and the abſence of carbonic acid gas, would ſeem to indicate that all plants do not imbibe the very ſame food.

The ſap of the carpinus ſylveſtris contains water, acetite of potaſs, acetite of lime, ſugar, mucilage, vegetable extract. It cannot be doubted that the ſugar and the mucilage are the produce of vegetation.

The ſap of the betula alba, or common birch, contains water, ſugar, vegetable extract, acetite of lime, acetite of alumina, and acetite of potaſs.

Theſe experiments are curious, and certainly add to the preciſion of our notions concerning the food of plants; but they are not deciſive enough to entitle us to draw concluſions. They would ſeem to ſhew, either that acetite of potaſs and lime are a part of the food of plants, or at leaſt ſome ſubſtances which have the property of aſſuming theſe combinations.

128 Whether the food is altered by the roots.

16. Theſe experiments led to the concluſion that acetous acid forms a component part of the ſap. Now it is not eaſy to ſuppoſe that this ſubſtance is actually abſorbed by the roots in the ſtate of acetous acid. The thing might be determined by examining the mould in which plants grow. This examination indeed has been performed; but no chemiſt has ever found acetous acid, at leaſt in any ſenſible quantity. Is it not probable, then, that the food, after it is imbibed, is ſomewhat modified and altered by the roots? In what manner this is done we cannot ſay, as we know very little about the vaſcular ſtructure of the roots. We may conclude, however, that this modification is nearly the ſame in moſt plants: for one plant may be engrafted on another, and each continue to produce its own peculiar products; which could not be, unleſs the proper ſubſtances were conveyed to the digeſtive organs of all. There are ſeveral circumſtances, however, which render the modifying power of the roots ſomewhat probable. The ſtrongeſt of theſe is the nature of the ingredients found in the ſap. It is even poſſible that the roots may, by ſome means or other, throw out again ſome part of the food which they have imbibed as excrementitious. This has been ſuſpected by ſeveral phyſiologiſts; and there are ſeveral circumſtances which render it probable. It is well known that ſome plants will not vegetate well after others; and that ſome again vegetate unuſually well when planted in ground where certain plants had been growing. Theſe facts, without doubt, may be accounted for on other principles. If there be any excrementitious matter emitted by the roots, it is much more probable that this happens in the laſt ſtage of vegetation. That is to ſay, when the food, after digeſtion, is applied to the purpoſes which the root requires. But the fact ought to be ſupported by experiments, otherwiſe it cannot be admitted.

17. The ſap, as Dr Hales has ſhewn us, aſcends with a very conſiderable force. It iſſued during the bleeding ſeaſon with ſuch impetuoſity from the cut end of a vine branch, that it ſupported a column of mercury 32½ inches high.*

129 Sap aſcends

Now what is the particular channel through which the ſap aſcends, and what is the cauſe of the force with which it moves? Theſe are queſtions which have excited a great deal of the attention of thoſe philoſophers who have made the phyſiology of vegetables their particular ſtudy; but the examination of them is attended with ſo many difficulties that they are very far from being decided.

It is certain that the ſap flows from the roots towards the ſummit of the tree. For if in the bleeding ſeaſon a number of openings be made in the tree, the ſap begins firſt to flow from the loweſt opening, then from the loweſt but one, and ſo on ſucceſſively, till at laſt it makes its appearance at the higheſt of all. And when Duhamel and Bonnet made plants vegetate in coloured liquors, the colouring matter, which was depoſited in the wood, appeared firſt in the loweſt part of the tree, and gradually aſcended higher and higher, till at laſt it reached the top of the tree, and tinged the very leaves.

130 Through the wood.

It ſeems certain too, that the ſap aſcends through the wood, and not through the bark of the tree: for a plant continues to grow even when ſtript of a great part of its bark; which could not happen if the ſap aſcended through the bark. When an inciſion deep enough to penetrate the bark, and even part of the wood, is carried quite round a branch, provided the wound be covered up from the external air, the branch continues to vegetate as if nothing had happened; which could not be the caſe if the ſap aſcended between the bark and the wood. It is well known, too, that in the bleeding ſeaſon little or no ſap can be got from a tree unleſs our inciſion penetrate deeper than the bark.

131 Not by the parenchyma;

If the ſap aſcended through the parenchyma of plants, as ſome phyſiologiſts have ſuppoſed, ſince there is a communication between every part of that organ, it is evident that the tree ought to bleed whenever any part of the parenchyma is wounded. But this is not the caſe. Conſequently the ſap does not aſcend through the parenchyma. Beſides, if the ſuppoſition were true, the ſap, from the very ſtructure of the parenchyma, muſt aſcend in the ſame manner as water through a ſponge; and in that caſe could not poſſibly poſſeſs the force with which we know that it aſcends. But if the ſap is not found in the parenchyma, as is now well known to be the caſe, it muſt, of neceſſity, be confined in particular veſſels; for if it were not, it would undoubtedly make its appearance there. Now what are the veſſels through which the ſap aſcends?

132 But in veſſels.

Grew and Malpighi, the firſt philoſophers who examined the ſtructure of plants, took it for granted that the woody fibres were tubes, and that the ſap aſcended through them. For this reaſon they gave theſe fibres the name of *lymphatic* veſſels. But they were unable, even when aſſiſted by the beſt microſcopes, to detect any thing in theſe fibres which had the appearance of a tube; and ſucceeding obſervers have been equally unſucceſsful. The conjecture therefore of Malpighi and Grew, about the nature and uſe of theſe fibres, remains totally unſupported by any proof. Duhamel has even gone far to overturn it altogether. For he found that theſe woody fibres are diviſible into ſmaller fibres, and theſe again into ſtill ſmaller; and even, by the aſſiſtance of the beſt microſcopes, he could find no end of this ſubdiviſion.* Now granting theſe fibres to be veſſels, it is ſcarcely poſſible, after this, to ſuppoſe that the ſap really moves through tubes, whoſe diameters are almoſt infinitely ſmall. There are, however, veſſels in plants which may eaſily be diſtinguiſhed by the help of a ſmall microſcope, and even, in many caſes, by the naked eye. Theſe were ſeen, and diſtinctly deſcribed, by Grew and Malpighi. They conſiſt of a fibre twiſted round like a corkſcrew. If we take a ſmall cylinder of wood, and wrap round it a ſlender braſs wire, ſo cloſely that all the rings of the wire touch each other, and if, after this, we pull out the wooden cylinder altogether, the braſs wire thus twiſted will give us a very good repreſentation of theſe veſſels. If we take hold of the two ends of the braſs wire thus twiſted, and pull them, we can eaſily draw out the wire to a conſiderable length. In the ſame manner, when we lay hold of the two extremities of theſe veſſels, we can draw them out to a great length. Malpighi and Grew finding them always empty, concluded that they were intended for the circulation of the air through the plant, and therefore gave them the name of *tracheæ*; which word is uſed to denote the *windpipe* of animals. Theſe *tracheæ* are not found in the bark; but Hedwig has ſhewn that they are much more numerous in the wood than was ſuppoſed; and that they are of very different diameters; and Reichel has demonſtrated that they go to the minuteſt branches, and ſpread through every leaf. He has ſhewn, too, that they contain ſap; and Hedwig has proved that the notion which generally prevailed of their containing nothing but air, aroſe from this circumſtance, that the larger tracheæ, which alone were attended to, loſe their ſap as ſoon as they are cut; and, of courſe, unleſs they are inſpected the inſtant they are divided, they appear empty.† Is it not probable, then, or rather is it not certain, from the diſcoveries of that very ingenious phyſiologiſt, that the tracheæ are, in reality, the ſap veſſels of plants? Indeed it ſeems eſtabliſhed by the experiments both of Reichel and Hedwig, that all, or almoſt all the veſſels of plants may, if we attend only to their ſtructure, be denominated *tracheæ*.

133 Why it aſcends.

But by what powers is the ſap made to aſcend in theſe veſſels? And not only to aſcend, but to move with very conſiderable force; a force, as Hales has ſhewn, ſufficient to overcome the preſſure of 43 feet perpendicular of water?‡

134 Hypothe of Grew Malpigh and De Hire.

Grew aſcribed this phenomenon to the levity of the ſap: which, according to him, entered the plant in the ſtate of a very light vapour. But this opinion will not bear the ſlighteſt examination. Malpighi ſuppoſed that the ſap was made to aſcend by the contraction and dilation of the air contained in the air veſſels. But even were we to grant that the tracheæ are air veſſels, the ſap, according to this hypotheſis, could only aſcend when a change of temperature takes place; which is contrary to fact. And even if we were to wave every objection of that kind, the hypotheſis would not account for the circulation of the ſap, unleſs the ſap veſſels be provided with valves. Now the experiments of Hales and Duhamel ſhew that no valves can poſſibly exiſt in them. For branches imbibe moiſture nearly equally

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* *Veg. Stat.* i. 105.

* *Phyſiqu des Arbre* i. 57.

† *Fundament. Hi Nat. Mu cor. Fron* Part i. 54.

‡ *Veget. Stat.* i. 1

equally by either end; and conſequently the ſap moves with equal facility both upwards and downwards, which it could not do were there valves in the veſſels. Beſides, it is known, from many experiments, that we may convert the roots of a tree into the branches, and the branches into the roots, by covering the branches with earth, and expoſing the roots to the air. Now this would be impoſſible if the ſap veſſels were provided with valves. The ſame remarks overturn the hypotheſis of Mr de la Hire, which is merely that of Malpighi, expreſſed with greater preciſion, and with a greater parade of mechanical knowledge. Like Borelli, he placed the aſcending power of the ſap in the parenchyma. But his very experiments, had he attended to them with care, would have been ſufficient to ſhew the imperfection of his theory.

The greater number of philoſophers (for it is needleſs to mention theſe who, like Perrault, had recourſe to fermentation, nor thoſe who introduced the weight of the atmoſphere) have aſcribed the motion of the ſap to *capillary attraction*.

There exiſts a certain attraction between many ſolid bodies and liquids; in conſequence of which, if theſe ſolid bodies be formed into ſmall tubes, the liquid enters them, and riſes in them to a certain height. But this is perceptible only when the diameter of the tube is very ſmall. Hence the attraction has been denominated *capillary*. We know that there is ſuch an attraction between vegetable fibres and watery liquids. For ſuch liquids will aſcend through dead vegetable matter. It is highly probable, therefore, that the food of plants enters the roots, in conſequence of the capillary attraction which ſubſiſts between the ſap veſſels and the liquid imbibed. This ſpecies of attraction then, will account perfectly well for the entrance of moiſture into the mouths of the ſap veſſels. But will it account alſo, as ſome have ſuppoſed, for the aſcent of the ſap, and for the great force with which it aſcends?

The nature and laws of capillary attraction have been very much overlooked by philoſophers. But we know enough concerning it to enable us to decide the preſent queſtion. It conſiſts in a certain attraction between the particles of the liquid and of the tube. It has been demonſtrated, that it does not extend, or at leaſt that it produces no ſenſible effect, at greater diſtances than $\frac{1}{1000}$ part of an inch. It has been demonſtrated, that the water aſcends, not by the capillary attraction of the whole tube, but of a ſlender film of it; and Clairaut has ſhewn that this film is ſituated at the lowermoſt extremity of the tube (G). This film attracts the liquid with a certain force; and if this force be greater than the coheſion between the particles of the liquid, part enters the tube, and continues to enter, till the quantity above the attracting film of the tube juſt equals, by its weight, the exceſs of the capillary attraction between the tube and the liquid, above the coheſion of the liquid. The quantity of water therefore in the tube is pretty nearly the meaſure of this exceſs; for the attracting film is probably very minute.

It has been demonſtrated, that the heights to which liquids riſe in capillary tubes, are inverſely as the diameter of the tube. Conſequently the ſmaller the diameter of the tube, the greater is the height to which the liquid will riſe. But the particles of water are not infinitely ſmall; therefore whenever the diameter of the tube is diminiſhed beyond a certain ſize, water cannot aſcend in it, becauſe its particles are now larger than the bore of the tube. Conſequently the riſe of water in capillary tubes muſt have a limit: if they exceed a certain length, how ſmall ſoever their bore may be, water will either not riſe to the top of them, or it will not enter them at all. We have no method of aſcertaining the preciſe height to which water would riſe in a capillary tube, whoſe bore is juſt large enough to admit a ſingle particle of water. Therefore we do not know the limit of the height to which water may be raiſed by capillary attraction. But whenever the bore is diminiſhed beyond a certain ſize, the quantity of water which riſes in it is too ſmall to be ſenſible. We can eaſily aſcertain the height which water cannot exceed in capillary tubes before this happens; and if any perſon calculate, he will find that this height is not nearly equal to the length of the ſap veſſels of many plants. But beſides all this, we ſee in many plants very long ſap veſſels, of a diameter too large for a liquid to riſe in them a ſingle foot by capillary attraction, and yet the ſap riſes in them to very great heights.

If any perſon ſays that the ſap veſſels of plants gradually diminiſh in diameter as they aſcend; and that, in conſequence of this contrivance, they act preciſely as an indefinite number of capillary tubes, one ſtanding upon another, the inferior ſerving as a reſervoir for the ſuperior: we anſwer, that the ſap may aſcend by that means to a conſiderable height; but certainly not in any greater quantity than if the whole ſap veſſel had been preciſely of the bore of its upper extremity. For the quantity of ſap raiſed muſt depend upon the bore of the upper extremity, becauſe it muſt all paſs through that extremity. The quantity of ſap, too, on that ſuppoſition, muſt diminiſh the farther we go from the root, becauſe the bore of the ſap veſſels is conſtantly diminiſhing; the aſcending force muſt alſo diminiſh, becauſe it is, in all caſes, proportional to the quantity of water raiſed. Now neither of theſe, as Dr Hales has demonſtrated, is true.

137 And refuted.

But farther, if the ſap moved only in the veſſels of plants by capillary attraction, it would be ſo far from flowing out at the extremity of a branch, with a force ſufficient to overcome the preſſure of a column of water 43 feet high, that it could not flow out at all. It would be impoſſible in that caſe for any ſuch thing as the bleeding of trees ever to happen.

If we take a capillary tube, of ſuch a bore that a liquid will riſe in it ſix inches, and after the liquid has riſen to its greateſt height, break it ſhort three inches from the bottom, none of the liquid in the under half flows over. The tube, thus ſhortened, continues indeed full, but not a ſingle particle of liquid ever eſcapes from it. And how is it poſſible for it to eſcape? The film,

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(G) The action of all the other films, of which the tube is compoſed, on the water, as far as it is meaſured by its effect, is nothing at all. For every particle of water in the tube (except thoſe attracted by the undermoſt film) is attracted upwards and downwards by the ſame number of films: it is therefore preciſely in the ſame ſtate as if it were not attracted at all.

film, at the *upper* extremity of the tube, muſt certainly have as ſtrong an attraction for the liquid as the film at the *lower* extremity. As part of the liquid is within its attracting diſtance, and as there is no part of the tube above to counterbalance this attraction, it muſt of neceſſity attract the liquid neareſt it, and with a force ſufficient to counterbalance the attraction of the undermoſt film, how great ſoever we may ſuppoſe it. Of courſe no liquid can be forced up, and conſequently none can flow out of the tube. Since then the ſap *flows out* at the upper extremity of the ſap veſſels of plants, we are abſolutely certain that it does not aſcend in them merely by its capillary attraction, but that there is ſome other cauſe.

It is impoſſible therefore to account for the motinn of the ſap in plants by any mechanical or chemical principles whatever; and he who aſcribes it to theſe principles has not formed to himſelf any clear or accurate conception of the ſubject. We know indeed that heat is an agent; for Dr Walker found that the aſcent of the ſap is much promoted by heat, and that after it had begun to flow from ſeveral inciſions, cold made it give over flowing from the higher orifices while it continued to flow at the lower.* But this cannot be owing to the dilating power of heat; for unleſs the ſap veſſels of plants were furniſhed with valves (and they have no valves), dilatation would rather retard than promote the aſcent of the ſap. Conſequently the effect of heat can give us no aſſiſtance in explaining the aſcent of the ſap upon mechanical and chemical principles.

138
The veſſels muſt contract,

We muſt therefore aſcribe it to ſome other cauſe: the veſſels themſelves muſt certainly act. Many philoſophers have ſeen the neceſſity of this, and have accordingly aſcribed the aſcent of the ſap to *irritability*. But the firſt perſon who gave a preciſe view of the manner in which the veſſels probably act was Sauſſure. He ſuppoſes that the ſap enters the open mouths of the veſſels, at the extremity of the roots; that theſe mouths then contract, and by that contraction propel the ſap upwards; that this contraction gradually follows the ſap, puſhing it up from the extremity of the root to the ſummit of the plant. In the mean time the mouths are receiving new ſap, which in the ſame manner is puſhed upwards.† Whether we ſuppoſe the contraction to take place preciſely in this manner or not, we can ſcarcely deny that it muſt take place; but by what means it is impoſſible to ſay. The agents cannot preciſely reſemble the muſcles of animals; becauſe the whole tube, however cut or maimed, ſtill retains its contracting power, and becauſe the contraction is performed with equal readineſs in every direction. It is evident, however, that they muſt be the ſame in kind. Perhaps the particular ſtructure of the veſſels may fit them for their office. Does ring after ring contract its diameter? The contracting agents, whatever they are, ſeem to be excited to act by ſome ſtimulus communicated to them by the ſap. This capacity of being excited to action is known in phyſiology by the name of *irritability*; and there are not wanting proofs that plants are poſſeſſed of it. It is well known that different parts of plants move when certain ſubſtances act upon them. Thus the flowers of many plants open at ſunriſe, and cloſe again at night. Linnæus has given us a liſt of theſe plants. Des Fontaines has ſhewn that the ſtamina and antheræ of many plants exhibit diſtinct motions.‡ Dr Smith has obſerved, that the ſtamina of the barberries are thrown into motions when touched.§ Roth has aſcertained that the leaves of the droſera longifolia and rotundifolia have the ſame property. Mr Coulon, too, who has adopted the opinion that the motion of the ſap in plants is produced by the contraction of veſſels, has even made a number of experiments in order to ſhew this contraction. But the fact is, that every one has it in his power to make a deciſive experiment. Simply cutting a plant, the *euphorbia peplis* for inſtance, in two places, ſo as to ſeparate a portion of the ſtem from the reſt, is a complete demonſtration that the veſſels actually do contract. For whoever makes the experiment, will find that the milky juice of that plant flows out at both ends ſo completely, that if afterwards we cut the portion of the ſtem in the middle, no juice whatever appears. Now it is impoſſible that theſe phenomena could take place without a contraction of the veſſels; for the veſſels in that part of the ſtem which has been detached cannot have been *more* than full; and their diameter is ſo ſmall, that if it were to continue unaltered, the capillary attraction would be more than ſufficient to retain their contents, and conſequently not a drop could flow out. Since, therefore, the whole liquid eſcapes, it muſt be driven out forcibly, and conſequently the veſſels muſt contract.

139
In conſ
quence
ſtimuli.

It ſeems pretty plain, too, that the veſſels are excited to contract by various ſtimuli; the experiments of Coulon and Sauſſure render this probable, and an obſervation of Dr Benjamin Smith Barton makes it pretty certain. He found that plants growing in water vegetated with much greater vigour, provided a little camphor was thrown into the water.*

140
Peculia
juice f
ed from
ſap;

18. Beſides the ſap which aſcends upwards towards the leaves, they contain alſo another fluid, known by the name of *ſuccus proprius*, or *peculiar juice*. This juice differs very conſiderably in different plants. It ſeems to be the ſap altered by ſome proceſs or other, and fitted for the various purpoſes of vegetation. That it flows from the leaves of the plant towards the roots, appears from this circumſtance, that when we make an inciſion into a plant, into whatever poſition we put it, much more of the ſuccus proprius flows from that ſide of the wound which is next the leaves and branches, than from the other ſide: and this happens even though the leaves and branches be held undermoſt.† When a ligature is tied about a plant, a ſwelling appears above, but not below the ligature.

The veſſels containing the peculiar juice are found in all the parts of the plant. Hedwig, who has examined the veſſels of plants with very great care, ſeems to conſider them as of the ſame ſtructure with the tracheæ. The peculiar juice is eaſily known by its colour and its conſiſtence. In ſome plants it is green, in ſome red, in many milky. It cannot be doubted that its motion in the veſſels is performed in the ſame way as that of the ſap.

141
In the
leaves.

19. It appears, then, that the ſap aſcends to the leaves, that there it undergoes certain alterations, and is converted into the peculiar juices; which, like the blood in animals, are afterwards employed in forming the various ſubſtances found in plants. Now the changes which the ſap undergoes in the leaves, provided we can trace them, muſt throw a great deal of light upon the nature of vegetation.

No

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* Edin. Tranſ. i.

† Encyc. Meth. Phyſ. Veget. p. 367.

‡ Mem. Par. 1

§ Phil. Tranſ. lxxviii.

* Ann. Chim. xxiii. 6

† Bell. Manch. Mem. i 402.

42
of the
per-
s thro'
eaves.

No ſooner has the ſap arrived at the leaves, than a great part of it is thrown off by evaporation. The quantity thus perſpired bears a very great proportion to the moiſture imbibed. Mr Woodward found that a ſprig of mint in 77 days imbibed 2558 grains of water, and yet its weight was only increaſed 15 grains;* therefore it muſt have given out 2543 grains. Another branch, which weighed 127 grains, increaſed in weight 128, and it had imbibed 14190 grains. Another ſprig, weighing 76 grains, growing in water mixed with earth, increaſed in weight 168 grains, and had imbibed 10731 grains of water. Theſe experiments demonſtrate the great quantity of matter which is conſtantly leaving the plant. Dr Hales found that a cabbage tranſmitted daily a quantity of moiſture equal to about half its weight; and that a ſun flower, three feet high, tranſmitted in a day 1lb. 14 oz. avoirdupois.† He ſhewed, that the quantity of tranſpiration in the ſame plant was proportional to the ſurface of the leaves, and that when the leaves were taken off, the tranſpiration nearly ceaſed.‡ By theſe obſervations, he demonſtrated that the leaves are the organs of tranſpiration. He found, too, that the tranſpiration was nearly confined to the day, very little taking place during the night;§ that it was much promoted by heat, and ſtopped by rain and froſt.‖ And Millar,¶ Guettard,* and Senebier, have ſhown that the tranſpiration is alſo very much promoted by ſunſhine.

The quantity of moiſture imbibed by plants depends very much upon what they tranſpire: the reaſon is evident: when the veſſels are once filled with ſap, if none be carried off, no more can enter; and, of courſe, the quantity which enters muſt depend upon the quantity emitted.

In order to diſcover the nature of the tranſpired matter, Hales placed plants in large glaſs veſſels, and by that means collected a quantity of it.† He found that it reſembled pure water in every particular, excepting only that it ſometimes had the odour of the plant. He remarked, too, as Guettard and du Hamel did after him, that when kept for ſome time it putrefied, or at leaſt acquired a ſtinking ſmell. Senebier ſubjected a quantity of this liquid to a chemical analyſis.

43
ature.

He collected 13030 grains of it from a vine during the months of May and June. After filtration he gradually evaporated the whole to dryneſs. There remained behind two grains of reſiduum. Theſe two grains conſiſted of nearly $\frac{1}{2}$ grain of carbonat of lime, $\frac{1}{12}$ grain of ſulphat of lime, $\frac{1}{2}$ grain of matter ſoluble in water, and having the appearance of gum, and $\frac{1}{2}$ grain of matter which was ſoluble in alcohol, and apparently reſinous. He analyzed 60768 grains of the ſame liquid, collected from the vine during the months of July and Auguſt. On evaporation he obtained $2\frac{1}{8}$ grains of reſiduum, compoſed of $\frac{3}{4}$ grain of carbonat of lime, $\frac{1}{4}$ grain of ſulphat of lime, $\frac{1}{4}$ grain of mucilage, and $\frac{1}{2}$ grain of reſin. The liquid tranſpired by the *aſter novæ Angliæ* afforded preciſely the ſame ingredients.‡

44
quan-

Senebier attempted to aſcertain the proportion which the liquid tranſpired bore to the quantity of moiſture imbibed by the plant. But it is eaſy to ſee that ſuch experiments are liable to too great uncertainties to be depended on. His method was as follows: He plunged the thick end of the branch on which he made the experiment into a bottle of water, while the other end, containing all its leaves, was thruſt into a very large glaſs globe. The apparatus was then expoſed to the ſunſhine. The quantity imbibed was known exactly by the water which diſappeared from the bottle, and the quantity tranſpired was judged of by the liquid which condenſed and trickled down the ſides of the glaſs globe. The following table exhibits the reſult of his experiments:

Plants.	*Imbibed.*	*Perſpired.*	*Time.*
Peach -	100 gr. -	35 gr.	
Ditto - -	210 - -	90	
Ditto .	220 - -	120	
Mint - -	200 - -	90 - -	2 days.
Ditto -	575 - -	120 -	10
Raſp - -	725 - -	560 - -	2
Ditto -	1232 - -	765 -	2
Peach - -	710 - -	295 - -	1
Apricot -	210 - -	180 -	1

In ſome of his experiments no liquid at all was condenſed. Hence it is evident that the quantity of matter tranſpired cannot be deduced from theſe experiments. The mouth of the glaſs globe does not ſeem to have been accurately cloſed; the air within it communicated with the external air: conſequently the quantity condenſed muſt have depended entirely upon the ſtate of the external air, the heat, &c.

The firſt great change, then, which takes place upon the ſap after it arrives at the leaves, is the evaporation of a great part of it; conſequently what remains muſt be very different in its proportions from the ſap. The leaves ſeem to have particular organs adapted for throwing off part of the ſap by tranſpiration. For the experiments of Guettard,* Duhamel,† and Bonnet,‡ ſhew that it is performed chiefly by the upper ſurfaces of leaves, and may be nearly ſtopped altogether by varniſhing the upper ſurface.

145
Why the
leaves fall
off.

The leaves of plants become gradually leſs and leſs fit for this tranſpiration; for Senebier found, that when all other things are equal, the tranſpiration is much greater in May than in September.* Hence the reaſon that the leaves are renewed annually. Their organs become gradually unfit for performing their functions, and therefore it is neceſſary to renew them. Thoſe trees which retain their leaves during the winter, were found by Hales and ſucceeding phyſiologiſts to tranſpire leſs than others. It is now well known that theſe trees alſo renew their leaves.

20. Leaves have alſo the property of abſorbing carbonic acid gas from the atmoſphere.

146
Leaves abſorb carbonic acid gas.

We are indebted for this very ſingular diſcovery to the experiments of Dr Prieſtley, though he himſelf did not diſcover the truth, and though he even refuſed to acknowledge it when it was pointed out by others. It has been long known, that when a candle has been allowed to burn out in any quantity of air, no candle can afterwards be made to burn in it. In the year 1771 Dr Prieſtley made a ſprig of mint vegetate for ten days in contact with a quantity of ſuch air; after which he found that a candle would burn in it perfectly well.¶ This experiment he repeated frequently, and found that it was always attended with the ſame reſult. According to the opinion at that time univerſally received, that the

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d. 49.

. Meth.
. Veget.

* Mem. Par. 1749.

† Phyſique des Arbres, i. 158.

‡ Traité des Feuilles, 1 Mem.

* Enc. Method. Veget. 285.

¶ On Air, iii. 251.

the burning of candles rendered air impure by communicating phlogiſton to it, he concluded from it, that plants, while they vegetate, abſorb phlogiſton.

Carbonic acid gas was at that time ſuppoſed to contain phlogiſton. It was natural, therefore, to ſuppoſe that it would afford nouriſhment to plants, ſince they had the property of abſorbing phlogiſton from the atmoſphere. Dr Percival had publiſhed a ſet of experiments; by which he endeavoured to ſhew that this was actually the caſe.

Theſe experiments induced Dr Prieſtley, in 1776, to conſider the ſubject with more attention. But as, in all the experiments which he made, the plants confined in carbonic acid gas very ſoon died, he concluded, that carbonic acid gas was not a food, but a poiſon to plants.* Mr Henry of Mancheſter was led, in 1784, probably by the contrariety of theſe reſults, to examine the ſubject. His experiments, which were publiſhed in the Mancheſter Tranſactions,† perfectly coincided with thoſe of Dr Percival. For he found, that carbonic acid gas, ſo far from killing plants, conſtantly promoted their growth and vigour. Meanwhile Mr Senebier was occupied at Geneva with the ſame ſubject; and he publiſhed the reſult of his reſearches in his *Memoires Phyſico-chymique* about the year 1780. His experiments ſhewed, in the cleareſt manner, that carbonic acid gas is uſed by plants as food. The ſame thing was ſupported by Ingenhouſz in his ſecond volume. The experiments of Sauſſure the Son, publiſhed in 1797, have at laſt put the ſubject beyond the reach of diſpute. From a careful compariſon of the experiments of theſe philoſophers, it will not be difficult for us to diſcover the various phenomena, and to reconcile all the ſeeming contradictions which occur in them. The facts are as follows:

Mr Sauſſure has ſhewn, that plants will not vegetate when totally deprived of carbonic acid gas. They vegetate indeed well enough in air which has been previouſly deprived of carbonic acid gas; but when a quantity of lime was put into the glaſs veſſel which contained them, they no longer continued to grow, and the leaves in a few days fell off.‡ The air, when examined, was found to contain no carbonic acid gas. The reaſon of this phenomenon is, that plants (as we ſhall ſee afterwards) have the power of forming and giving out carbonic acid in certain circumſtances; and this quantity is ſufficient to continue their vegetation for a certain time. But if this new formed gas be alſo withdrawn, by quicklime, for inſtance, which abſorbs it the inſtant it appears, the leaves droop, and refuſe to perform their functions. Carbonic acid gas, then, applied to the leaves of plants, is *eſſential* to vegetation.

147
Decompoſe it and emit the oxygen;

Dr Prieſtley, to whom we are indebted for many of the moſt important facts relative to vegetation, obſerved, in the year 1778, that plants, in certain circumſtances, emitted oxygen gas;∥ and Ingenhouſz very ſoon after diſcovered that this gas is emitted by the *leaves* of plants, and only when they are expoſed to the bright light of day. His method was to plunge the leaves of different plants into veſſels full of water, and then expoſe them to the ſun, as Bonnet, who had obſerved the ſame phenomenon, though he had given a wrong explanation of it, had done before him. Bubbles of oxygen gas very ſoon detached themſelves from the leaves, and were collected in an inverted glaſs veſſel.* He obſerved, too, that it was not a matter of indifference what kind of water was uſed. If the water, for inſtance, had been previouſly boiled, little or no oxygen gas eſcaped from the leaves; river water afforded but little gas; but pump water was the moſt productive of all.†

Senebier proved, that if the water be previouſly deprived of all its air by boiling, the leaves do not emit a particle of air; that thoſe kinds of water which yield moſt air, contain in them the greateſt quantity of carbonic acid gas; that leaves do not yield any oxygen when plunged in water totally deſtitute of carbonic acid gas; that they emit it abundantly when the water, rendered unproductive by boiling, is impregnated with carbonic acid gas; that the quantity of oxygen emitted, and even its purity, is proportional to the quantity of carbonic acid gas which the water contains; that water impregnated with carbonic acid gas gradually loſes the property of affording oxygen gas with leaves; and that whenever this happens, all the carbonic acid gas has diſappeared; and on adding more carbonic acid gas the property is renewed.‡ Theſe experiments prove, in a moſt ſatiſfactory manner, that the oxygen gas which the leaves of plants emit depends upon the preſence of carbonic acid gas; that the leaves abſorb carbonic acid gas, decompoſe it, give out the oxygen, and retain the carbon.

14
But du
the day
ly.

We now ſee why plants will not vegetate without carbonic acid gas. They abſorb it and decompoſe it; but this proceſs goes on only when the plants are expoſed to the light of day. Therefore we may conclude, that the abſorption and decompoſition of carbonic acid gas is confined to the day, and that light is an eſſential agent in the decompoſition. Probably it is by its agency, or by its entering into combination with the oxygen, that this ſubſtance is enabled to aſſume the gaſeous form, and to ſeparate from the carbon.

If we reaſon from analogy, we ſhall conclude, that during this proceſs a quantity of caloric is neceſſary; and that therefore no increaſe of temperature takes place, but rather the contrary. This may be one reaſon why the operation takes place only during the day.

14
In this
plants
acquire
much c
bon.

It is extremely probable that plants by this proceſs acquire the greateſt part of the carbonaceous matter which they contain; for if we compare the quantity of carbon contained in plants vegetating in the dark, where this proceſs cannot go on, with the quantity which thoſe plants contain which vegetate in the uſual manner, we ſhall perceive a very conſpicuous difference. Chaptal found that a byſſus, which was vegetating in the dark, contained only $\frac{1}{80}$ of its weight of carbonaceous matter; but the ſame plant, after being made to vegetate in the light for 30 days, contained $\frac{1}{24}$th of its weight of carbonaceous matter.* Haſſenfratz aſcertained, that plants growing in the dark contain much more water, and much leſs carbon and hydrogen, than plants growing in the light. Senebier analyſed both with the ſame reſult. Plants growing in the dark yielded leſs hydrogen gas and oil: their reſinous matter was to that of plants growing in the light as 2 to 5,5, and their moiſture as 13 to 6; they contain even one-half leſs of fixed matters.

It is evident, however, that this abſorption and decompoſition of carbonic acid gas does not depend upon the

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* *On Air*, i. 100.

† ii. 341.

‡ *Ann. de Chim.* xxiv. 145. 148.

∥ *On Air*, iii. 284.

* *Ingen*
on Vege
i. 15,

† *Ibid.*

‡ *Enc.*
thod. P
Veget.

* *Mem.*
Par. 1

the light alone. The nature of the ſap has alſo its influence; for Haſſenfratz found, that the quantity of carbon did not increaſe when plants vegetated in pure water. Here the ſap ſeems to have wanted that part which combines with and retains the carbon; and which therefore is by far the moſt important part of the food of plants. Upon the diſcovery and mode of applying this ſubſtance, whatever it is, the improvements in agriculture muſt in a great meaſure depend.

If we conſider the difference in the proportion of carbonaceous matter in plants vegetating in the dark and in the uſual manner, we can ſcarcely avoid concluding that the quantity of carbonic acid gas abſorbed by plants is conſiderable. To form an eſtimate of it, would require a ſet of experiments performed in a very different manner from any hitherto made. The ſtems and branches of plants vegetating in a rich ſoil ſhould be confined within a large glaſs globe, the inſide of which ought to have no communication with the external air. A very ſmall ſtream of carbonic acid gas ſhould be made occaſionally to flow into this globe, ſo as to ſupply the quantity that may appear neceſſary; and there ſhould be a contrivance to carry off and examine the air within the globe when it increaſes beyond a certain quantity. Experiments conducted in this manner would probably throw a great deal of light upon this part of vegetation, and enable us to calculate the quantity of carbonic acid decompoſed, and the quantity of oxygen emitted by plants; to compare theſe with the waſte of oxygen by the reſpiration of animals and combuſtion, and to ſee whether or not they balance each other.

Senebier has aſcertained, that the decompoſition of the carbonic acid takes place in the parenchyma. He found, that the epidermis of a leaf would, when ſeparated, give out no air, neither would the nerves in the ſame circumſtances; but upon trying the parenchyma, thus ſeparated from its epidermis and part of its nerves, it continued to give out oxygen as before.† He remarked alſo, that every thing elſe being equal, the quantity of oxygen emitted, and conſequently of carbonic acid decompoſed, is proportional to the thickneſs of the leaf; and this thickneſs depends upon the quantity of parenchyma.

That the decompoſition is performed by peculiar organs, is evident from an experiment of Ingenhouſz. Leaves cut into ſmall pieces continued to give out oxygen as before; but leaves pounded in a mortar loſt the property entirely. In the firſt ſtate, the peculiar ſtructure remained; in the other, it was deſtroyed. Certain experiments of Count Rumford, indeed, are totally incompatible with this concluſion; and they will naturally occur to the reader, as an unſurmountable objection. He found, that dried leaves, black poplar, fibres of raw ſilk, and even glaſs, when plunged into water, gave out oxygen gas by the light of the ſun. But when Senebier repeated theſe experiments, not one of them would ſucceed;‡ and we have attempted them with the ſame bad ſucceſs. The Count muſt have been miſled by ſomething which he has not mentioned.

Thus we have ſeen, that when the ſap arrives at the leaves, great part is thrown off by evaporation, and that the nature of the remainder is conſiderably altered by the addition of a quantity of carbon: but theſe are by no means all the alterations produced upon the ſap in the leaves.

Vegetation.

151
Leaves abſorb oxygen,

21. Plants will not vegetate unleſs atmoſpheric air or oxygen gas have acceſs to their leaves. This was rendered probable by thoſe philoſophers who, about the end of the 17th century, turned their attention particularly towards the phyſical properties of the air: But Mr Ingenhouſz was perhaps the firſt of the modern chemiſts who put it beyond doubt. He found that carbonic acid gas, azot, and hydrogen gas, deſtroyed plants altogether, unleſs they were mixed with atmoſpheric air or oxygen gas. He found alſo, that plants grew very well in oxygen gas and in atmoſpheric air.* Theſe experiments are ſufficient to ſhew, that oxygen gas is neceſſary to vegetation. The leaves of plants ſeem to abſorb it; and moſt probably this abſorption takes place only in the night. We know, at leaſt, that in germination, light is injurious to the abſorption of oxygen gas; and therefore it is probable that this is the caſe alſo in vegetation.

152
And water,

22. The leaves of plants not only abſorb carbonic acid gas and oxygen gas, but water alſo. This had been ſuſpected in all ages: the great effect which dew, ſlight ſhowers, and even wetting the leaves of plants, have in recruiting their ſtrength, and making them vegetate with vigour, are ſo many proofs that the leaves imbibe moiſture from the atmoſphere. Hales rendered this ſtill more probable, by obſerving, that plants increaſe conſiderably in weight when the atmoſphere is moiſt; and Mr Bonnet put the matter beyond doubt in his *Reſearches concerning the Uſe of the Leaves*. He ſhewed, that leaves continue to live for weeks when one of their ſurfaces is applied to water; and that they not only vegetate themſelves, but even imbibe enough of water to ſupport the vegetation of a whole branch, and the leaves belonging to it. He diſcovered alſo, that the two ſurfaces of leaves differ very conſiderably in their power of imbibing moiſture; that in trees and ſhrubs, the under ſurface poſſeſſes almoſt the whole of the property, while the contrary holds in many of the other plants; the kidney bean for inſtance.

Theſe facts prove, not only that the leaves of plants have the power of abſorbing moiſture, but alſo that the abſorption is performed by very different organs from thoſe which emit moiſture; for theſe organs lie on different ſides of the leaf. If we conſider that it is only during the night that the leaves of plants are moiſtened with dew, we can ſcarcely avoid concluding, that, except in particular caſes, it is during the night that plants imbibe almoſt all the moiſture which they do imbibe.

153
And emit carbonic acid gas.

23. During the night the leaves of plants emit carbonic acid gas. This fact was firſt demonſtrated by Mr Ingenhouſz,† and it has been ſince confirmed by every philoſopher who has attended to the ſubject.

Thus we have ſeen that the leaves of plants perform very different operations at different times. During the day they are giving out moiſture, abſorbing carbonic acid gas, and emitting oxygen gas; during the night, on the contrary, they are abſorbing moiſture, giving out carbonic acid gas, and abſorbing oxygen gas.

The emiſſion of the carbonic acid gas ſeems to be the conſequence of the decompoſition of water; either of the water which is already contained in the ſap, or

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* *Ingenhouſz* ii. paſſim.

† *On Vegetables*, i. 47. and ii. paſſim.

of that which the leaves imbibe during the night ; but which of the two, it is impoſſible to determine, nor is it of much conſequence. We may conclude that this is the caſe, becauſe it takes place during the germination of the ſeed, where all the circumſtances ſeem to be perfectly analogous. The water is decompoſed, its oxygen is combined with part of the carbon which had been abſorbed during the day, and the hydrogen enters into new combinations in the ſap. It appears, alſo, that this decompoſition of water depends in a good meaſure upon the quantity of oxygen gas abſorbed ; for Dr Ingenhouſz found, that when plants are confined in oxygen gas, they emit more carbonic acid gas than when they are confined in common air.†

154
Sap converted by theſe proceſſes into the peculiar juice.

To deſcribe in what manner theſe decompoſitions take place, is impoſſible ; becauſe we neither know preciſely the ſubſtances into which the ſap has been converted by the operations performed during the day, nor the new ſubſtances formed by the operations of the night. We only ſee the elementary ſubſtances which are added and ſubtracted ; which is far from being ſufficient to give us preciſe notions concerning the chemical changes and the affinities by which theſe changes are produced. We have reaſon, however, to conclude, that during the day the carbon of the ſap is increaſed, and that during the night the hydrogen and oxygen are increaſed ; but the preciſe new ſubſtances formed are unknown to us. Nor let any one ſuppoſe that the increaſe of the hydrogen, and of the oxygen of the ſap, is the ſame thing as the addition of a quantity of water. Far from it. The ſubſtances into which the ſap is converted have been enumerated in the laſt chapter ; almoſt all of them conſiſt chiefly of carbon, hydrogen, and oxygen, and yet none of them has the ſmalleſt reſemblance to water. In water, oxygen and hydrogen are already combined together in a certain proportion ; and this combination muſt be broken before theſe elementary bodies can enter into thoſe triple compounds with carbon, of which a great part of the vegetable products conſiſt. We have not the ſmalleſt conception of the manner in which theſe triple combinations are formed, and as little of the manner in which the bodies which compoſe vegetable ſubſtances are combined together. The combination may, for any thing we know to the contrary, be very complicated, though it conſiſts only of three ingredients ; and analogy leads us to ſuppoſe, that it actually is very complicated : for in chemiſtry it may be conſidered as a truth, to which at preſent few or no exceptions are known, that bodies are decompoſed with a facility inverſely as the ſimplicity of their compoſition ; that is to ſay, that thoſe bodies which conſiſt of the feweſt ingredients are moſt difficultly decompoſed, and that thoſe which are formed of many ingredients are decompoſed with the greateſt facility.

Neither let any one ſuppoſe, that the abſorption of carbonic acid gas, during the day, is balanced by the quantity emitted during the night, and that therefore there is no increaſe of carbon : for Ingenhouſz has ſhewn, that the quantity of oxygen gas emitted during the day is much greater than the carbonic acid gas emitted during the night ; and that in favourable circumſtances, the quantity of oxygen gas in the air ſurrounding plants is very much increaſed, and the carbonic acid gas diminiſhed ; ſo much ſo, that both Dr Prieſtley and Dr Ingenhouſz found, that air which had been ſpoiled by a lighted candle, or by animals, was rendered as good as ever by plants. Now we know, that combuſtion and reſpiration diminiſh the oxygen gas, and add carbonic acid gas to air ; therefore vegetation, which reſtores the purity of air altered by theſe proceſſes, muſt increaſe the oxygen, and diminiſh the carbonic acid gas of that air ; conſequently the quantity of carbonic acid gas abſorbed by plants during the day is greater than the quantity emitted by them during the night, and of courſe the carbon of the ſap is increaſed in the leaves.

It is true, that when plants are made to vegetate for a number of days in a given quantity of air, its ingredients are not found to be altered. Thus Haſſenfratz aſcertained, that the air in which young cheſnuts vegetated for a number of days together, was not altered in its properties, whether the cheſnuts were vegetating in water or in earth.* And Sauſſure the Younger proved, that peaſe growing for ten days in water did not alter the ſurrounding air.† But this is preciſely what ought to be the caſe, and what muſt take place, provided the concluſions which we have drawn be juſt. For if plants only emit oxygen gas, by abſorbing and decompoſing carbonic acid gas, it is evident, that unleſs carbonic acid gas be preſent, they can emit no oxygen gas ; and whenever they have decompoſed all the carbonic acid gas contained in a given quantity of air, we have no longer any reaſon to look for their emitting any more oxygen gas ; and if the quantity of carbonic acid gas emitted during the night be ſmaller than that abſorbed during the day, it is evident, that during the day the plant will conſtantly decompoſe all the acid which had been formed during the night. By theſe proceſſes, the mutual changes of day and night compenſate each other ; and they are prevented from more than compenſating each other by the forced ſtate of the plant. It is probable, that when only part of a plant is made to vegetate in this forced ſtate, ſome *carbonated ſap* (if we may be allowed the expreſſion) is ſupplied by the reſt of the plant ; and that therefore the quantity of carbonic acid gas emitted during the night may bear a nearer proportion to that emitted in a ſtate of nature, than that of the abſorption of fixed air can poſſibly do. And probably, even when the whole plant is thus confined, the nightly proceſs goes on for a certain time at the expence of the carbon already in the ſap ; for Haſſenfratz found, that in theſe caſes the quantity of carbon in the plant, after it had vegetated for ſome time in the dark, was leſs than it had been when it began to vegetate.* This is the reaſon that plants growing in the dark, when confined, abſorb all the oxygen gas, and emit an equal quantity of carbonic acid gas : and whenever this has happened, they die ; becauſe then neither the daily nor nightly proceſſes can go on.

24. Certain changes are alſo produced on the ſap in the leaves by the action of light ; and theſe changes ſeem to be in ſome meaſure independent, or at leaſt different from the abſorption and decompoſition of carbonic acid gas, in which light, as we have ſeen, acts an important part.

155
Green lour of plants p duced b light.

The green colour of plants is owing entirely to their vegetating in the light ; for when they vegetate in the dark they are white ; and when expoſed to the light, they acquire a green colour in a very ſhort time, in what-

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† *Ingenhouſz* ii.

* *Ann. Chim.* 225.

† *Ibid.* 139.

* *Ann. Chim.* 188.

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whatſoever ſituation they are placed, even though plunged in water, provided always that oxygen be preſent; for Mr Gough has ſhewn, that light without oxygen has not the power of producing the green colour.* In what manner this change is operated, cannot, in the preſent limited ſtate of our knowledge, be aſcertained. We know too little about the properties of light to be able even to conjecture with any plauſibility. We know indeed, that part of the light is abſorbed by green plants; but this will not account for the phenomenon. When dilated, it amounts to no more than this, that plants which have grown in the dark reflect all the rays of light; while thoſe which vegetate in the light reflect the green and abſorb the others. The very mention of this phenomenon is enough to ſhew us, that we have not advanced far enough to be able to explain it.

*Vauch.
moirs,
501.*

Etiolated (E) plants want ſomething, or poſſeſs ſomething peculiar; and it is on this ſomething that the phenomenon depends. But what is this ſomething? The ſudden appearance of the green colour is rather againſt the ſuppoſition, that it is owing to any ſpecific change in the qualities of the ſap.

Senebier has obſerved, that when plants are made to vegetate in the dark, their etiolation is much diminiſhed by mixing a little hydrogen gas with the air that ſurrounds them.* Ingenhouſz had already remarked, that when a little hydrogen gas is added to the air in which plants vegetate, even in the light, it renders their verdure deeper;† and he ſeems to think alſo, that he has proved by experiments, that plants abſorb hydrogen gas in theſe circumſtances.‡ Mr Humbolt has obſerved, that the poa anua and compreſſa, plantago lanceolata, trifolium arvenſe, cheiranthus cheiri, lichen verticillatus, and ſeveral other plants which grow in the galleries of mines, retain their green colour even in the dark, and that in theſe caſes the air around them contains a quantity of hydrogen gas. Theſe facts are ſufficient to ſhew that there is ſome connection between the green colour of plants and the action of hydrogen gas on them; but what that connection is, it is impoſſible at preſent to ſay.

*nc. Me-
Phyſ.
t. 77.
nn. de
. iii.
id. 61.*

25. By theſe different changes which go on in the leaves, the nature of the ſap is altogether changed. It is now converted into what is called the *peculiar juice*, and is fit for being aſſimilated to the different parts of the plant, and for being employed in the formation of thoſe ſecretions which are neceſſary for the purpoſes of the vegetable economy.

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The leaves, therefore, may be conſidered as the digeſting organs of plants, and as equivalent in ſome meaſure to the ſtomach and lungs of animals. The leaves conſequently are not mere ornaments; they are the moſt important parts of the plant. Accordingly we find, that whenever we ſtrip a plant of its leaves, we ſtrip it entirely of its vegetating powers till new leaves are formed. It is well known, that when the leaves of plants are deſtroyed by inſects, they vegetate no longer, and that their fruit never makes any farther progreſs in ripening, but decays and dries up. Even in germination no progreſs is made in the growth of the ſtem till the ſeed leaves appear. As much food indeed is laid up in the cotyledons as advances the plant to a certain ſtate, the root is prepared, and made ready to perform its functions; but the ſap which it imbibes muſt be firſt carried to the ſeed leaves, and digeſted there, before it be proper for forming the plumula into a ſtem. Accordingly if the ſeed leaves are cut off, the plant refuſes to vegetate.

Vegetation.

157
How they
are produced.

It will be very natural to aſk, If this be true, how come the leaves themſelves to be produced? Even if no anſwer could be given to this queſtion, it could not overturn a ſingle fact which has been formerly mentioned, nor affect a ſingle concluſion as far as it has been fairly deduced from theſe facts. We know that the leaves exiſt long before they appear; they have been traced even five years back. They are completely formed in the bud, and fairly rolled up for evolution, many months before that ſpring in which they expand. We know, too, that if we take a bud, and plant it properly, it vegetates, forms to itſelf a root, and becomes a complete plant. It will not be ſaid, ſurely, that in this caſe the bud imbibes nouriſhment from the earth; for it has to form a root before it can obtain nouriſhment in that manner; and this root cannot be formed without nouriſhment. Is not this a demonſtration that the bud contains, already laid up in itſelf, a ſufficient quantity of nouriſhment, not only to develope its own organs, but alſo to form new ones. This we conſider as a ſufficient anſwer to the objection. During the ſummer, the plant lays up a ſufficient quantity of nouriſhment in each bud, and this nouriſhment is afterwards employed in developing the leaves. This is the reaſon that the leaves make their appearance, and that they grow during the winter, when the plant is deprived of its organs of digeſtion.

Hence we ſee why the branch of a vine, if it be introduced into a hothouſe during the winter, puts forth leaves and vegetates with vigour, while every other part of the plant gives no ſigns of life. Hence alſo the reaſon that the inoculation of plants ſucceeds (F).

If a tree be deprived of its leaves, new leaves make their appearance, becauſe they are already prepared for that purpoſe: but what would be the conſequence if a tree were deprived of its leaves and of all its buds for

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(E) Plants of a white colour, from vegetating in the dark, are called *etiolated*, from a French word which ſignifies a *ſtar*, as if they grew by *ſtar light*.

(F) Hence alſo the cauſe of another well known phenomenon. The ſap flows out of trees very readily in ſpring before the leaves appear, but after that the bleeding ceaſes altogether. It is evident that there can be ſcarcely any circulation of ſap before the leaves appear; for as there is no outlet, when the veſſels are once full, they can admit no more. It appears, however, from the bleeding, that the roots are capable of imbibing, and the veſſels of circulating, the ſap with vigour. Accordingly, whenever there is an outlet, they perform their functions as uſual, and the tree bleeds; that is, they ſend up a quantity of ſap to be digeſted as uſual: but as there are no digeſting organs, it flows out, and the tree receives no injury, becauſe the ſap that flows out would not have been imbibed at all, had it not been for the artificial opening. But when the digeſtive organs appear, the tree will not bleed; becauſe theſe organs require all the ſap, and it is conſtantly flowing to them.

five years back? That plants do not vegetate without leaves, is evident from an experiment of Duhamel. He ſtript the bark off a tree in ringlets, ſo as to leave five or ſix rings of it at ſome diſtance from each other, with no bark in the intervals. Some of theſe rings had buds and leaves; theſe increaſed conſiderably in ſize; but one ring which had none of theſe remained for years unaltered.

158 Nature of the peculiar juices.

26. The peculiar juice thus formed in the leaves is carried by veſſels intended for that uſe to all the parts of the plant, in order to be employed for the purpoſes of vegetation;—to increaſe the wood, the bark, the roots; to prepare the ſeeds, lay up nouriſhment for the buds, and to repair the decayed parts of the ſyſtem, or form new ones.

If we had any method of obtaining this peculiar juice in a ſtate of purity, the analyſis of it would throw a great deal of light upon vegetation; but this is ſcarce poſſible, as we cannot extract it without dividing at the ſame time the veſſels which contain the ſap. In many caſes, however, the peculiar juice may be known by its colour; and then its analyſis may be performed with an approach towards accuracy. The experiments made on ſuch juices have proved, as might have been expected, that they differ very conſiderably from each other, and that every plant has a juice peculiar to itſelf. Hence it follows, that the proceſſes which go on in the leaves of plants muſt differ at leaſt in degree, and that we have no right to transfer the concluſions deduced from experiments on one ſpecies of plants to thoſe of another ſpecies. It is even probable, that the proceſſes in different plants are not the ſame in kind; for it is not reaſonable to ſuppoſe, that the phenomena of vegetation in an agaric or a boletus are preciſely the ſame as thoſe which take place in trees and in larger vegetables, on which alone experiments have hitherto been made.

To attempt any general account of the ingredients of the peculiar juice of plants, is at preſent impoſſible. We may conclude, however, from the experiments of Chaptal, that it contains the *vegetable fibre* of wood, either ready formed, or very nearly ſo; juſt as the blood in animals contains a ſubſtance which bears a ſtrong reſemblance to the muſcular fibres.

When oxy-muriatic acid was poured into the peculiar juice of the euphorbia, which in all the ſpecies of that ſingular genus is of a milky colour and conſiſtency, a very copious white precipitate fell down. This powder, when waſhed and dried, had the appearance of fine ſtarch, and was not altered by keeping. It was neither affected by water nor alkalies. Alcohol, aſſiſted by heat, diſſolved two-thirds of it; which were again precipitated by water, and had all the properties of reſin. The remaining third part poſſeſſed the properties of the *woody fibre*. Mr Chaptal tried the ſame experiment on the juices of a great number of other plants, and he conſtantly found that oxy-muriatic acid precipitated from them *woody fibre*. The ſeeds of plants exhibited exactly the ſame phenomenon; and a greater quantity of woody fibre was obtained from them than from an equal portion of the juices of plants.* Theſe experiments are ſufficient to ſhew, that the proper juices of plants contain their nouriſhment ready prepared, nearly in the ſtate in which it exiſts in the ſeed for the uſe of the young embryo.

159 Its uſes.

The peculiar juices of plants, then, contain more carbon, hydrogen, and oxygen, and leſs water, and probably lime alſo, than the ſap. They are conveyed to every part of the plant; and all the ſubſtances which we find in plants, and even the organs themſelves, by which they perform their functions, are formed from them. But the thickeſt veil covers the whole of theſe proceſſes; and ſo far have philoſophers hitherto been from removing this veil, that they have not even been able to approach it. All theſe operations, indeed, are evidently chemical decompoſitions and combinations; but we neither know what theſe decompoſitions and combinations are, nor the inſtruments in which they take place, nor the agents by which they are regulated.

160 Plants d cay and die.

27. Such, as far as we are acquainted with them, are the changes produced by vegetation. But plants do not continue to vegetate for ever; ſooner or later they decay, and wither, and rot, and are totally decompoſed. This change indeed does not happen to all plants at the end of the ſame time. Some live only for a ſingle ſeaſon, or even for a ſhorter period; others live two ſeaſons, others three, others a hundred or more; and there are ſome plants which continue to vegetate for a thouſand years. But ſooner or later they all ceaſe to live; and then thoſe very chemical and mechanical powers which had promoted vegetation combine to deſtroy the remains of the plant. Now, What is the cauſe of this change? Why do plants die?

This queſtion can only be anſwered by examining with ſome care what it is which conſtitutes the *life* of plants; for it is evident, that if we can diſcover what that is which conſtitutes the life of a plant, it cannot be difficult to diſcover what conſtitutes its death.

161 Phenom na of veg table life

Now the phenomena of vegetable life are in general *vegetation*. As long as a plant continues to vegetate, we ſay that it lives; when it ceaſes to vegetate, we conclude that it is dead.

The life of vegetables, however, is not ſo intimately connected with the phenomena of vegetation that they cannot be ſeparated. Many ſeeds may be kept for years without giving any ſymptom of vegetation; yet if they vegetate when put into the earth, we ſay that they poſſeſs life: and if we would ſpeak accurately, we muſt ſay alſo, that they poſſeſſed life even before they were put into the earth; for it would be abſurd to ſuppoſe that the ſeed *obtained* life merely by being put into the earth. In like manner, many plants decay, and give no ſymptoms of vegetation during winter; yet if they vegetate when the mild temperature of ſpring affects them, we conſider them as having lived all winter. The life of plants, then, and the phenomena of vegetation, are not preciſely the ſame thing; for the one may be ſeparated from the other, and we can even ſuppoſe the one to exiſt without the other. Nay, what is more, we can, in many caſes, *decide*, without heſitation, that a vegetable is not dead, even when no vegetation appears; and the proof which we have for its life is, that it *remains unaltered*; for we know that when a vegetable is dead, it ſoon changes its appearance, and falls into decay.

Thus it appears that the *life* of a vegetable conſiſts in two things. 1. In remaining unaltered, when circumſtances are unfavourable to vegetation; 2. In exhibiting

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* *Ann. de Chim.* xxi. 285.

hibiting the phenomena of vegetation when circumſtances are favourable. When neither of theſe two things happens, we ſay that a vegetable is dead.

The phenomena of vegetation have been enumerated above. They conſiſt in the formation or expanſion of the organs of the plant, in the taking in of nouriſhment, in carrying it to the leaves, in digeſting it, in diſtributing it through the plant, in augmenting the bulk of the plant, in repairing decayed parts, in forming new organs when they are neceſſary, in producing ſeeds capable of being converted into plants ſimilar to the parent. The *cauſe* of theſe phenomena, whatever it may be, is the *cauſe* alſo of *vegetable life*.

All the ſubſtances which have been enumerated in the firſt part of the article CHEMISTRY, *Suppl.* together with their compounds and component parts, poſſeſs certain qualities in common; in conſequence of which, a term has been invented which includes them all. This term is *matter*. Now theſe common qualities may all ultimately be reſolved into certain attractions and repulſions which theſe ſubſtances exert. Theſe qualities may be ſaid, without any impropriety, to be *eſſential to matter*; becauſe every body to which we give the name of *matter* poſſeſſes them; and if any body were to be deprived of theſe qualities, it could no longer be included under the denomination *matter*. In ſhort, the word *matter* comprehends under it certain qualities; every ſubſtance which poſſeſſes theſe qualities is called *matter*; and no other ſubſtance except theſe can receive the name of *matter* without altering the meaning of the word.

62 redu- to the of er;

The attractions and repulſions of matter have been examined with care; and the changes which they produce have been aſcertained with conſiderable accuracy. They have even been reduced to general principles under the name of *mechanical and chemical laws*. Whenever any change is obſerved, if that change be a caſe of a mechanical or chemical law, we ſay that the agent is *matter*; but if the change cannot be reduced under theſe laws, or if it be incompatible with theſe laws, we muſt ſay, unleſs we would pervert the meaning of words altogether, that the agent is not *matter*.

Now it cannot be diſputed that ſeveral of the phenomena of life in vegetables are incompatible with the laws of mechanics and chemiſtry. The motion of the ſap, for inſtance, muſt be produced by the contraction of the veſſels; and the contraction of veſſels, on the application of ſtimuli, is incompatible with the laws of chemiſtry, becauſe no decompoſition takes place; and of mechanics, becauſe a much greater force is generated than the generating body itſelf poſſeſſed. The evolution of the organs of vegetables, the reparation of decayed organs, the formation of new ones to ſupply the place of the old, the production of ſeeds capable of producing new plants, the conſtant ſimilarity of individuals of the ſame ſpecies;—theſe, and many other well known phenomena, cannot be reduced under mechanical and chemical laws. The cauſe of life, then, in plants, is a *ſubſtance* (for we can form no conception of an agent which is not a ſubſtance) which does not act according to the laws of mechanics and chemiſtry, and which conſequently is *not matter*. We ſhall therefore, till a better name be choſen, denominate it the *vegetative principle* (G).

63 e- tly g to ima- cauſe.

164 Nature of the vegetative principle.

The nature of the *vegetative principle* can only be deduced from the phenomena of vegetation. It evidently follows a fixed plan, and its actions are directed to promote the good of the plant. It has a power over matter, and is capable of directing its attractions and repulſions, in ſuch a manner as to render them the inſtruments of the formation, and improvement, and preſervation of the plant. It is capable alſo of generating ſubſtances endowed with powers ſimilar to itſelf. The plan according to which it acts, diſplays the moſt conſummate wiſdom and foreſight, and a knowledge of the properties of matter infinitely beyond what man can boaſt.

165 Whether endowed with conſciouſneſs.

Metaphyſicians have thought proper to divide all ſubſtances into two claſſes, *matter* and *mind*. If we follow this diviſion, the vegetative principle, as it is not *material*, muſt undoubtedly be ranked under *mind*. But if *conſciouſneſs* and *intelligence* be conſidered as eſſential to mind, which is the caſe according to their definition, we cannot give the vegetative principle the name of *mind*, becauſe it has not been proved that it poſſeſſes conſciouſneſs and intelligence. It acts indeed according to a fixed plan, which diſplays the higheſt degree of intelligence; but this plan may belong, not to the vegetative principle itſelf, but to the Being who formed that principle. We can conceive it to have been endowed by the Author of Nature with peculiar powers, which it muſt always exert according to certain fixed laws; and the phenomena of vegetation *may be* the reſult of this mode of acting. This, as far as we can ſee, is not impoſſible. It muſt be ſhewn to be impoſſible by every perſon who wiſhes to prove that plants poſſeſs conſciouſneſs and intelligence; for the proofs of this conſciouſneſs can only be deduced from the deſign which the actions of plants manifeſt. Thoſe philoſophers who have aſcribed conſciouſneſs and intelligence to plants, have founded their belief principally on certain actions which plants perform on the application of ſtimuli. But theſe actions prove nothing more than what cannot be denied, that there exiſts a vegetative principle, which is not material, and which has certain properties in common with the living principles of animals; but whether or not this vegetative principle poſſeſſes conſciouſneſs and intelligence, is a very different queſtion, and muſt be decided by very different proofs. We do not ſay that the heart of an animal is conſcious, becauſe it continues to beat on the application of proper ſtimuli for ſome time after it has been ſeparated from the reſt of the body.

166 Death of plants.

The death of plants, if we can judge from the phenomena, is owing, not to the vegetative principle leaving them, but to the organs becoming at laſt altogether unfit for performing their functions, and incapable of being repaired by any of the powers which that principle poſſeſſes. The changes which vegetable ſubſtances undergo after death come now to be examined. They ſhall form the ſubject of the enſuing chapter.

(G) Phyſiologiſts have uſually given it the name of *living principle*. We would have adopted that name, if it had not been too general for our purpoſe.

CHAP. III. OF THE DECOMPOSITION OF VEGETABLE SUBSTANCES.

167
Vegetable decompoſitions,

NOT only entire plants undergo decompoſition after death, but certain vegetable ſubſtances alſo, whenever they are mixed together, and placed in proper circumſtances, mutually decompoſe each other, and new compound ſubſtances are produced. Theſe mutual decompoſitions, indeed, are naturally to be expected: for as all vegetable ſubſtances are compoſed of ſeveral ingredients, differing in the ſtrength of their affinity for each other, it is to be ſuppoſed that, when two ſuch ſubſtances are mixed together, the divellent affinities will, in many caſes, prove ſtronger than the quieſcent; and therefore decompoſition, and the formation of new compounds, muſt take place: juſt as happens when the acetite of lead and ſulphat of potaſs are mixed together.

Theſe mutual decompoſitions of vegetable ſubſtances are by no means ſo eaſily traced, or ſo readily explained, as the mutual decompoſitions of neutral ſalts; partly on account of the number of ſubſtances, whoſe affinities for each other are brought into action, and partly becauſe we are ignorant of the manner in which the ingredients of vegetable ſubſtances are mutually combined.

168
Called FERMENTATION.

Chemiſts have agreed to give theſe mutual decompoſitions which take place in vegetable ſubſtances the name of *fermentation*; a word firſt introduced into chemiſtry by Van Helmont;* and the new ſubſtances produced they have called the *products* of fermentation. All the phenomena of fermentation lay for many years concealed in the completeſt darkneſs, and no chemiſt was bold enough to hazard even an attempt to explain them. They were employed, however, and without heſitation too, in the explanation of other phenomena; as if giving to one proceſs, the name of another of which we are equally ignorant, could, in reality, add any thing to our knowledge. The darkneſs which enveloped theſe phenomena, has lately begun to diſperſe; but they are ſtill ſurrounded with a very thick miſt; and we muſt be much better acquainted with the compoſition of vegetable ſubſtances, and the mutual affinities of their ingredients, than we are at preſent, before we can explain them in a ſatisfactory manner.

* *Stall, Fundament. Chem.* i. 124.

169
Diviſion of them.

The vegetable fermentations or decompoſitions may be arranged under five heads; namely, that which produces *bread*, that which produces *wine*, that which produces *beer*, that which produces *acetous acid* or *vinegar*, and the *putrefactive* fermentation, or that which produces the ſpontaneous decompoſition of decayed vegetables. Theſe ſhall be the ſubject of the five following ſections. In order to avoid long titles, we ſhall give to the firſt three ſections the name of the new ſubſtances produced by the fermentation.

SECT. I. *Of BREAD.*

170
Diſcovery of bread.

SIMPLE as the manufacture of bread may appear to us who have been always accuſtomed to conſider it as a common proceſs, its diſcovery was probably the work of ages, and the reſult of the united efforts of men, whoſe ſagacity, had they lived in a more fortunate period of ſociety, would have rendered them the rivals of Ariſtotle or of Newton.

The method of making bread ſimilar to ours was known in the Eaſt at a very early period; but neither the preciſe time of the diſcovery, nor the name of the perſon who publiſhed it to the world, has been preſerved. We are certain that the Jews were acquainted with it in the time of Moſes: for in Exodus* we find a prohibition to uſe leavened bread during the celebration of the paſſover. It does not appear, however, to have been known to Abraham; for we hear in his hiſtory of cakes frequently, but nothing of leaven. Egypt, both from the nature of the ſoil and the early period at which it was civilized, bids faireſt for the diſcovery of making bread. It can ſcarcely be doubted, that the Jews learned the art from the Egyptians. The Greeks aſſure us, that they were taught the art of making bread by the god Pan. We learn from Homer that it was known during the Trojan war.† The Romans were ignorant of the method of making bread till the year 580, after the building of Rome, or 200 years before the commencement of the Chriſtian era.‡ Since that period the art has never been unknown in the ſouth of Europe; but it made its way to the north very ſlowly, and even at preſent in many northern countries fermented bread is but very ſeldom uſed.

* Chap
v. 15.

† *Iliad,*
216.

‡ *Plin.*
cap. 1

17
Subſta
which
make
bread.

The only ſubſtance well adapted for making bread, we mean *loaf bread*, is wheat flour, which is compoſed of four ingredients; namely, gluten, ſtarch, albumen, and a *ſweet mucous matter*, which poſſeſſes nearly the properties of ſugar, and which is probably a mixture of ſugar and mucilage. It is to the gluten that wheat flour owes its ſuperiority to every other as the baſis of bread. Indeed, there are only two other ſubſtances at preſent known of which good loaf bread can be made; theſe are *rye* and *potatoes*. The rye loaf is by no means ſo well raiſed as the wheat loaf; and potatoes will not make bread at all without particular management. Potatoes, previouſly boiled and reduced to a very fine tough paſte by a rolling pin, muſt be mixed with an equal weight of potato ſtarch. This mixture, baked in the uſual way, makes a very white, well raiſed, pleaſant bread. We are indebted for the proceſs to Mr Permentier. Barley-meal perhaps might be ſubſtituted for ſtarch.

17
Bakin
bread.

The baking of bread conſiſts in mixing wheat flour with water, and forming it into a paſte. The average proportion of theſe is two parts of water to three of flour. But this proportion varies conſiderably, according to the age and the quality of the flour. In general, the older and the better the flour is, the greater is the quantity of water required. If the paſte, after being thus formed, be allowed to remain for ſome time, its ingredients gradually act upon each other, and the paſte acquires new properties. It gets a diſagreeable ſour taſte, and a quantity of gas (probably carbonic acid gas) is evolved. In ſhort, the paſte ferments (H). Theſe changes do not take place without water; that liquid, therefore is a neceſſary agent. Poſſibly it is decompoſed by the action of the ſtarch upon it; for when ſtarch is diluted with water, it gradually becomes ſour. The gluten, too, is altered, either by the action of the water on it, or of the ſtarch; for if we examine the paſte after

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(H) It was from this proceſs that Van Helmont transferred the word *fermentation* into chemiſtry.

ead. after it has undergone fermentation, the gluten is no longer to be found. If paſte, after ſtanding for a ſufficient time to ferment, be baked in the uſual way, it forms a loaf full of eyes like our bread, but of a taſte ſo ſour and unpleaſant that it cannot be eaten. If a ſmall quantity of this old paſte, or *leaven* as it is called, be mixed with new made paſte, the whole begins to ferment in a ſhort time; a quantity of gas is evolved; but the glutinous part of the flour renders the paſte ſo tough, that the gas cannot eſcape; it therefore cauſes the paſte to ſwell in every direction: and if it be now baked into loaves, the immenſe number of air bubbles impriſoned in every part renders the bread quite full of eyes, and very light. If the preciſe quantity of leaven neceſſary to produce the fermentation, and no more, has been uſed, the bread is ſufficiently light, and has no unpleaſant taſte; but if too much leaven be employed, the bread has a bad taſte; if too little, the fermentation does not come on, and the bread is too compact and heavy. To make good bread with leaven, therefore, is very difficult.

The ancient Gauls had another method of fermenting bread. They formed their paſte in the uſual way; and inſtead of leaven, mixed with it a little of the *barm* which collects on the ſurface of fermenting beer.* This mixture produced as complete and as ſpeedy a fermentation as leaven; and it had the great advantage of not being apt to ſpoil the taſte of the bread. About the end of the 17th century, the bakers in Paris began to introduce this practice into their proceſſes. The practice was diſcovered, and exclaimed againſt; the faculty of medicine, in 1688, declared it prejudicial to health; and it was not till after a long time that the bakers ſucceeded in convincing the public that bread baked with *barm* is ſuperior to bread baked with leaven. In this country the bread has for theſe many years been fermented with barm.

n.
. 7.

73
arm.

What is this *barm* which produces theſe effects? The queſtion is curious and important; but we are not able to anſwer it completely. Mr Henry of Mancheſter has concluded, from a number of very intereſting experiments, that the only uſeful part of barm is carbonic acid gas, and that this gas therefore is the real fermenter of paſte.†

ncb.
. ii.

That the barm of beer, in its uſual ſtate, contains carbonic acid gas, cannot be doubted; and that carbonic acid gas acts as a ferment, the experiments of Mr Henry prove deciſively. But that the only active part of barm is carbonic acid gas, and nothing but carbonic gas, is extremely doubtful, or rather we are certain that it is not true. It has been cuſtomary with the bakers of Paris to bring their barm from Flanders and Picardy in a ſtate of dryneſs. When ſkimmed off the beer, it is put into ſacks, and the moiſture allowed to drop out; then theſe ſacks are ſubjected to a ſtrong preſſure, and when the barm is dry it is made up into balls.† Now, in this ſtate, it is not to be ſuppoſed that bubbles of carbonic acid can remain entangled in the barm; they muſt have been ſqueezed out by the preſs, and by the ſubſequent formation of the barm into balls: yet this barm, when moiſtened with water, ferments the bread as well as new barm.

Meth.
249.

Bread.

174
Heat of the oven

After the bread has fermented, and is properly raiſed, it is put into the oven previouſly heated, and allowed to remain till it be baked. The mean heat of an oven, as aſcertained by Mr Tillet, is 448°.* The bakers do not uſe a thermometer; but they judge that the oven is arrived at the proper heat when flour thrown on the floor of it becomes black very ſoon without taking fire. We ſee, from Tillet's experiment, that this happens at the heat of 448°.

* *Enc. Meth.* art. i. 275.

175
Loſs of weight ſuſtained in it.

When the bread is taken out of the oven, it is found to be lighter than when put in; as might naturally have been expected, from the evaporation of moiſture, which muſt have taken place at that temperature. Mr Tillet, and the other commiſſioners who were appointed to examine this ſubject in conſequence of a petition from the bakers of Paris, found that a loaf, which weighed before it was put into the oven 4.625 lbs. after being taken out baked, weighed, at an average, only 3 813 lbs. or 0.812 lb. leſs than the paſte. Conſequently 100 parts of paſte loſe, at an average, 17.34 parts, or ſomewhat more than $\frac{1}{5}$th by baking.* They found, however, that this loſs of weight was by no means uniform, even with reſpect to thoſe loaves which were in the oven at the ſame time, of the ſame form, and in the ſame place, and which were put in and taken out at the ſame inſtant. The greateſt difference in theſe circumſtances amounted to .2889, or 7.5 parts in the hundred, which is about $\frac{1}{13}$th of the whole. This difference is very conſiderable, and it is not eaſy to ſay to what it is owing. It is evident, that if the paſte has not all the ſame degree of moiſture, and if the barm be not accurately mixed through the whole, if the fermentation of the whole be not preciſely the ſame, that theſe differences muſt take place. Now it is needleſs to obſerve how difficult it is to perform all this completely. The French commiſſioners found, as might indeed have been expected, that other things being equal, the loſs of weight ſuſtained is proportional to the extent of ſurface of the loaf, and to the length of time that it remains in the oven; that is to ſay, the ſmaller the extent of the external ſurface, or, which is the ſame thing, the nearer the loaf approaches to a globular figure, the ſmaller is the loſs of weight which it ſuſtains; and the longer it continues in the oven, the greater is the loſs of weight which it ſuſtains. Thus a loaf which weighed exactly 4 lbs. when newly taken out of the oven, being replaced as ſoon as weighed, loſt, in ten minutes, .125 lb. of its weight, and in ten minutes more it again loſt .0625 lb.†

* *Ibid.* 275.

† *Ibid.* p. 270.

Loaves are heavieſt when juſt taken out of the oven; they gradually loſe part of their weight, at leaſt if not kept in a damp place, or wrapt round with a wet cloth (K). Thus Mr Tillet found that a loaf of 4 lbs. after being kept for a week, wanted .3125, or nearly $\frac{1}{13}$th of its original weight.‡

‡ *Ibid.*

176
Properties of bread.

When bread is newly taken out of the oven, it has a peculiar, and rather pleaſant ſmell, which it loſes by keeping; as it does alſo the peculiar taſte by which new bread is diſtinguiſhed. This ſhews us, that the bread undergoes chemical changes; but what theſe changes are, or what the peculiar ſubſtance is to which the odour of bread is owing, is not known.

Bread

(K) This is an excellent method of preſerving bread freſh, and free from mould, for a long time.

Wine.

Bread differs very completely from the flour of which it is made, for none of the ingredients of the flour can now be diſcovered in it. The only chemiſt who has attempted an analyſis of bread is Mr Geoffroy. He found that 100 parts of bread contained the following ingredients:

24.735	water.
32 030	gelatinous matter, extracted by boiling water.
39.843	reſiduum inſoluble in water.
96 608	
3.392	loſs.
100.	

But this analyſis, which was publiſhed in the Memoirs of the French Academy for the year 1732, was made at a time when the infant ſtate of the ſcience of chemiſtry did not admit of any thing like accuracy.

SECT. II. *Of Wine.*

177 Fruits affording wine

THERE is a conſiderable number of ripe fruits from which a ſweet liquor may be expreſſed, having at the ſame time a certain degree of acidity. Of ſuch fruits we have in this country the apple, the cherry, the gooſeberry, the currant, &c. but by far the moſt valuable of theſe fruits is the *grape*, which grows luxuriantly in the ſouthern parts of Europe. From grapes, fully ripe, may be expreſſed a liquid of a ſweet taſte, to which the name of *muſt* has been given. This liquid is compoſed almoſt entirely of five ingredients; namely, *water*, *ſugar*, *jelly*, *mucilage*, and *tartarous* acid partly ſaturated with potaſs. The quantity of ſugar which grapes fully ripe contain is very conſiderable; it may be obtained in cryſtals by evaporating muſt to the conſiſtence of ſyrup, ſeparating the tartar which precipitates during the evaporation, and then ſetting the muſt aſide for ſome months. The cryſtals of ſugar are gradually formed.

178 Undergo the vinous fermentation;

When muſt is put into the temperature of about 70°, the different ingredients begin to act upon each other, and what is called *vinous fermentation* commences. The phenomena of this fermentation are an inteſtine motion in the liquid, its becoming thick and muddy, a temperature equal to 72.5°, and an evolution of carbonic acid gas. In a few days the fermentation ceaſes, the thick part ſubſides to the bottom, the liquid becomes clear, it has loſt much of its ſaccharine taſte, and aſſumed a new one, its ſpecific gravity is diminiſhed; and, in ſhort, it has become the liquid well known under the name of *wine*.

Now what is the cauſe of this fermentation; what are the ſubſtances which mutually decompoſe each other; and what is the nature of the new ſubſtance formed?

These changes are produced altogether by the mutual action of the ſubſtances contained in muſt; for they take place equally well, and wine is formed equally well in cloſe veſſels as in the open air.§

179 For which water,

If the *muſt* be evaporated to the conſiſtency of a thick ſyrup, or to a *rob*, as the elder chemiſts termed it, the fermentation will not commence, though the proper temperature, and every thing elſe neceſſary to produce fermentation, be preſent.‖ But if this ſyrup be again diluted with water, and placed in favourable circumſtances, it will ferment. Therefore the preſence of *water* is abſolutely neceſſary for the exiſtence of vinous fermentation.

180 Sugar,

If the juice of thoſe fruits which contain but little ſugar, as currants, be put into a favourable ſituation, fermentation indeed takes place, but ſo ſlowly, that the product is not *wine*, but *vinegar:* but if a ſufficient quantity of ſugar be added to theſe very juices, wine is readily produced. No ſubſtance whatever can be made to undergo vinous fermentation, and to produce wine, unleſs ſugar be preſent. *Sugar* therefore is abſolutely neceſſary for the exiſtence of vinous fermentation; and we are certain that it is decompoſed during the proceſs; for no ſugar can be obtained from properly fermented wine.

181 An acid,

All thoſe juices of fruits which undergo the vinous fermentation, either with or without the addition of ſugar, contain an acid. We have ſeen already in the firſt chapter that the vegetable acids are obtained chiefly from fruits. The apple, for inſtance, contains malic acid; the lemon, citric acid; the grape, tartarous acid. The Marquis de Bullion has aſcertained, that *muſt* will not ferment if all the tartarous acid which it contains be ſeparated from it.* We may conclude from this, that the preſence of a vegetable acid is abſolutely neceſſary for the commencement of the vinous fermentation. This renders it probable that the eſſential part of barm is a vegetable acid, or ſomething equivalent; for if ſugar be diſſolved in four times its weight of water, mixed with the yeaſt of beer, and placed in a proper temperature, it undergoes the vinous fermentation.†

182 And jelly are neceſ-ſary.

All the juices of fruits which undergo the vinous fermentation contain a quantity of jelly, or mucilage, or of both. Theſe two ſubſtances reſemble each other in ſo many particulars, and it is ſo difficult to ſeparate them, that we ſhall ſuppoſe they have the ſame effect in the mixture. The preſence of theſe ſubſtances renders it probable that they alſo are neceſſary for the vinous fermentation. Perhaps they act chiefly by their tendency to become acid.

Thus we ſee, that for the production of wine a certain temperature, a certain portion of water, ſugar, a vegetable acid, and, in all probability, jelly alſo, is neceſſary. Mr Lavoiſier found that ſugar would not ferment unleſs diſſolved in at leaſt four times its weight of water. This ſeems to indicate that the particles of ſugar muſt be removed to a certain diſtance from each other before the other ingredients can decompoſe them. The evolution and ſeparation of carbonic acid gas in ſuch quantity, ſhews us that the proportion of the carbon and the oxygen of the ſugar is diminiſhed. It is not certain that the mucilage of the wine is decompoſed ſo completely as the ſugar; for it has been obſerved, that when the muſt abounds in mucilage, the wine is apt to become ſour.

183 Decompo-ſition of wine.

When wine is diſtilled by means of a low heat, there comes over a quantity of *alcohol*, and the remainder is a ſolution of acetous acid. From this fact, it has been concluded that wine is compoſed of acetous acid and alcohol. But that the diſtillation occaſions a chemical change in the ingredients of wine is evident from this, that if we again mix the alcohol and acetous acid, we do not reproduce the wine.

Fourcroy has attempted to ſhew that alcohol exiſted ready formed; but his proofs are not concluſive. Fabroni

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§ *Fabroni, Ann. de Chim.* xxxi. 302.

‖ *Stahl*, i.

* *Chaptal*

† *Bergma*

roni has ſhewn, that alcohol cannot be obtained from new made wine by any other method than diſtillation. When wine is ſaturated with very dry carbonat of potaſs, no alcohol makes its appearance on the ſurface of the mixture, yet a very ſmall quantity of alcohol, artificially mixed with wine, may be detected by this method. It is certain, however, that alcohol exiſts ready formed in old wine.

SECT. III. *Of BEER.*

THE method of making beer was known in the moſt remote ages; we are ignorant to whom the world is indebted for the diſcovery of it. Beer is uſually made from *barley*.

The barley is ſteeped in water for about ſixty hours, in order to ſaturate it with that liquid. It ought then to be removed as ſpeedily as poſſible, otherwiſe the water diſſolves, and carries off the moſt valuable part of the grain. The barley is then to be laid in a heap for twenty-four hours; heat is evolved, oxygen gas abſorbed, carbonic acid gas emitted, and germination commences with the ſhooting forth of the radicle. It is then ſpread upon a cool floor, dried ſlowly, and is afterwards known by the name of *malt*.*

Malt, previouſly ground to a coarſe powder, is to be infuſed in a ſufficient quantity of pure water, of the temperature of 160°, for an hour. The infuſion is then to be drawn off, and more water may be added, at a higher temperature, till all the ſoluble part of the malt is extracted. This infuſion is known by the name of *wort*. It has a ſweet taſte, and contains a quantity of ſaccharine, and doubtleſs alſo of gelatinous matter.

When *wort* is placed in the temperature of about 60°, fermentation gradually takes place in it, and the very ſame phenomena appear which diſtinguiſh the production of wine. The fermentation of wort, then, is nothing but a particular caſe of the vinous fermentation. But wort does not ferment ſo well, nor ſo ſoon, nor does it produce nearly ſo great a quantity of good fermented liquor, as when *yeaſt* is added to it. The reaſon of which is, probably, that the fermentation does not commence till an acid is generated in the wort, and before that happens part of the ſaccharine contents are decompoſed; whereas the yeaſt adds an acid, or, at leaſt, ſomething equivalent to it, at once.

Wort ferments in cloſe veſſels, as Mr Collier aſcertained by experiment, equally well as in the open air. Therefore the decompoſition is produced entirely by the ſubſtances contained in the wort, without the addition of any thing from the air. The quantity of beer produced in cloſe veſſels is much greater than when the proceſs takes place in the open air. The reaſon of which is, that in the open air the beer gradually evaporates during the fermentation. Thus Mr Collier found that 11 quarts, $3\frac{1}{2}$ oz. fermented in open veſſels, loſt, in 12 days, 40 oz.; whereas an equal weight, fermented in cloſe veſſels, loſt only 8 oz. in the ſame time. Yet the quality of the *beer* was the ſame in each; for equal quantities of both, when diſtilled, yielded preciſely the ſame portion of alcohol.† During the fermentation, a quantity of carbonic acid gas is conſtantly diſengaged, not in a ſtate of purity, but containing, combined with it, a portion of the wort; and if this gas be made to paſs through water, it will depoſite wort, which may be fermented in the uſual manner.*

When beer is diſtilled, alcohol is obtained, and the reſiduum is an acid liquor.† The theory of beer is ſo obviouſly the ſame with that of wine that it requires no additional explanation.

SECT. IV. *Of the ACETOUS FERMENTATION.*

187 Subſtances which undergo the acetous fermentation.

IF wine or beer be kept at a temperature between 70° and 90°, it gradually loſes its properties, and is converted into *acetous acid*.

During this change, a quantity of oxygen gas is abſorbed, and the whole of the ſpirituous part of the wine or beer diſappears. Conſequently its ingredients have mutually decompoſed each other.

Neither pure alcohol, nor alcohol diluted with water, are capable of undergoing this change, neither do they abſorb any oxygen. This abſorption, then, is made by the mucilaginous matter which always exiſts in theſe liquids. No acetous acid is ever produced, unleſs ſome acid be preſent in the liquid. We may conclude, then, that the mucilage acquires the properties of an acid before it begins to act upon the ſpirituous part of the beer or the wine.

As the acetous acid has been already treated of in the article CHEMISTRY, *Suppl.* it is unneceſſary to dwell any longer on this ſubject here.

SECT. V. *Of PUTREFACTION.*

188 Nature of putrefaction.

ALL vegetable ſubſtances, both complete plants and their component parts ſeparately, when left entirely to themſelves, are gradually decompoſed and deſtroyed, provided moiſture be preſent, and the temperature be not much under 45°, nor too high to evaporate ſuddenly all the moiſture. This decompoſition has obtained the name of *putrefaction*.

It proceeds with moſt rapidity in the open air; but the contact of air is not abſolutely neceſſary. Water is, in all caſes, eſſential to the proceſs, and therefore is moſt probably decompoſed.

Putrefaction is conſtantly attended with a fetid odour, owing to the emiſſion of certain gaſeous matters, which differ according to the putrefying ſubſtance. Some vegetable ſubſtances, as gluten, and cruciform plants, emit ammonia; others, as onions, ſeem to emit phoſphorated hydrogen gas. Carbonic acid gas, and hydrogen gas, impregnated with unknown vegetable matters, are almoſt conſtantly emitted in abundance. When the whole proceſs is finiſhed, ſcarcely any thing remains but the earths, the ſalts, and the metals, which formed conſtituent parts of the vegetable. But our chemical knowledge of vegetable compounds is by far too limited to enable us to follow this very complicated proceſs with any chance of ſucceſs.

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* Collier, Manch. Mem.

† Henry, Manch. Mem. ii. 257.

PART II. OF ANIMAL SUBSTANCES.

Ingredients of Animals, Fibrina.

189 Claſſes of animals and vegetables

WHEN we compare animals and vegetables together, each in their moſt perfect ſtate, nothing can be eaſier than to diſtinguiſh them. The plant is confined to a particular ſpot, and exhibits no marks of conſciouſneſs or intelligence; the animal, on the contrary, can remove at pleaſure from one place to another, is poſſeſſed of conſciouſneſs, and a high degree of intelligence. But on approaching the contiguous extremities of the animal and vegetable kingdom, theſe ſtriking differences gradually diſappear, the objects acquire a greater degree of reſemblance, and at laſt approach each other ſo nearly, that it is ſcarcely poſſible to decide whether ſome of thoſe ſituated on the very boundary belong to the animal or vegetable kingdom.

190 Difficultly diſtinguiſhed,

To draw a line of diſtinction, then, between animals and vegetables, would be a very difficult taſk; but it is not neceſſary for us, in this place at leaſt, to attempt it; for almoſt the only animals whoſe bodies have been hitherto examined with any degree of chemical accuracy, belong to the moſt perfect claſſes, and conſequently are in no danger of being confounded with plants. Indeed the greater number of facts which we have to relate, apply only to the human body, and to thoſe of a few domeſtic animals. The taſk of analyſing all animal bodies is immenſe, and muſt be the work of ages of indefatigable induſtry.

191 Diviſion of this part.

We ſhall divide this part of the article into four chapters. In the firſt chapter, we ſhall give an account of the different ingredients hitherto found in animals, ſuch of them at leaſt as have been examined with any degree of accuracy: in the ſecond, we ſhall treat of the different members of which animal bodies are compoſed; which muſt conſiſt each of various combinations of the ingredients deſcribed in the firſt chapter: in the third, we ſhall treat of thoſe animal functions which may be elucidated by chemiſtry: and, in the fourth, of the changes which animal bodies undergo after death.

CHAP. I. OF THE INGREDIENTS OF ANIMALS.

THE ſubſtances which have been hitherto detected in the animal kingdom, and of which the different parts of animals, as far as theſe parts have been analyſed, are found to be compoſed, may be arranged under the following heads:

1. Fibrina,
2. Albumen,
3. Gelatine,
4. Mucilage,
5. Baſis of bile,
6. Urea,
7. Sugar,
8. Sulphur,
9. Oils,
10. Acids,
11. Alkalies,
12. Earths,
13. Metals.

Theſe ſhall form the ſubject of the following ſections:

SECT. I. *Of FIBRINA.*

Album

19 Fibrina how o tained.

IF a quantity of blood, newly drawn from an animal, be allowed to remain at reſt for ſome time, a thick red clot gradually forms in it, and ſubſides. Separate this clot from the reſt of the blood, waſh it repeatedly in water till it ceaſes to give out any colour or taſte to the liquid; the ſubſtance which remains after this proceſs is denominated *fibrina*. It has been long known to phyſicians under the name of the *fibrous part of the blood*, but has not till lately been accurately deſcribed.

19 Its pro ties.

Fibrina is of a white colour, has no taſte, and is inſoluble in water and in alcohol. It is ſoft and ductile, has a conſiderable degree of elaſticity, and reſembles very much the gluten of vegetables.

Pure fixed alkalies do not act upon it, unleſs they be very much concentrated, and then they decompoſe it. All the acids combine with it readily, and diſſolve it. Water and alkalies ſeparate it again; but it has loſt entirely its former properties. With muriatic acid it forms a green coloured jelly.

When nitric acid is poured upon fibrina, azotic gas is diſengaged, as Berthollet firſt diſcovered. The quantity of this gas is greater than can be obtained from the ſame quantity of other animal ſubſtances by the ſame proceſs.* After this, pruſſic acid and carbonic acid gas are exhaled. By the aſſiſtance of heat the fibrina is diſſolved; much nitrous gas is diſengaged; the liquid, when concentrated, yields oxalic and malic acids; and white flakes are depoſited, conſiſting of an oily ſubſtance, and of phoſphat of lime.†

When fibrina is diſtilled, it yields a very large quantity of ammonia.‡

Theſe properties are ſufficient to ſhew us that this ſubſtance is compoſed of azot, hydrogen, and carbon; but neither the preciſe proportion of theſe ingredients, nor the manner of their combination, are at preſent known.

SECT. II. *Of ALBUMEN.*

19 Album contain in eggs

THE eggs of fowls contain two very different ſubſtances: a yellow oily like matter, called the *yolk*; and a colourleſs gloſſy viſcid liquid, diſtinguiſhed by the name of *white*. This laſt is the ſubſtance which chemiſts have agreed to denominate *albumen* (L). The white of an egg, however, is not pure albumen. It contains, mixed with it, ſome carbonat of ſoda, and ſome ſulphur; but the quantity of theſe ſubſtances is ſo ſmall that they do not much influence its properties. We ſhall therefore conſider it as *albumen*.

19 Coagul by heat

On the application of a heat of 165°§ it *coagulates*, as is well known, into a white ſolid maſs; the conſiſtency of which, when other things are equal, depends, in ſome meaſure, on the time during which the heat was applied. The coagulated maſs has preciſely the ſame weight that it had while fluid.

The taſte of coagulated albumen is quite different from that of liquid albumen: its appearance, too, and its

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(L) This is merely the Latin term for the white of an egg. It was firſt introduced into chemiſtry by the phyſiologiſts.

* *Fourc Ann. de Chim.* i

† *Fourc*

‡ *Fourc Ann. de Chim.* i

§ *Cullen*

its properties, are entirely changed ; for it is no longer ſoluble, as before, either in hot or in cold water.

The coagulation of albumen takes place even though air be completely excluded; and even when air is preſent there is no abſorption of it, nor does albumen in coagulating change its volume.* Acids have the property of coagulating albumen, as Scheele aſcertained.‡ Alcohol alſo produces, in ſome meaſure, the ſame effect *Heat*, then, *acids*, and *alcohol*, are the agents which may be employed to coagulate albumen.

It is remarkable, that if albumen be diluted with a ſufficient quantity of water, it can no longer be coagulated by any of theſe agents. Scheele mixed the white of an egg with ten times its weight of water, and then, though he even *boiled* the liquid, no coagulum appeared. Acids indeed, and alcohol, even then coagulated it ; but they alſo loſe their power, if the albumen be diluted with a much greater quantity of water, as has been aſcertained by many experiments. Now we know, that when water is poured into albumen, not only a mechanical mixture takes place, but a chemical combination ; for the albumen is equally diſtributed through every part of the liquid. Conſequently its integrant particles muſt be farther ſeparated from each other, and their diſtance muſt increaſe with the quantity of water with which they are diluted. We ſee, therefore, that albumen ceaſes to coagulate whenever its particles are ſeparated from each other beyond a certain diſtance. That no other change is produced, appears evident from this circumſtance, that whenever the watery ſolution of albumen is ſufficiently concentrated by evaporation, coagulation takes place, upon the application of the proper agents, preciſely as formerly.

It does not appear that the diſtance of the particles of albumen is changed by coagulation ; for coagulated albumen occupies preciſely the ſame ſenſible ſpace as liquid albumen.*

Thus two things ſeem certain reſpecting the coagulation of albumen : 1. That its particles muſt not be beyond a certain diſtance ; 2. That the coagulation does not produce any ſenſible change in their diſtance. To what, then, is the coagulation of albumen owing? We can conceive no change to take place from a ſtate of liquidity to that of ſolidity, without ſome change in the figure of the particles of the body which has undergone that change : for if the figure and the diſtance of the particles of bodies continue the ſame, it is impoſſible to conceive any change at all to take place. Since, then, the diſtance of the particles of albumen does not, as far at leaſt as we can perceive, change, we muſt conclude, that the figure of the particles actually does change. Now ſuch a change may take place three ways : 1. The figure may be changed by the addition of ſome new molecules to each of the molecules of the body. 2. Some molecules may be abſtracted from every integrant particle of the body. 3. Or the molecules, of which the integrant particles are compoſed, may enter into new combinations, and form new integrant particles, whoſe form is different from that of the old integrant particles. Some one or other of theſe three things muſt take place during the coagulation of albumen.

1. Scheele and Fourcroy have aſcribed the coagulation of albumen to the firſt of theſe cauſes, namely, to the addition of a new ſubſtance. According to Scheele, *caloric* is the ſubſtance which is added. Fourcroy, on the contrary, affirms that it is *oxygen*.

Scheele ſupported his opinion with that wonderful ingenuity which ſhone ſo eminently in every thing which he did. He mixed together one part of white of egg and four parts of water, added a little pure alkali, and then dropt in as much muriatic acid as was ſufficient to ſaturate the alkali. The albumen coagulated : but when he repeated the experiment, and uſed carbonat of alkali inſtead of pure alkali, no coagulation enſued. In the firſt caſe, ſays he, there was a double decompoſition : the muriatic acid ſeparated from a quantity of caloric with which it was combined, and united with the alkali ; while, at the ſame inſtant, the caloric of the acid united with the albumen, and cauſed it to coagulate. The ſame combination could not take place when the alkaline carbonat was uſed, becauſe the carbonic acid gas carried off the caloric, for which it has a ſtrong affinity.*

This explanation is plauſible ; but it is contrary to every other known fact in chemiſtry, to ſuppoſe that caloric can combine with a ſubſtance without occaſioning any alteration in its bulk, and cannot therefore be admitted without the moſt rigid proof.

Fourcroy obſerves, in ſupport of his opinion, that the white of an egg is not at firſt capable of forming a hard coagulum, and that it only acquires that property by expoſure to the atmoſphere. It is well known that the white of a new laid egg is milky after boiling ; and that if the ſhell be covered over with greaſe, to exclude the external air, it continues long in that ſtate ; whereas the white of an old egg, which has not been preſerved in that manner, forms a very hard tough coagulum. Theſe facts are undoubted ; and they render it exceedingly probable, that albumen acquires the property of forming a hard coagulum only by abſorbing oxygen : but they by no means prove that coagulation itſelf is owing to ſuch an abſorption. And ſince coagulation takes place without the preſence of air, and ſince no air, even when it is preſent, is abſorbed, this opinion cannot be maintained without inconſiſtency.

2. The only ſubſtance which can be ſuppoſed to leave albumen during coagulation, ſince it does not loſe weight, is *caloric*. We know that in moſt caſes where a fluid is converted into a ſolid, caloric is actually diſengaged. It is extremely probable, then, that the ſame diſengagement takes place here. But the opinion has not been confirmed by any proof. Fourcroy indeed ſays, that in an experiment made by him, the thermometer roſe a great number of degrees. But as no other perſon has ever been able to obſerve any ſuch thing, it cannot be doubted that this philoſopher has been miſled by ſome circumſtance or other to which he did not attend.† It is uſual, in many caſes, for bodies to loſe bulk when they give out caloric ; but that there are exceptions to this rule, is well known.

3. Even if the ſecond opinion were true, it is ſcarcely poſſible to conceive the coagulation of albumen to take place without ſome change in its integrant particles. We can ſee how all the ſubſtances which coagulate albumen might produce ſuch a change ; and the inſolubility of coagulated albumen in water, and its other different properties, render it more than probable that ſome ſuch change actually takes place. But what that change is, cannot even be conjectured.

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* Scheele, ii. 58.

† Thomſon's Fourcroy, iii. 271.

198 Properties of albumen. The coagulation of albumen is intimately connected with one of the moſt important problems in chemiſtry, namely, the cauſe of fluidity and ſolidity. But this problem can only be reſolved, with any proſpect of ſucceſs, by a geometrical inveſtigation of the phenomena of heat.

Coagulated albumen is diſſolved by the mineral acids, greatly diluted with water; and if a concentrated acid be added to the ſolution, the albumen is again precipitated [*] Alkalies, however, do not precipitate it from its ſolution in acids.[†] But if a ſolution of tan be poured into the acid ſolution of albumen, a very copious precipitate appears.[‡]

If the ſolution of tan be poured into an aqueous ſolution of uncoagulated albumen, it forms with it a very copious precipitate, which is inſoluble in water. This precipitate is a combination of tan and albumen. This property which albumen has of precipitating with tan, was diſcovered by Seguin:[§] it furniſhes us with a method of detecting the preſence of albumen in any liquid in which we ſuſpect it.

Pure alkalies and lime water alſo diſſolve albumen; at the ſame time ammonia is diſengaged, owing to the decompoſition of part of the albumen. Acids precipitate the albumen from alkalies, but its properties are changed.[*]

Nitric acid, when aſſiſted by heat, diſengages azotic gas from albumen;[†] but the quantity is not ſo great as may be obtained from fibrina [‡] The albumen is gradually diſſolved, nitrous gas is emitted, oxalic and malic acids are formed, and a thick oily matter makes its appearance on the ſurface [§] When diſtilled, it furniſhes the ſame products as fibrina, only the quantity of ammonia is not ſo great.[‖]

Hence it follows, that albumen is compoſed of azot, hydrogen, and carbon, as well as fibrina; but the proportion of azot is not ſo great in the firſt ſubſtance as in the ſecond.

SECT. III. *Of GELATINE.*

199 Gelatine how obtained. If a piece of the freſh ſkin of an animal, an ox for inſtance, after the hair and every impurity is carefully ſeparated, be waſhed repeatedly in cold water, till the liquid ceaſes to be coloured, or to abſtract any thing; if the ſkin, thus purified, be put into a quantity of pure water, and boiled for ſome time, part of it will be diſſolved. Let the decoction be ſlowly evaporated till it is reduced to a ſmall quantity, and then put aſide to cool. When cold, it will be found to have aſſumed a ſolid form, and to reſemble preciſely that tremulous ſubſtance well known to every body under the name of *gelly*. This is the ſubſtance called in chemiſtry *gelatine*. If the evaporation be ſtill farther continued, by expoſing the gelly to dry air, it becomes hard, ſemitranſparent, breaks with a glaſſy fracture, and is in ſhort the ſubſtance ſo much employed in different arts under the name of *glue*. Gelatine, then, is preciſely the ſame with glue; only that it muſt be ſuppoſed always free from thoſe impurities with which glue is ſo often contaminated.

200 Its properties. Gelatine is tranſparent and colourleſs; when thrown into water, it very ſoon ſwells, and aſſumes a gelatinous form, and gradually diſſolves completely. By evaporating the water, it may be obtained again unaltered in the form of gelly.

When an infuſion of tan is dropt into a ſolution of gelatine in water, there is inſtantly formed a copious white precipitate, which has all the properties of leather. This precipitate is compoſed of tan and gelatine. Theſe two ſubſtances, therefore, when combined, form leather. Albumen and gelatine are the only animal ſubſtances known which have the property of combining with tan, and forming with it an inſoluble compound. They may be always eaſily detected, therefore, by means of tan; and they may be readily diſtinguiſhed from each other, as albumen alone coagulates by heat, and gelatine alone concretes into a gelly.

Gelatine is inſoluble in alcohol, and is even precipitated from water by it; but both acids and alkalies diſſolve it. Nitric acid diſengages from it a ſmall quantity of azotic gas; diſſolves it, when aſſiſted by heat, excepting an oily matter, which appears on the ſurface of the ſolution; and converts it, partly into oxalic and malic acids.[*]

When diſtilled, there comes over firſt water, containing ſome animal matter; the gelatine then ſwells, becomes black, emits a fetid odour, accompanied with acrid fumes: Some empyreumatic oil then comes over, and a very ſmall quantity of carbonat of ammonia: its coaly reſiduum remains behind. Theſe phenomena ſhew, that gelatine is compoſed of carbon, hydrogen, and azot; but the proportion of azot is evidently much ſmaller than in either fibrina or albumen.[†]

SECT. IV. *Of ANIMAL MUCILAGE.*

No word in chemiſtry is uſed with leſs accuracy than *mucilage*. It ſerves as a common name for almoſt every animal ſubſtance which cannot be referred to any other claſs.

None of the ſubſtances to which the name of *animal mucilage* has been given, have been examined with care; of courſe it is unknown whether theſe ſubſtances be the ſame or different.

201 Propert of muci lage. Whenever an animal ſubſtance poſſeſſes the following properties, it is at preſent denominated an animal mucilage by chemiſts.

1. Soluble in water.
2. Inſoluble in alcohol.
3. Neither coagulable by heat, nor concreting into a gelly by evaporation.
4. Not precipitated by the ſolution of tan.

Moſt of the ſubſtances called *mucilage* have alſo the property of abſorbing oxygen, and of becoming by that means inſoluble in water.

The mucilaginous ſubſtances ſhall be pointed out in the next chapter. In the preſent ſtate of our knowledge, any account of them here would merely be a repetition of the properties juſt mentioned.

SECT. V. *Of the BASIS of BILE.*

202 Baſis of how ob tained. INTO 32 parts of freſh ox-bile pour one part of concentrated muriatic acid. After the mixture has ſtood for ſome hours, paſs it through a filter, in order to ſeparate a white coagulated ſubſtance. Pour the filtrated liquor, which has a fine green colour, into a glaſs veſſel, and evaporate it by a moderate heat. When it has arrived at a certain degree of concentration, a green coloured ſubſtance precipitates. Decant off the clear liquid, and waſh the precipitate in a ſmall quantity of pure

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[*] Scheele, ii. 57.

[†] Vauquelin, Ann. de Chim. xxix. 15.

[‡] Ibid.

[§] Nicholſon's Journal, i. 271.

[*] Scheele, ii. 57.

[†] Scheele and Berthollet.

[‡] Fourcroy, Ann. de Chim. i. 41.

[§] Scheele, Crell's Annals, ii. 17. Eng. Tranſl.

[‖] Fourcroy, Ann. de Chim. i. 43.

[*] Scheele, Crell's A ii. 17. E Tranſl.

[†] Fourcr Ann. de Chim. i.

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pure water. This precipitate is the *baſis of bile*, or the *reſin of bile*, as it is ſometimes called.*

03 oper-

The baſis of bile is of a black colour; but when ſpread out upon paper or on wood, it is green: its taſte is intenſely bitter †

et, Par.

When heated to about 122°, it melts; and if the heat be ſtill farther increaſed, it takes fire, and burns with rapidity. It is ſoluble in water, both cold and hot, and ſtill more ſoluble in alcohol; but water precipitates it from that liquid ‡

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rcroy, de vii.

It is ſoluble alſo in alkalies, and forms with them a compound which has been compared to a ſoap. Acids, when ſufficiently diluted, precipitate it both from water and alkalies without any change; but if they be concentrated, the precipitate is rediſſolved.§

et and urg.

When diſtilled, it furniſhes ſome ſebacic acid.||

rcroy.

04 bines oxy-

From theſe properties, it is clear that the baſis of bile has a conſiderable reſemblance to oils; but it differs from them entirely in ſeveral of its properties. The addition of oxygen, with which it combines readily, alters it ſomewhat, and brings it ſtill nearer to the claſs of oils.

In this altered ſtate, the baſis of bile may be obtained by the following proceſs. Pour oxy-muriatic acid cautiouſly into bile till that liquid loſes its green colour; then paſs it through a filter to ſeparate ſome albumen which coagulates. Pour more oxy-muriatic acid into the filtered liquid, and allow the mixture to repoſe for ſome time. The oxy-muriatic acid is gradually converted into common muriatic acid; and in the mean time the baſis of bile abſorbs oxygen, and acquires new properties. Pour into the liquid, after it has remained a ſufficient time, a little common muriatic acid, a white precipitate immediately appears, which may be ſeparated from the fluid. This precipitate is the baſis of bile combined with oxygen.

It has the colour and the conſiſtence of tallow, but ſtill retains its bitter taſte. It melts at the temperature of 104°. It diſſolves readily in alcohol, and even in water, provided it be aſſiſted by heat. Acids precipitate it from theſe ſolutions ¶

rcroy, de vii.

SECT. VI. *Of UREA.*

05 how ned.

EVAPORATE, by a gentle heat, a quantity of human urine voided ſix or eight hours after a meal, till it be reduced to the conſiſtence of a thick ſyrup. In this ſtate, when put by to cool, it concretes into a cryſtalline maſs. Pour, at different times, upon this maſs four times its weight of alcohol, and apply a gentle heat; a great part of the maſs will be diſſolved, and there will remain only a number of ſaline ſubſtances. Pour the alcohol ſolution into a retort, and diſtil by the heat of a ſand bath till the liquid, after boiling ſome time, is reduced to the conſiſtence of a thick ſyrup. The whole of the alcohol is now ſeparated, and what remains in the retort cryſtallizes as it cools. Theſe cryſtals conſiſt of the ſubſtance known by the name of *urea.**

rcroy au- Ann. m. 86.

This ſubſtance was firſt deſcribed by Rouelle the Younger in 1773, under the name of the *ſaponaceous extract of urine.* He mentioned ſeveral of its properties; but very little was known concerning its nature till Fourcroy and Vauquelin publiſhed their experiments on it in 1799. Theſe celebrated chemiſts have given it the name of *urea*, which we have adopted.

Urea. 206 Its properties.

Urea, obtained in this manner, has the form of cryſtalline plates croſſing each other in different directions. Its colour is yellowiſh white; it has a fetid ſmell, ſomewhat reſembling that of garlic or arſenic; its taſte is ſtrong and acrid, reſembling that of ammoniacal ſalts; it is very viſcid and difficult to cut, and has a good deal of reſemblance to thick honey.† When expoſed to the open air, it very ſoon attracts moiſture, and is converted into a thick brown liquid. It is extremely ſoluble in water; and during its ſolution, a conſiderable degree of cold is produced.‡ Alcohol diſſolves it with facility, but ſcarcely in ſo large a proportion as water. The alcohol ſolution yields cryſtals much more readily on evaporation than the ſolution in water.

† *Fourcroy and Vauquelin, Ann. de Chim.* xxxii. p. 87.

‡ *Ibid*, p. 88.

When nitric acid is dropt into a concentrated ſolution of urea in water, a great number of bright pearl coloured cryſtals are depoſited, compoſed of urea and nitric acid. No other acid produces this ſingular effect. The concentrated ſolution of urea in water is brown, but it becomes yellow when diluted with a large quantity of water. The infuſion of nut galls gives it a yellowiſh brown colour, but cauſes no precipitate. Neither does the infuſion of tan produce any precipitate.||

|| *Ibid.*

207 Its component parts.

When heat is applied to urea, it very ſoon melts, ſwells up, and evaporates, with an inſupportably fetid odour. When diſtilled, there comes over firſt benzoic acid, then carbonat of ammonia in cryſtals, ſome carbonated hydrogen gas, with traces of pruſſic acid and oil; and there remains behind a large reſiduum, compoſed of charcoal, muriat of ammonia, and muriat of ſoda. The diſtillation is accompanied with an almoſt inſupportably fetid alliaceous odour. Two hundred and eighty-eight parts of urea yield by diſtillation 200 parts of carbonat of ammonia, 10 parts of carbonated hydrogen gas, 7 parts of charcoal, and 68 parts of benzoic acid, muriat of ſoda, and muriat of ammonia. Theſe three laſt ingredients Fourcroy and Vauquelin conſider as foreign ſubſtances, ſeparated from the urine by the alcohol at the ſame time with the urea. Hence it follows, that 100 parts of urea, when diſtilled, yield

92.027	carbonat of ammonia,
4.608	carbonated hydrogen gas,
3.225	charcoal.
99.860	

Now 200 parts of carbonat of ammonia are compoſed of 86 ammonia, 90 carbonic acid gas, and 24 water. Hence it follows, that 100 parts of urea are compoſed of

39.5	oxygen,
32.5	azot,
14.7	carbon,
13.3	hydrogen.
100.0	

But it can ſcarcely be doubted, that the water which was found in the carbonat of ammonia exiſted ready formed in the urea before the diſtillation.¶

¶ *Ibid.*

When the ſolution of urea in water is kept in a boiling heat, and new water is added as it evaporates, the urea is gradually decompoſed, a very great quantity of carbonat of ammonia is diſengaged, and at the ſame time acetous acid is formed, and ſome charcoal precipitates.*

* *Ibid.* p. 96.

208 Spontaneous decompoſition.

When a ſolution of urea in water is left to itſelf for ſome time, it is gradually decompoſed. A froth collects

Urea.

lects on its ſurface; air bubbles are emitted which have a ſtrong diſagreeable ſmell, in which ammonia and acetous acid are diſtinguiſhable. The liquid contains a quantity of acetous acid. The decompoſition is much more rapid if a little gelatine be added to the ſolution. In that caſe more ammonia is diſengaged, and the proportion of acetous acid is not ſo great.*

209 Action of acids. When the ſolution of urea is mixed with one-fourth of its weight of diluted ſulphuric acid, no efferveſcence takes place; but, on the application of heat, a quantity of oil appears on the ſurface, which concretes upon cooling; the liquid, which comes over into the receiver, contains acetous acid, and a quantity of ſulphat of ammonia remained in the retort diſſolved in the undiſtilled maſs. By repeated diſtillations, the whole of the urea is converted into acetous acid and ammonia.†

When nitric acid is poured upon cryſtallized urea, a violent efferveſcence takes place, the mixture froths, aſſumes the form of a dark red liquid, great quantities of nitrous gas, azotic gas, and carbonic acid gas, are diſengaged. When the efferveſcence is over, there remains only a concrete white matter, with ſome drops of reddiſh liquid. When heat is applied to this reſiduum, it detonates like nitrat of ammonia. Into a ſolution of urea, formed by its attracting moiſture from the atmoſphere, an equal quantity of nitric acid, of the ſpecific gravity 1.460, diluted with twice its weight of water, was added; a gentle efferveſcence enſued: very gentle heat was applied, which ſupported the efferveſcence for two days. There was diſengaged the firſt day a great quantity of azotic gas and carbonic acid gas: the ſecond day, carbonic acid gas, and at laſt nitrous gas. At the ſame time with the nitrous gas an odour was perceivable of the oxygenated pruſſic acid of Berthollet. At the end of the ſecond day, the matter in the retort, which was become thick, took fire, and burnt with a violent exploſion. The reſiduum contained traces of pruſſic acid and ammonia. The receiver contained a yellowiſh acid liquor, on the ſurface of which ſome drops of oil ſwam.‡

Muriatic acid diſſolves urea, but does not alter it. Oxy-muriatic acid gas is abſorbed very rapidly by a diluted ſolution of urea; ſmall whitiſh flakes appear, which ſoon become brown, and adhere to the ſides of the veſſel like a concrete oil. After a conſiderable quantity of oxy-muriatic acid had been abſorbed, the ſolution, left to itſelf, continued to efferveſce exceeding ſlowly, and to emit carbonic acid and azotic gas. After this efferveſcence was over, the liquid contained muriat and carbonat of ammonia.

210 Of alkalies. Urea is diſſolved very rapidly by a ſolution of potaſs or ſoda; and at the ſame time a quantity of ammonia is diſengaged, the ſame ſubſtance is diſengaged when urea is treated with barytes, lime, or even magneſia. Hence it is evident, that this appearance muſt be aſcribed to the muriat of ammonia, with which it is conſtantly mixed. When pure ſolid potaſs is triturated with urea, heat is produced, a great quantity of ammonia is diſengaged. The mixture becomes brown, and a ſubſtance is depoſited, having the appearance of an empyreumatic oil. One part of urea and two of potaſs, diſſolved in four times its weight of water, when diſtilled give out a great quantity of ammoniacal water; the reſiduum contained acetite and carbonat of potaſs.‖

Sug

When muriat of ſoda is diſſolved in a ſolution of urea in water, it is obtained by evaporation, not in cubic cryſtals, its uſual form, but in regular octohedrons. Muriat of ammonia, on the contrary, which cryſtallizes naturally in octohedrons, is converted into cubes, by diſſolving and cryſtallizing it in the ſolution of urea.

Such are the properties of this ſingular ſubſtance, as far as they have been aſcertained by the experiments of Fourcroy and Vauquelin. It differs from all animal ſubſtances hitherto examined, in the great proportion of azot which enters into its compoſition, and in the facility with which it is decompoſed, even by the heat of boiling water.

SECT. VII. *Of Sugar.*

SUGAR has been already deſcribed in the former part of this article as a vegetable ſubſtance; nothing therefore is neceſſary here but to point out the different ſtates in which it is found in animals. It has never indeed been found in animals in every reſpect ſimilar to the ſugar of vegetables; but there are certain animal ſubſtances which have ſo many properties in common with ſugar, that they can ſcarcely be arranged under any other name. Theſe ſubſtances are,

1. Sugar of milk,
2. Honey,
3. Sugar of diabetic urine.

21 Sugar milk. 1. The method of obtaining ſugar of milk has been already detailed in the article CHEMISTRY, nº 488. to which we refer the reader. For an account of its properties, we are indebted to the obſervations of Mr Lichtenſtein.

When pure, it has a white colour, a ſweetiſh taſte, and no ſmell. Its cryſtals are ſemitranſparent regular parallelopipeds, terminated by four-ſided pyramids. Its ſpecific gravity, at the temperature of 55°, is 1.543. At that temperature, it is ſoluble in ſeven times its weight of water; but is perfectly inſoluble in alcohol. When burnt, it emits the odour of caromel, and exhibits preciſely the appearance of burning ſugar. When diſtilled, it yields the ſame products as ſugar, only the empyreumatic oil obtained has the odour of benzoic acid.§

21 Honey 2. Honey is prepared by bees, and perhaps rather belongs to the vegetable than the animal kingdom. It has a white or yellowiſh colour, a ſoft and grained conſiſtence, a saccharine and aromatic ſmell; by means of alcohol, and even by water, with peculiar management, a true ſugar is obtained; by diſtillation it affords an acid phlegm and an oil, and its coal is light and ſpongy like that of the mucilages of plants. Nitric acid extracts the oxalic acid, which is entirely ſimilar to that of ſugar; it is very ſoluble in water, with which it forms a ſyrup, and like ſugar paſſes to the vinous fermentation.*

3. The urine of perſons labouring under the diſeaſe known to phyſicians by the name of *diabetes*, yields, when evaporated, a conſiderable quantity of matter, which poſſeſſes the properties of ſugar.

SECT. VIII. *Of Oils.*

21 Fixed THE oily ſubſtances found in animals may be arranged under three heads: 1. Fixed oils; 2 Fat; 3. Spermaceti.

1. The fixed oils are obtained chiefly from different kinds of fiſh, as the whale, &c.; and they are diſtinguiſhed

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* *Fourcroy and Vauquelin, Ann. de Chim.* xxxii p. 96.

† *Ibid*, p. 104.

‡ *Ibid*, p. 107.

‖ *Ibid.*

§ *Sch* ii. 70.

* *Four*

s. guiſhed by the name of the animal from which they are obtained, as *whale oil*, &c. Theſe oils agree in their properties with other fixed oils, which have been already deſcribed in the article CHEMISTRY, Part II. Chap. iii. *Suppl.*

2. *Fat*, or rather tallow, is a well known animal ſubſtance, much employed in the manufacture of candles and ſoap.

4 ties It has a white colour, often with a ſhade of yellow. When freſh, it has no ſmell, and but little taſte. While cold, it is hard and brittle; but when expoſed to the heat of 92°, it melts, and aſſumes the appearance of oil. The fat, however, which is extracted from fleſh by boiling, does not melt till it reach the temperature of 127°.* Tallow and fat, in other reſpects, have the properties of fixed oils. They ſeem to be compoſed of a fixed oil combined with ſebacic acid. When ſtrongly heated, with contact of air, it emits a ſmoke of a penetrating ſmell, which excites tears and coughing, and takes fire when ſufficiently heated to be volatilized: the charcoal it affords is not abundant. If fat be diſtilled on a water-bath, an inſipid water, of a ſlight animal ſmell, is obtained, which is neither acid nor alkaline, but which ſoon acquires a putrid ſmell, and depoſites filaments of a mucilaginous nature. This phenomenon, which takes place with the water obtained by diſtillation on the water bath from any animal ſubſtance, proves, that this fluid carries up with it a mucilaginous principle, which is the cauſe of its alteration. Fat, diſtilled in a retort, affords phlegm, at firſt aqueous, and afterwards ſtrongly acid; an oil, partly liquid, and partly concrete; and a very ſmall quantity of charcoal, exceedingly difficult to incinerate, in which Crell found a ſmall quantity of phoſphat of lime. Theſe products have an acid and penetrating ſmell, as ſtrong as that of ſulphurous acid. The acid is the ſebacic.

ol- our- 71.

5 rties ma- 3. *Spermaceti*, is an oily, concrete, cryſtalline, ſemitranſparent matter, of a peculiar ſmell, which is taken out of the cavity of the cranium of the cachalot; it is purified by liquefaction, and the ſeparation of another, fluid and inconcreſcible oil, with which it is mixed. This ſubſtance exhibits very ſingular chemical properties; for it reſembles fixed oils in ſome reſpects and volatile oils in others.

When heated to the temperature of 133°,† it melts; and if the heat be increaſed, it evaporates without much alteration. When repeatedly diſtilled, however, it loſes its ſolid form, and becomes like oil. When heated in contact with air, it takes fire, and burns uniformly without any diſagreeable odour: hence its uſe in making candles.

By long expoſure in hot air it becomes yellow and rancid. Pure alkali combines with it, and forms a ſoap. Nitric and muriatic acids do not affect it, but ſulphuric acid diſſolves it and alters its colour.

SECT. IX. *Of Acids.*

Acids.

THE acids hitherto diſcovered in the animal kingdom are the nine following.

1. Sulphuric,
2. Muriatic,
3. Phoſphoric,
4. Carbonic,
5. Benzoic,
6. Sebacic,
7. Formic,
8. Bombyc,
9. Uric.

The firſt eight of theſe have been already deſcribed in the article CHEMISTRY, *Suppl.* it is unneceſſary therefore to deſcribe them here.

216 Diſcovery of uric acid.

Few perſons are ignorant that concretions ſometimes form in the human urinary bladder, and produce that very formidable diſeaſe known by the names of the *ſtone* and the *gravel*. Theſe concretions are often extracted by a ſurgical operation: they are called *urinary calculi*.

The moſt common of theſe calculi is of a brown colour, and very ſoluble in pure potaſs or ſoda ley.

If into an alkaline ſolution of one of theſe calculi a quantity of acetous acid be poured, a copious brown coloured precipitate immediately appears, which may be ſeparated and edulcorated in a ſmall quantity of water. This ſubſtance is *uric acid*.*

It was diſcovered by Scheele in 1776, and the French chemiſts afterwards called it *lithic acid*: but this name, in conſequence chiefly of ſome remarks of Dr Pearſon on its impropriety, has been lately given up, and that of *uric* (L) acid ſubſtituted in its place. We have adopted the new name, becauſe we think it preferable to the old; which indeed conveyed a kind of inconſiſtency to thoſe who attended to the etymological meaning of the word.

217 Its properties.

Uric acid poſſeſſes the following properties: it cryſtallizes in thin plates; has a brown colour, and ſcarcely any taſte. Cold water ſcarcely diſſolves any part of it; but it is ſoluble in 360 parts of boiling water. The ſolution reddens vegetable blues, eſpecially the tincture of turnſol. A great part of the acid precipitates again as the water cools. It combines readily with alkalies and earths; but the compound is decompoſed by every other acid. Sulphuric acid, when concentrated, decompoſes it entirely.* Nitric acid diſſolves it readily: the ſolution is of a pink colour, and has the property of tinging animal ſubſtances, the ſkin for inſtance, of the ſame colour.† When this ſolution is boiled, a quantity of azotic gas, carbonic acid gas, and of pruſſic acid, is diſengaged.‡ Oxy-muriatic acid converts it in a few minutes into oxalic acid.§

When diſtilled, about a fourth of the acid paſſes over a little altered, and is found in the receiver cryſtallized in plates; a few drops of thick oil make their appearance; $\frac{1}{8}$th of the acid of concrete carbonat of ammonia, ſome pruſſiat of ammonia, ſome water, and carbonic acid; and there remains in the retort charcoal, amounting to about $\frac{1}{85}$th of the weight of the acid diſtilled.||

Theſe facts are ſufficient to ſhew us, that uric acid is compoſed of carbon, azot, hydrogen, and oxygen; and that the proportion of the two laſt ingredients is much ſmaller than of the other two.

The different ſalts which uric acid forms with alkaline and earthy baſes have not been examined with attention; but urat of potaſs, of ſoda, and of lime, have been formed both by Scheele and Fourcroy; and urat of

* Fourcroy, *Ann. de Chim.* xvi. 116.

* *Scheele*, i. 200.

† *Ibid.* and *Pearſon.*

‡ *Fourcroy*, *Ann. de Chim.* xxvii. 267.

§ *Brugnatelli*, *ibid.* xxxii. 184.

|| *Fourcroy*, *ibid.* xvi. 116.

(L) From *urine*; becauſe this acid is always found in human urine.

Alkalies, Earths, and Metals.

of ammonia is not unfrequently found cryſtallized in urinary calculi.

The order of the affinities of the different baſes for uric acids is entirely unknown; but it has been aſcertained, that its affinity for theſe baſes is much weaker than that of any other acid. Its ſalts are decompoſed even by pruſſic and carbonic acid.

SECT. X. *Of ALKALIES, EARTHS, and METALS.*

1. ALL the three alkalies have been found in the animal kingdom, as we ſhall ſhew in the next chapter.

2. The only earths which have been found in animals are,
1. Lime,
2. Magneſia,
3. Silica.

The firſt in great abundance, almoſt in every large animal; the other two very rarely, and only as it were by accident.

3. The metals hitherto found in animals are,
1. Iron,
2. Manganeſe.

The firſt exiſts in all the larger animals in ſome conſiderable quantity; the ſecond has ſcarce ever been found in any quantity ſo great as to admit of being weighed.

218 Subſtances found in animals.

Such are the ſubſtances hitherto found in animals. The ſimple bodies of which all of them conſiſt are the following:
1. Azot,
2. Carbon,
3. Hydrogen,
4. Oxygen,
5. Lime,
6. Phoſphorus,
7. Muriatic acid,
8. Potaſs,
9. Soda,
10. Sulphur,
11. Magneſia,
12. Silica,
13. Iron,
14. Manganeſe.

Of theſe, magneſia and ſilica may in a great meaſure be conſidered as foreign bodies; for they are only found in exceedingly minute quantities, and the laſt not unleſs in caſes of diſeaſe. The principal elementary ingredients are the firſt ſix: animal ſubſtances may be conſidered as in a great meaſure compoſed of them. The firſt four conſtitute almoſt entirely the ſoft parts, and the other two form the baſis of the hard parts. But we will be able to judge of this much better, after we have taken a view of the various parts of animals as they exiſt ready formed in the body. This ſhall be the ſubject of the next chapter.

CHAP. II. OF THE PARTS OF ANIMALS.

THE different ſubſtances which compoſe the bodies of animals have been deſcribed with ſufficient minuteneſs in the article ANATOMY, *Encycl.* to which we beg leave to refer the reader. Any repetition in this place would be improper. Theſe ſubſtances are the following:
1. Bones and ſhells,
2. Muſcles,
3. Tendons,
4. Ligaments,
5. Membranes,
6. Cartilages,
7. Skin,
8. Brain and nerves,
9. Horns and nails,
10. Hair and feathers.

Beſides theſe ſubſtances which conſtitute the ſolid part of the bodies of animals, there are a number of fluids, the moſt important of which is the *blood*, which pervades every part of the ſyſtem in all the larger animals: The reſt are known by the name of *ſecretions*, becauſe they are formed or *ſecreted*, as the anatomiſts term it, from the blood. The principal animal ſecretions are the following:
1. Milk,
2. Saliva,
3. Pancreatic juice,
4. Bile and biliary calculi,
5. Tears,
6. Mucus of the noſe,
7. Sinovia,
8. Semen,
9. Liquor of the amnios,
10. Urine and urinary calculi.

Theſe ſubſtances ſhall form the ſubject of the following ſections.

Bones

SECT. I. *Of BONES.*

BY *bones*, we mean thoſe hard, ſolid, well-known ſubſtances, to which the firmneſs, ſhape, and ſtrength of animal bodies, are owing; which, in the larger animals, form, as it were, the ground-work upon which all the reſt is built. In man, in quadrupeds, and many other animals, the bones are ſituated below the other parts, and ſcarcely any of them are expoſed to view; but ſhell-fiſh and ſnails have a hard covering on the outſide of their bodies, evidently intended for defence. As theſe coverings, though known by the name of *ſhells*, are undoubtedly of a bony nature, we ſhall include them alſo in this ſection. For the very ſame reaſons, it would be improper to exclude *egg-ſhells*, and thoſe coverings of certain animals, the tortoiſe for inſtance, known by the name of *cruſts*.

It had been long known, that bones may be rendered ſoft and cartilaginous by keeping them in diluted acid ſolutions, and that ſome acids even diſſolve them altogether; that when expoſed to a violent heat, they become white, opaque, and brittle; and Dr Lewis had obſerved, that a ſudden and violent heat rendered them hard, ſemitranſparent, and ſonorous. But their component parts remained unknown till Scheele mentioned in his diſſertation on Fluor Spar, publiſhed in the Stockholm Tranſactions for 1771, that the earthy part of bones is *phoſphat of lime* (M). Since that time conſiderable additions have been made to the chemical analyſis of theſe ſubſtances by Berniard, Bouillon, and Rouelle. Mr Hatchett has publiſhed a very valuable paper on the ſubject in the Philoſophical Tranſactions for 1799; and in the 34th volume of the *Annales de Chimie*, Mr Merat-Guillot has given us a table of the component parts of the bones of a conſiderable number of animals.

The *bony parts* of animals may be divided into three claſſes; namely, *bones*, *cruſts*, and *ſhells*.

219 Proper of bone

1. Bones have a conſiderable degree of hardneſs; when recent, they contain a quantity of marrow, which may be partly ſeparated from them. When the water in which bones have been for ſome time boiled is evaporated to a proper conſiſtence, it aſſumes the form of a *gelly*; bones therefore contain *gelatine*.

220 Their c ponent parts.

If a piece of bone be kept for ſome time in diluted muriatic, or even acetous acid, it gradually loſes a conſiderable part of its weight, becomes ſoft, and acquires a

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(M) The diſcoverer of this has not been completely aſcertained: Scheele does not claim it in that paper; Bergman gives it to Gahn; but Crell affirms that it was made by Scheele.

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a certain degree of tranſparency; and, in ſhort, acquires all the properties of *cartilage*. Bone therefore conſiſts of *cartilage*, combined with ſome ſubſtance which theſe acids are capable of diſſolving and carrying off.

If pure ammonia be dropt into the acid which has reduced the bone to this ſtate, a quantity of white powder precipitates, which poſſeſſes all the properties of *phoſphat of lime*. The ſubſtance, then, which was combined with the cartilage is *phoſphat of lime*.

After the phoſphat of lime has precipitated, the addition of carbonat of ammonia occaſions a farther precipitate, which conſiſts of carbonat of lime: but the quantity of this precipitate is inconſiderable.* When concentrated acids are poured on bones, whether recent or calcined, an efferveſcence is perceptible; the gas which eſcapes renders lime water turbid, and is therefore *carbonic acid*. Now ſince bones contain carbonic acid, and ſince they contain lime alſo uncombined with any acid ſtronger than carbonic—it is evident that they contain a little *carbonat of lime*. Mr Hatchett found this ſubſtance in all the bones of quadrupeds and of fiſh which he examined.†

chett, Tranſ. p.

When bones are calcined, and the reſiduum is diſſolved in nitric acid, nitrat of barytes cauſes a ſmall precipitate, which is inſoluble in muriatic acid, and is therefore ſulphat of barytes.‡ Conſequently bones contain ſulphuric acid. It has been aſcertained, that this acid is combined with lime. The proportion of *ſulphat of lime* in bones is very inconſiderable.

Thus we have ſeen, that bones are compoſed of cartilage, which conſiſts almoſt entirely of gelatine, of phoſphat of lime, carbonat of lime, and ſulphat of lime. The following table, drawn up by Merat-Guillot,‖ exhibits a comparative view of the relative proportion of theſe ingredients in a variety of bones. The ſulphat of lime, which occurs only in a very ſmall quantity, has been confounded with phoſphat of lime.

. de 71.

One hundred parts contain	Gelatine,	Phoſp. of lime	Carb. of lime	Loſs.
Human bones from a burying ground,	16	67	1.5	15.5
Do. dry, but not from under the earth,	23	63	2	2
Bone of ox, - - - -	3	93	2	2
calf, - - -	25	54	trace	21
horſe, - - -	9	67 5	1.25	22.25
ſheep, - -	16	70	0.5	13.5
elk, - - - -	1.5	90	1	7.5
hog, - - -	17	52	1	30
hare, - - -	9	85	1	5
pullet, - -	6	72	1.5	20.5
pike, - - -	12	64	1	23
carp, - - -	6	45	0.5	48 5
Horſe tooth, - - -	12	85.5	0.25	2 25
Ivory, - - - - -	24	64	0.1	11.15
Hartſhorn, - - - -	27	57.5	1	14.5

chett, Tranſ. p. 21

The enamel of the teeth is compoſed of the ſame earthy ingredients as other bones; but it is totally deſtitute of cartilage.*

o- parts lls.

2. The cruſtaceous coverings of animals, as of echini, crabs, lobſters, prawns, and cray-fiſh, and alſo the ſhells of eggs, are compoſed of the ſame ingredients as bones; but in them the proportion of carbonat of lime far exceeds that of phoſphat.*

Bones.

Thus 100 parts of lobſter cruſt contain
60 carbonat of lime,
14 phoſphat,
26 cartilage.

100 †

One hundred parts of crawfiſh cruſt contain
60 carbonat of lime,
12 phoſphat of lime,
28 cartilage.

100 ‡

One hundred parts of hens egg-ſhells contain
89.6 carbonat of lime,
5.7 phoſphat of lime,
4.7 animal matter.

100.0 ‖

Mr Hatchett found traces of phoſphat of lime alſo in the ſhells of ſnails.

222 Component parts of ſhells.

3. The ſhells of ſea animals may be divided into two claſſes: The firſt has the appearance of porcelain; their ſurface is enamelled, and their texture is often ſlightly fibrous. Mr Hatchett has given them the name of *porcellaneous* ſhells. The ſecond kind of ſhell is known by the name of *mother of pearl*. It is covered with a ſtrong epidermis, and below it lies the ſhelly matter in layers.* The ſhell of the freſh water muſcle, mother of pearl, heliotis iris, and turbo olearius, are inſtances of theſe ſhells.

Porcellaneous ſhells are compoſed of carbonat of lime cemented together by a very ſmall quantity of animal matter.†

Mother of pearl ſhells are compoſed of alternate layers of carbonat of lime and a thin membranaceous or cartilaginous ſubſtance. This cartilage ſtill retains the figure of the ſhell, after all the carbonat of lime has been ſeparated by acids.‡

Mother of pearl contains 66 carbonat of lime,
34 cartilage.

100.‖

Coral, which is a bony ſubſtance formed by certain ſea inſects, has a nearer relation to mother of pearl ſhells in its ſtructure than to any other bony ſubſtance, as the following table¶ will ſhew.

	White coral.	Red coral.	Articulated coraline.
Carbonat of lime,	50	53.5	49
Animal matter,	50	46.5	51
	100	100.0	100

SECT. II. *Of the* MUSCLES *of* ANIMALS.

THE muſcular parts of animals are known in common language by the name of *fleſh*. They conſtitute a conſiderable proportion of the food of man.

Muſcular fleſh is compoſed of a great number of fibres or threads, commonly of a reddiſh or whitiſh colour; but its appearance is too well known to require any deſcription. Hitherto it has not been ſubjected to any accurate chemical analyſis. Mr Thouvenel, indeed, has publiſhed a very valuable diſſertation on the

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* *Hatchett, Phil. Tranſ.* 1799, p. 321. and 324.

† *Merat-Guillot, Ann. de Chim.* xxxiv. 71.

‡ *Ibid.*

‖ *Vauquelin, ibid.* xxix. 6.

* *Heriſſant, Mem. Par.* 1766, p. 22. *Hatchett, ibid.* 317.

† *Hatchett, ibid.*

‡ *Ibid.* 318.

‖ *Merat-Guillot, ibid.*

¶ *Merat-Guillot, ibid.*

ſubject; but his analyſis was made before the method of examining animal ſubſtances was ſo well underſtood as it is at preſent. It is to him, however, that we are indebted for almoſt all the facts known concerning the compoſition of muſcle.

It is ſcarcely poſſible to ſeparate the muſcle from all the other ſubſtances with which it is mixed. A quantity of fat often adheres to it cloſely; blood pervades the whole of it; and every fibre is enveloped in a particular thin membranous matter, which anatomiſts diſtinguiſh by the name of *cellular ſubſtance*. The analyſis of the muſcle, then, cannot be ſuppoſed to exhibit an accurate view of the compoſition of pure muſcular fibres, but only of muſcular fibre not perfectly ſeparated from other ſubſtances.

223 Analyſis of muſcles.

1. When a muſcle is well waſhed in cold water, ſeveral of its parts are diſſolved, and may be obtained by the uſual chemical methods. When the water is evaporated ſlowly, it at laſt coagulates, and the coagulum may be ſeparated by means of a filter. It poſſeſſes the properties of *albumen*.

2. The water is then to be evaporated gently to dryneſs, and alcohol poured upon the dry maſs: part of it is diſſolved by digeſtion, and there remains a ſaline ſubſtance, which has not been examined; but which Fourcroy conjectures to be a *phoſphat*.

3. When the alcohol is evaporated to dryneſs, it leaves a peculiar mucous ſubſtance, ſoluble both in water and alcohol; and when its watery ſolution is very much concentrated, it aſſumes an acid and bitter taſte. It ſwells upon hot coals, and melts, emitting an acid and penetrating ſmell. It attracts moiſture from the air, and forms a ſaline efflореſcence. In a hot atmoſphere it becomes ſour and putrefies. All theſe properties render it probable that this ſubſtance of Mr Thouvenel is that which is converted into *zoonic* acid during the roaſting of meat.

4. The muſcle is now to be boiled in water for ſome time. A quantity of fat appears on its ſurface in the form of oil, which may be taken off.

5. The water, when evaporated ſufficiently, aſſumes the form of a jelly on cooling, and therefore contains a portion of *gelatine*. It contains alſo a little of the ſaline ſubſtance, and of the mucous ſubſtance mentioned above.

6. The reſiduum of the muſcle is now white and inſipid, of a fibrous ſtructure, and inſoluble in water, and has all the properties of *fibrina*.

Thus it appears that muſcle is compoſed of

Albumen,
Mucous matter,
Gelatine,
Fibrina,
A ſalt.

The French chemiſts have diſcovered, that when a piece of muſcle is allowed to remain a ſufficient time in diluted ſulphuric acid, it is converted into a ſubſtance reſembling tallow: weak nitric acid, on the other hand, converts it into a ſubſtance reſembling *wax*.*

SECT. III. *Of the SOFT and WHITE PARTS of ANIMALS.*

THOSE parts of animals to which anatomiſts have given the names of cartilage, tendon, ligament, membrane, differ altogether in their appearance from the muſcles. They have never been analyſed. We know only that they are compoſed, in a great meaſure, of *gelatine*; for it is partly from them that *glue* is made; which does not differ from gelatine, except in not being perfectly pure.

Mr Hatchett has aſcertained that they contain no phoſphat of lime as a conſtituent part, and ſcarcely any ſaline ingredients; for when calcined they leave but a very inconſiderable reſiduum. Thus 250 grains of hog's bladder left only 0.02 grain of reſiduum.†

SECT. IV. *Of the SKIN.*

THE ſkin is that ſtrong thick covering which envelopes the whole external ſurface of animals. It is compoſed chiefly of two parts: a thin white elaſtic layer on the outſide, which is called *epidermis*, or *cuticle*; and a much thicker layer, compoſed of a great many fibres, cloſely interwoven, and diſpoſed in different directions; this is called the *cutis*, or *true ſkin*. The *epidermis* is that part of the ſkin which is raiſed in bliſters.

224 Epider

1. The epidermis is eaſily ſeparated from the cutis by maceration in hot water. It poſſeſſes a very great degree of elaſticity.

225 Its prop ties.

It is totally inſoluble in water and in alcohol. Pure fixed alkalies diſſolve it completely, as does lime likewiſe, though ſlowly.‡ Sulphuric and muriatic acids do not diſſolve it, at leaſt they have no ſenſible action on it for a conſiderable time; but nitric acid ſoon deprives it of its elaſticity, cauſes it to fall to pieces, and probably ſoon decompoſes it.§

It is well known that the living epidermis is tinged yellow almoſt inſtantaneouſly by nitric acid; but this effect does not take place, at leaſt ſo ſpeedily, when the dead cuticle is plunged in nitric acid altogether.‖

226 Cuti

2. When a portion of cutis is macerated for ſome hours in water, and agitation and preſſure is employed to accelerate the effect, the blood, and all the extraneous matter with which it was loaded, are ſeparated from it, but its texture remains unaltered. On evaporating the water employed, a ſmall quantity of gelatine may be obtained. No ſubſequent maceration in cold water has any farther effect; the weight of the cutis is not diminiſhed, and its texture is not altered: but if it be boiled in a ſufficient quantity of water, it may be completely diſſolved, and the whole of it, by evaporating the water, obtained in the ſtate of *gelatine* *

227 Compo of gela

Seguin informs us that he has aſcertained, by a great variety of experiments, that the cutis differs from gelatine merely in containing an additional quantity of oxygen. Hot water (he ſays) expels this oxygen, and thus converts cutis into gelatine.† As theſe experiments have not been publiſhed, it is impoſſible to form any judgment of their weight.

228 Nature tanning

It is the ſkin or cutis of animals of which leather is formed. The proceſs of converting ſkin into leather is called *tanning*. This proceſs, though practiſed in the earlieſt ages, was merely empyrical, till the happy ingenuity of Mr Seguin led him to diſcover its real nature. After the epidermis and all the impurities of the ſkin have been ſeparated, and its pores have been ſo far opened as to admit of being completely penetrated, it is ſteeped in an infuſion of oak-bark, which conſiſts of gallic acid and tan. The gallic acid (if we believe Seguin) deprives the ſkin gradually of oxygen, and thus converts it into gelatine, and the tan combines with this gelatine the inſtant it is formed; and this proceſs goes

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* *Humboldt on Galvaniſm*, 170.

† *Phil. Tranſ.* 1 p. 333.

‡ *Chapt Ann. de Chim.* x 221.

§ *Cruiſ on Inſen Perſpir* p. 32.

‖ *Ibid.*

* *Seguin Nicholſ Journal* 271.

† *Ibid.*

in and
rves.

goes on ſo ſlowly that the texture of the ſkin is not altered. Leather, therefore, is merely a combination of gelatine and tan.‡

cholſon's
rnal, i.

SECT. V. *Of the BRAIN and NERVES.*

THE brain and nerves are the inſtruments of ſenſation, and even of motion; for an animal loſes the power of moving a part the inſtant that the nerves which enter it are cut.

The brain and nerves have a ſtrong reſemblance to each other; and it is probable that they agree alſo in their compoſition. But hitherto no attempt has been made to analyſe the nerves. The only chemiſts who have examined the nature of *brain* are Mr Thouret* and Mr Fourcroy.‡

our. de
viii. 329
nn. de
. xvi.

The brain conſiſts of two ſubſtances, which differ from each other ſomewhat in colour, but which, in other reſpects, ſeem to be of the ſame nature. The outermoſt matter, having ſome ſmall reſemblance in colour to wood-aſhes, has been called the *cineritious* part; the innermoſt part has been called the *medullary* part.

129
perties
rain.

Brain has a ſoft feel, not unlike that of ſoap; its texture appears to be very cloſe; its ſpecific gravity is greater than that of water.

When brain is kept in cloſe veſſels ſo that the external air is excluded, it remains for a long time unaltered. Fourcroy filled a glaſs veſſel almoſt completely with pieces of brain, and attached it to a pneumatic apparatus; a few bubbles of carbonic acid gas appeared at firſt, but it remained above a year without undergoing any farther change.‡

id. 297.

This is very far from being the caſe with brain expoſed to the atmoſphere. In a few days (at the temperature of 60°) it exhales a moſt deteſtable odour, becomes acid, aſſumes a green colour, and very ſoon a great quantity of ammonia makes its appearance in it.

Cold water does not diſſolve any part of the brain; but by trituration in a mortar, it forms, with water, a whitiſh coloured emulſion, which appears homogeneous, may be paſſed through a filter, and the brain does not precipitate by reſt. When this emulſion is heated to 145°, a white coagulum is formed. The addition of a great quantity of water alſo cauſes a coagulum to appear, which ſwims on the ſurface, but the water ſtill retains a milky colour. When ſulphuric acid is dropt into the watery emulſion of brain, white flakes ſeparate and ſwim on the ſurface, and the liquid becomes red. Nitric acid produces the ſame effects, only the liquid becomes yellow. Alcohol alſo ſeparates a white coagulum from the emulſion, after it has been mixed with it for ſome hours. When nitric acid is added to the emulſion till it becomes ſlightly acid, a coagulum is alſo ſeparated. This coagulum is of a white colour; it is inſoluble in water and in alcohol. Heat ſoftens, but does not melt it. When dried, it becomes tranſparent, and breaks with a glaſſy fracture. It has therefore ſome reſemblance to *albumen*.§

l. 288.

When brain is triturated in a mortar with diluted ſulphuric acid, part is diſſolved, the reſt may be ſeparated, by filtration, in the form of a coagulum. The acid liquor is colourleſs. By evaporation, the liquid becomes black, ſulphurous acid is exhaled, and cryſtals appear; and when evaporated to dryneſs, a black maſs remains behind. When this maſs is diluted with water, a quantity of charcoal ſeparates, and the water remains clear. The brain is completely decompoſed, a quantity of ammonia combines with the acid and forms ſulphat of ammonia, while charcoal is precipitated. The water, by evaporation and treatment with alcohol, yields ſulphats of ammonia and lime, phoſphoric acid, and phoſphats of ſoda and ammonia. Brain therefore contains Phoſphat of lime,
———— ſoda,
———— ammonia.

Brain and
Nerves.

230
Its analyſis.

Traces alſo of ſulphat of lime can be diſcovered in it. The quantity of theſe ſalts is very ſmall; altogether they do not amount to $\frac{1}{110}$th part.‖

‖ *Ann. de Chim.* xvi. 288.

Diluted nitric acid, when triturated with brain, likewiſe diſſolves a part, and coagulates the reſt. The ſolution is tranſparent. When evaporated till the acid becomes concentrated, carbonic acid gas and nitrous gas are diſengaged; an efferveſcence takes place, white fumes appear, an immenſe quantity of ammonia is diſengaged, a bulky charcoal remains mixed with a conſiderable quantity of oxalic acid.*

* *Ibid.* 307.

When brain is gradually evaporated to dryneſs by the heat of a water bath, a portion of tranſparent liquid ſeparates at firſt from the reſt, and the reſiduum, when nearly dry, acquires a brown colour; its weight amounts to about one-fourth of the freſh brain. It may ſtill be formed into an emulſion with water, but very ſoon ſeparates again ſpontaneouſly.

When alcohol is repeatedly boiled upon this dried reſiduum till it ceaſes to have any more action, it diſſolves about five-eighths of the whole. When this alcohol cools, it depoſits a yellowiſh white ſubſtance, compoſed of brilliant plates. When kneaded together by the fingers, it aſſumes the appearance of a ductile paſte: at the temperature of boiling water it becomes ſoft, and when the heat is increaſed it blackens, exhales empyreumatic and ammoniacal fumes, and leaves behind it a charry matter.† When the alcohol is evaporated, it depoſites a yellowiſh black matter, which reddens paper tinged with turnſol, and readily diffuſes itſelf through water.‡

† *Ibid.* 313.

‡ *Ibid.* 317.

Pure concentrated potaſs diſſolves brain, diſengaging a great quantity of ammonia.

Theſe facts are ſufficient to ſhew us, that, excluſive of the ſmall proportion of ſaline ingredients, brain is compoſed of a peculiar matter, differing in many particulars from all other animal ſubſtances, but having a conſiderable reſemblance in many of its properties to albumen. Brain has been compared to a ſoap; but it is plain that the reſemblance is very faint, as ſcarcely any oily matter could be extricated from brain by Fourcroy, though he attempted it by all the contrivances which the preſent ſtate of chemiſtry ſuggeſted; and the alkaline proportion of it is a great deal too ſmall to merit any attention.

SECT. VI. *Of NAILS, HORNS, HAIR, FEATHERS.*

THESE ſubſtances have not hitherto been analyſed. We know only that they have a great reſemblance to each other. They give out the ſame ſmell, and exhibit the ſame phenomena when burnt, and they yield the ſame products when diſtilled.

Pure fixed alkali has the property of decompoſing theſe ſubſtances, and of converting them into ammonia and oil. The ammonia is diſengaged in great abundance, and the oil combines with the alkali, and forms a ſpecies of ſoap. When muriatic acid is poured into the ſolution of theſe ſubſtances in pure ſoda, a quantity of ſulphurated hydrogen gas is diſengaged, and a black ſubſtance, doubtleſs charcoal, precipitates. Hence it follows that theſe ſubſtances contain in their compoſition a quantity of ſulphur. Accordingly, if a bit of ſilver is put into the ſolution, it inſtantly aſſumes a black colour.§

Theſe ſubſtances ſcarcely contain any earthy ingredients. One hundred grains of ox horn, after calcination, left only 0.04 grains of reſiduum, half of which was phoſphat of lime. Seventy-eight grains of chamois horn left five grains of reſiduum.‖

Such is a very imperfect account of the ſolids which compoſe animal bodies. We proceed next to the fluid which circulates through living bodies, namely *blood*; and to the various *ſecretions* formed from the blood, either in order to anſwer ſome important purpoſe to the animal, or to be evacuated as uſeleſs, that the blood thus purified may be more proper for anſwering the ends for which it is deſtined. Many of theſe ſubſtances have been examined with more care by chemiſts than the animal ſolids.

SECT. VII. *Of Blood.*

231 Properties of blood.

Blood is a well known fluid, which circulates in the veins and arteries of the more perfect animals. It is of a red colour, has a conſiderable degree of conſiſtency, and an unctuous feel, as if it contained a quantity of ſoap. Its taſte is ſlightly ſaline, and it has a peculiar ſmell.

The ſpecific gravity of human blood is, at a medium, 1.0527.* Mr Fourcroy found the ſpecific gravity of bullock's blood, at the temperature of 60°, to be 1.056.† The blood does not uniformly retain the ſame conſiſtence in the ſame animal, and its conſiſtence in different animals is very various. It is eaſy to ſee that its ſpecific gravity muſt be equally various.

232 Compoſed of red globules,

When the blood is viewed through a microſcope, a great many globules, of a red colour, are ſeen floating in it. It is to theſe globules that the red colour of the blood is owing. They were firſt examined with attention by Leuwenhoeck. Their form, their proportion, and the changes which they undergo from the addition of various ſubſtances, have been examined with the greateſt care; but hitherto without adding much to our knowledge. We neither know the ingredients of which the red globules are compoſed, nor the changes to which they are ſubjected, nor the uſeful purpoſes which they ſerve; nor has any accurate method been diſcovered of ſeparating them from the reſt of the blood, and of obtaining them in a ſtate of purity.

When blood, after being drawn from an animal, is allowed to remain for ſome time at reſt, it very ſoon coagulates into a ſolid maſs, of the conſiſtence of curdled milk. This maſs gradually ſeparates into two parts: one of which is fluid, and is called *ſerum*; the other, the coagulum, has been called *cruor*, becauſe it alone retains the red colour which diſtinguiſhes blood. This ſeparation is very ſimilar to the ſeparation of curdled milk into curds and whey. The cruor uſually ſinks to the bottom of the veſſel, and, of courſe, is covered by the ſerum.

233 Cruor,

The cruor, or *clot* as it is ſometimes called, is of a red colour, and poſſeſſes conſiderable conſiſtence. Its mean ſpecific gravity is about 1.245.‡ If we waſh the cruor in a ſufficient quantity of water, it gradually loſes its red colour, and aſſumes the appearance of a whitiſh, fibrous, elaſtic maſs, which poſſeſſes all the properties of *fibrina*. The cruor therefore is compoſed chiefly of fibrina. The water in which it has been waſhed aſſumes a red colour, but continues tranſparent. It is evident from this that it contains, diſſolved in it, the red globules; not, however, in a ſtate of purity, for it is impoſſible to ſeparate the cruor completely from the ſerum: conſequently the water muſt contain both ſerum and red globules. We know, however, from this, that the red globules are ſoluble in water. The cruor of the blood, then, is compoſed of red globules and fibrina.

If the cruor of the blood be expoſed to a gentle heat, it becomes gradually dry and brittle. If this dry maſs be ſubmitted to diſtillation, it yields water, ammonia, a thick empyreumatic oil, and much carbonat of ammonia: there remains a ſpongy coal of a brilliant appearance, from which ſulphuric acid extracts *ſoda* and *iron*; there remains behind a mixture of phoſphat of lime and charcoal.‖

When the fibrina is diſtilled, it yields preciſely the ſame products; but the reſiduum contains neither iron nor ſoda. The red water, on the contrary, which had been employed to waſh the cruor, contains both of theſe ſubſtances, eſpecially iron; which may be obtained in the ſtate of oxyd by evaporating this water to dryneſs, and calcining the reſiduum.¶ Theſe facts are ſufficient to demonſtrate that the red globules contain iron; conſequently the opinion that their colour depends upon that metal is at leaſt poſſible. It is probably owing to the ſoda which it contains, that the preſence of iron cannot be aſcertained in the ſolution of theſe globules by the uſual teſts. The pruſſian alkali cauſes no precipitate; the infuſion of nut galls gives it no blue or purpliſh tinge.*

234 And ſerum.

The ſerum is of a light greeniſh yellow colour; it has the taſte, ſmell, and feel of the blood, but its conſiſtence is not ſo great. Its mean ſpecific gravity is about 1.0287.† It converts ſyrup of violets to a green, and therefore contains an alkali. On examination, it is found that it owes this property to a portion of ſoda. When heated to the temperature of 156°,§ the ſerum coagulates, as Harvey firſt diſcovered.† It coagulates alſo when boiling water is mixed with it; but if ſerum be mixed with ſix parts of cold water, it does not coagulate by heat.‡ When thus coagulated, it has a greyiſh white colour, and is not unlike the boiled white of an egg.§ If the coagulum be cut into ſmall pieces, a muddy fluid may be ſqueezed from it, which has been termed the *ſeroſity*. After the ſeparation of this fluid, if the reſiduum be carefully waſhed in boiling water and examined, it will be found to poſſeſs all the properties of *albumen*. The ſerum, therefore, contains a conſiderable proportion of albumen. Hence its coagulation by heat and the other phenomena which albumen uſually exhibits.

If the ſeroſity be gently evaporated till it becomes concentrated, and then be allowed to cool, it aſſumes the form of a jelly, as was firſt obſerved by De Haen.‖ Conſequently it contains *gelatine*.

If ſerum be mixed with twice its weight of water, and, after coagulation by heat, the albumen be ſepara-

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§ *Merat-Guillot, Ann. de Chim.* xxxiv. 70.

‖ *Hatchett, Phil. Tranſ.* 1799, p. 332.

* *Haller's Phyſiology*, ii. 41.

† *Ann. de Chim.* vii. 147.

‡ *Jurin, Haller's Phyſiology*, ii. 41.

‖ *Fourcro* iii. 267.

¶ *Ibid.*

* *Well's Phil. Tr* 1797.

† *Jurin, Haller's Phyſiolog* ii. 41.

§ *Cullen.*

† *De Ge Anim.* p 161.

‡ *Fourcr Ann. de Chim.* vi 157.

§ *Ibid.* 1

‖ *Ibid.*

ted by filtration, and the liquid be ſlowly evaporated till it is conſiderably concentrated, a number of cryſtals are depoſited when the liquid is left ſtanding in a cool place. Theſe cryſtals conſiſt of muriat of ſoda and carbonat of ſoda.¶

Thus it appears that the ſerum of the blood contains albumen, gelatine, ſoda, muriat of ſoda, and carbonat of ſoda, beſides a portion of water.

Gelatine may be precipitated from the ſeroſity by the three mineral acids. Mr Hunter obſerved, that Goulard's extract, or, which is the ſame thing, acetite of lead diſſolved in acetous acid, produces with gelatine a copious precipitate.¶ When nitric acid is diſtilled off ſerum, it converts it partly into pruſſic acid.* Acids, alcohol, and tan, precipitate the albumen in different ſtates; but this, after what has been ſaid in the laſt chapter, ſection ii. requires no farther explanation.

The proportion between the cruor and ſerum of the blood varies much in different animals, and even in the ſame animal in different circumſtances. The moſt common proportion is about one part of cruor to three parts of ſerum; but in many caſes the cruor exceeds and falls ſhort of this quantity: the limits of the ratios of theſe ſubſtances to each other appear, from a compariſon of the concluſions of moſt of thoſe who have written accurately on the ſubject, to be 1 : 1 and 1 : 4; but the firſt caſe muſt be very rare indeed.*

When new-drawn blood is ſtirred briſkly round with a ſtick, or the hand, the whole of the fibrina collects together upon the ſtick, and in this manner may be ſeparated altogether from the reſt of the blood. The red globules, in this caſe, remain behind in the ſerum. It is in this manner that the blood is prepared for the different purpoſes to which it is put: as clarifying ſugar, making puddings, &c. After the fibrina is thus ſeparated, the blood no longer coagulates when allowed to remain at reſt, but a ſpongy flaky matter ſeparates from it and ſwims on the ſurface.†

When blood is dried by a gentle heat, water exhales from it, retaining a very ſmall quantity of animal matter in ſolution, and conſequently having the odour of blood. Blood dried in this manner being introduced into a retort and diſtilled, there comes over, firſt a clear watery liquor, then carbonic acid gas, and carbonat of ammonia, which cryſtallizes in the neck of the retort; after theſe products there comes over a fluid oil, carbonated hydrogen gas, and an oily ſubſtance of the conſiſtence of butter. The watery liquor poſſeſſes the property of precipitating from ſulphat of iron a green powder: muriatic acid diſſolves part of this powder, and there remains behind a little pruſſian blue. Conſequently this watery liquor contains both an alkali and pruſſic acid.‡

9216 grains of dried blood being put into a large crucible, and gradually heated, at firſt became nearly fluid, and ſwelled up conſiderably, emitted a great many fetid fumes of a yellowiſh colour, and at laſt took fire and burned with a white flame, evidently owing to the preſence of oil. After the flame and the fumes had diſappeared, a light ſmoke was emitted, which affected the eyes and the noſe, which had the odour of pruſſic acid, and reddened moiſt papers ſtained with vegetable blues. At the end of ſix hours, when the matter had loſt five-ſixths of its ſubſtance, it melted anew, exhibited a purple flame on its ſurface, and emitted a thick ſmoke. This ſmoke affected the eyes and noſtrils, and reddened blue paper, but it had not the ſmell of pruſſic acid. When a quantity of it was collected and examined, it was found to poſſeſs the properties of phoſphoric acid. The reſiduum amounted to 181 grains; it had a deep black colour, and a metallic brilliancy; and its particles were attracted by the magnet. It contained no uncombined ſoda, though the blood itſelf, before combuſtion, contains it abundantly; but water extracted from it muriat of ſoda, part of the reſt was diſſolved by muriatic acid, and, of courſe, was lime; there was beſides a little ſilica, which had evidently been ſeparated from the crucible. The iron had been reduced during the combuſtion.‡

255
Component parts of blood.

Such are the properties of blood, as far as they have been hitherto aſcertained by experiment. We have ſeen that it contains the following ingredients:

1. Water,
2. Fibrina,
3. Albumen,
4. Gelatine,
5. Iron,
6. Soda,
7. Muriat of ſoda,
8. Phoſphat of lime.

But our knowledge of this ſingular fluid is by no means ſo complete as it ought to be; a more accurate analyſis would probably diſcover the preſence of other ſubſtances, and enable us to account for many of the properties of blood which at preſent are inexplicable.

It would be of great conſequence alſo to compare together the blood of different animals, and of the ſame animal at different ages, and to aſcertain in what particulars they differ from each other. This would probably throw light on ſome of the obſcureſt parts of the animal economy. Very little progreſs has hitherto been made in theſe reſearches: if we except the labours of Rouelle, who obtained nearly the ſame ingredients, though in different proportions, from the blood of a great variety of animals, the experiments of Fourcroy on the blood of the human fœtus are almoſt the only ones of that kind with which we are acquainted.

236
Blood of the fœtus.

He found that it differs from the blood of the adult in three things: *1ſt*, Its colouring matter is darker, and ſeems to be more abundant; *2d*, It contains no fibrina, but probably a greater proportion of gelatine than blood of adults; *3d*, It contains no phoſphoric acid.§

237
Diſeaſed blood.

The examination of diſeaſed blood, too, would be of great conſequence; becauſe the difference of its properties from the blood of people in health, might throw much light on the nature of the diſeaſe. It is well known, that when a perſon labours under inflammation, his blood is not ſuſceptible of coagulating ſo ſoon as healthy blood. This longer time allows the red globules to ſink to the bottom, and the coagulated fibrina appears at the top of its natural whitiſh colour. Hence the appearance of the *buffy coat*, as it is called, which characterizes blood during inflammation.

During that diſeaſe which is known by the name of *diabetes*, in which the urine is exceſſive in quantity, and contains ſugar, the ſerum of blood often, as appears from the experiments of Dr Dobſon and Dr Rollo, aſſumes the appearance of whey; and, like it, ſeems to contain ſugar, or, at leaſt, it has loſt its uſual ſalt taſte.

Fourcroy mentions a caſe of extreme feebleneſs, in which all the parts of the body were in an unuſual relaxed

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ırcroy, de . vii.

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rcroy, de vi.

ller's ology, '.

rcroy, de vii.

. 153.

‡ Fourcroy, Ann. de Chim. vii. 151.

§ Ibid. 162.

laxed ſtate. In that patient a quantity of blood oozed out from the eye-lids, which tinged linen blue, as if it had been ſtained with pruſſian blue. Here pruſſic alkali ſeems to have been formed in the blood.

SECT. VIII. *Of Milk.*

Milk is a fluid ſecreted by the female of all thoſe animals denominated *mammalia*, and intended evidently for the nouriſhment of her offſpring.

The milk of every animal has certain peculiarities which diſtinguiſh it from every other milk. But the animal whoſe milk is moſt made uſe of by man as an article of food, and with which, conſequently, we are beſt acquainted, is the *cow*. Chemiſts, therefore, have made choice of cow's milk for their experiments. We ſhall at firſt confine ourſelves to the properties and analyſis of cow's milk, and afterwards point out in what reſpect the milk of other animals differs from it, as far at leaſt as theſe differences have hitherto been aſcertained.

238 Properties of milk.

Milk is an opaque fluid, of a white colour, a ſlight peculiar ſmell, and a pleaſant ſweetiſh taſte. When newly drawn from the cow, it has a taſte very different from that which it acquires after it has been kept for ſome hours.

It is liquid, and wets all thoſe ſubſtances which can be moiſtened by water; but its conſiſtence is greater than that of water, and it is ſlightly unctuous. Like water, it freezes when cooled down to about 30°; but Parmentier and Deyeux, to whom we are indebted for by far the completeſt account of milk hitherto publiſhed, found that its freezing point varies conſiderably in the milk of different cows, and even of the ſame cow at different times.* Milk boils alſo when ſufficiently heated; but the ſame variation takes place in the boiling point of different milks, though it never deviates very far from the boiling point of water. Milk is ſpecifically heavier than water, and lighter than blood; but the preciſe degree cannot be aſcertained, becauſe almoſt every particular milk has a ſpecific gravity peculiar to itſelf.

When milk is allowed to remain for ſome time at reſt, there collects on its ſurface a thick unctuous yellowiſh coloured ſubſtance, known by the name of *cream*. The cream appears ſooner in milk in ſummer than in winter, evidently owing to the difference of temperature. In ſummer, about four days of repoſe are neceſſary before the whole of the cream collects on the ſurface of the liquid; but in winter it requires at leaſt double the time.†

After the cream is ſeparated, the milk which remains is much thinner than before, and it has a bluiſh white colour. If it be heated to the temperature of 100°, and a little *rennet*, which is water digeſted with the inner coat of a calf's ſtomach, and preſerved with ſalt, be poured into it, coagulation enſues; and if the coagulum be broken, the milk very ſoon ſeparates into two ſubſtances: a ſolid white part, known by the name of *curd*; and a fluid part, called *whey*.

Thus we ſee that milk may be eaſily ſeparated into three parts; namely, *cream*, *curd*, and *whey*.

239 Cream

Cream is of a yellow colour, and its conſiſtence increaſes gradually by expoſure to the atmoſphere. In three or four days, it becomes ſo thick that the veſſel which contains it may be inverted without riſking any loſs. In eight or ten days more its ſurface is covered over with mucors and byſſi, and it has no longer the flavour of cream but of very fat cheeſe.* This is the proceſs for making what in this country is called a *cream cheeſe*.

Cream poſſeſſes many of the properties of an oil. It is ſpecifically lighter than water, it has an unctuous feel, ſtains clothes preciſely in the manner of oil; and if it be kept fluid, it contracts at laſt a taſte which is very analogous to the rancidity of oils.† When kept boiling for ſome time, a little oil makes its appearance, and floats upon its ſurface.‡ Cream is neither ſoluble in alcohol nor oils.§ Theſe properties are ſufficient to ſhew us that it contains a quantity of oil; but this oil is combined with a part of the curd, and mixed with ſome ſerum. Cream, then, is compoſed of a peculiar oil, curd, and ſerum. The oil may be eaſily obtained ſeparate by agitating the cream for a conſiderable time. This proceſs, known to every body, is called *churning*. After a certain time, the cream ſeparates into two portions: one fluid, and reſembling creamed milk; the other ſolid, and called *butter*.

240 Convert into but

Butter is of a yellow colour, poſſeſſes the properties of an oil, and mixes readily with other oily bodies. When heated to the temperature of 96°, it melts, and becomes tranſparent; if it be kept for ſome time melted, ſome curd and water or whey ſeparate from it, and it aſſumes exactly the appearance of oil.‖ But this proceſs deprives it in a great meaſure of its peculiar flavour.

When butter is kept for a certain time, it becomes rancid, owing in a good meaſure to the preſence of theſe foreign ingredients; for if butter be well waſhed, and a great portion of theſe matters ſeparated, it does not become rancid nearly ſo ſoon as when it is not treated in this manner. It was formerly ſuppoſed that this rancidity was owing to the developement of a peculiar acid; but Parmentier and Deyeux have ſhewn, that no acid is preſent in rancid butter.* When butter is diſtilled, there comes over water, ſebacic acid, and oil, at firſt fluid, but afterwards concrete. The carbonaceous reſiduum is but ſmall.

241 And how

Butter may be obtained by agitating cream newly taken from milk, or even by agitating milk newly drawn from the cow. But it is uſual to allow cream to remain for ſome time before it is churned. Now cream, by ſtanding, acquires a ſour taſte; butter therefore is commonly made from ſour cream. Freſh cream requires at leaſt four times as much churning before it yields its butter as ſour cream does;† conſequently cream acquires, by being kept for ſome time, new properties, in conſequence of which it is more eaſily converted into butter. When very ſour cream is churned, every one who has paid the ſmalleſt attention muſt have perceived, that the butter-milk, after the churning, is not nearly ſo ſour as the cream had been. The butter, in all caſes, is perfectly ſweet; conſequently the acid which had been evolved has in a great meaſure diſappeared during the proceſs of churning. It has been aſcertained, that cream may be churned, and butter obtained, though the contact of atmoſpheric air be excluded.‡ We have no doubt, that in all caſes where ſuch an experiment ſucceeded, the cream on which it was made had previouſly become ſour. On the other hand, it has been aſcertained, that when cream is churned in contact with air, it abſorbs a conſiderable quantity of it;§ and it cannot

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* *Jour. de Phyſ.* xxxvii. 362.

† *Fourcroy, Ann. de Chim.* vii. 167.

* *Parme tier and Deyeux, Ann. de Chim.* vi 372.

† *Ibid.* 3

‡ *Ibid.* 3

§ *Ibid.*

‖ *Fourcr Ann. de Chim.* vi 170.

* *Ibid.* 3

† *Fourcro ibid.* 169.

‡ *Young d Lacte*, 15

§ *Mid-L thian Rep for* 1795.

ilk.

cannot be doubted, that the portion abſorbed is oxygen.

Theſe facts are ſufficient to afford us a key to explain what takes place during the proceſs of churning. There is a peculiar oil in milk, which has ſo ſtrong an affinity for the other ingredients, that it will not ſeparate from them ſpontaneouſly; but it has an affinity for oxygen, and when combined with it, forms the concrete body called *butter*. Agitation produces this combination of the oil with oxygen; either by cauſing it to abſorb oxygen from the air, or, if that be impoſſible, by ſeparating it from the acid which exiſts in ſour cream. Hence the abſorption of air during churning; hence alſo the increaſe of temperature of the cream, which Dr Young found to amount conſtantly to 4°; and hence the ſweetneſs of the butter-milk compared with the cream from which it was obtained.

The affinity of the oil of cream for the other ingredients is ſuch, that it never ſeparates completely from them. Not only is curd and whey always found in the cream, but ſome of this oil is conſtantly found in creamed milk and even in whey: for it has been aſcertained by actual experiment, that butter may be obtained by churning whey; 27 Scotch pints of whey yield at an average about a pound of butter.|| This accounts for a fact well known to thoſe who ſuperintend dairies, that a good deal more butter may be obtained from the ſame quantity of milk, provided it be churned as drawn from the cow, than when the cream alone is collected and churned.

The butter-milk, as Parmentier and Deyeux aſcertained by experiment, poſſeſſes preciſely the properties of milk deprived of cream.¶

72 erties rd.

CURD, which may be ſeparated from creamed milk by rennet, has all the properties of coagulated albumen. It is white and ſolid; and when all the moiſture is ſqueezed out, it has a good deal of brittleneſs. It is inſoluble in water; but pure alkalies and lime diſſolve it readily, eſpecially when aſſiſted by heat; and when fixed alkali is uſed, a great quantity of ammonia is emitted during the ſolution. The ſolution of curd in ſoda is of a red colour, at leaſt if heat be employed; owing probably to the ſeparation of charcoal from the curd by the action of the alkali.* Indeed, when a ſtrong heat has been uſed, charcoal precipitates as the ſolution cools.† The matter diſſolved by the alkali may be ſeparated from it by means of any acid; but it has loſt all the properties of curd. It is of a black colour, melts like tallow by the application of heat, leaves oily ſtains on paper, and never acquires the conſiſtence of curd.‡ Hence it appears that curd, by the action of a fixed alkali, is decompoſed, and converted into two new ſubſtances, ammonia, and oil or rather fat.

Curd is ſoluble alſo in acids. If, over curd newly precipitated from milk, and not dried, there be poured eight parts of water, containing as much of any of the mineral acids as gives it a ſenſibly acid taſte, the whole is diſſolved after a little boiling.§ Acetous acid and lactic acid do not diſſolve curd when very much diluted.|| But theſe acids, when concentrated, diſſolve it readily, and in conſiderable quantity.¶ It is remarkable enough, that concentrated vegetable acids diſſolve curd readily, but have very little action on it when they are very much diluted: whereas the mineral diſſolve it when much diluted; but when concentrated, have either very little effect on it, as ſulphuric acid;* or decompoſe it, as nitric acid. By means of this laſt acid, as Berthollet diſcovered, a quantity of azotic gas may be obtained from curd.

Milk.

273 Of cheeſe.

Curd, as is well known, is uſed in making *cheeſe*; and the cheeſe is the better the more it contains of cream, or of that oily matter which conſtitutes cream. It is well known to cheeſemakers, that the goodneſs of it depends in a great meaſure on the manner of ſeparating the whey from the curd. If the milk be much heated, the coagulum broken in pieces, and the whey forcibly ſeparated, as is the practice in many parts of Scotland, the cheeſe is ſcarce good for any thing; but the whey is delicious, eſpecially the laſt ſqueezed-out whey, and butter may be obtained from it in conſiderable quantity. A full proof that nearly the whole creamy part of the milk has been ſeparated with the whey. Whereas if the milk be not too much heated (about 100° is ſufficient), if the coagulum be allowed to remain unbroken, and the whey be ſeparated by very ſlow and gentle preſſure, the cheeſe is excellent; but the whey is almoſt tranſparent, and nearly colourleſs.

Good cheeſe melts at a moderate heat; but bad cheeſe, when heated, dries, curls, and exhibits all the phenomena of burning horn. Hence it is evident, that all the properties in which curd differs from albumen are owing to its containing combined with it a quantity of the peculiar oil which conſtitutes the diſtinguiſhing characteriſtic of cream; hence its flavour and ſmell; and hence alſo the white colour of milk.

274 Coagulation of milk.

This ſameneſs of curd and albumen ſhews us, that the coagulation of milk and of albumen depend upon the ſame cauſe. Heat, indeed, does not coagulate milk, becauſe the albumen in it is diluted with too large a quantity of water. But if milk be boiled in contact with air, a pellicle ſoon forms on its ſurface, which has the properties of coagulated albumen: if this pellicle be removed, another ſucceeds; and by continuing the boiling, the whole of the albuminous or curdy matter may be ſeparated from milk.* When this pellicle is allowed to remain, it falls at laſt to the bottom of the veſſel, where, being expoſed to a greater heat, it becomes brown, and communicates to milk that diſagreeable taſte which, in this country is called a *ſinged* taſte. It happens more readily when milk is boiled along with rice, flour, &c.

If to boiling milk there be added as much of any neutral ſalt as it is capable of diſſolving, or of ſugar, or of gum arabic, the milk coagulates, and the curd ſeparates.† Alcohol alſo coagulates milk;‡ as do all acids, rennet, and the infuſion of the flowers of artichoke, and of the thiſtle.|| If milk be diluted with ten times its weight of water, it cannot be made to coagulate at all.¶

275 Properties of whey.

WHEY, after being filtered, to ſeparate a quantity of curd which ſtill continues to float through it, is a thin pellucid fluid, of a yellowiſh green colour and pleaſant ſweetiſh taſte, in which the flavour of milk may be diſtinguiſhed. It always contains ſome curd; but nearly the whole may be ſeparated by keeping the whey for ſome time boiling; a thick white ſcum gathers on the ſurface, which in Scotland is known by the name of *float whey*. When this ſcum, which conſiſts of the curdy part, is carefully ſeparated, the whey, after being allowed to remain at reſt for ſome hours, to give the remainder

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d-Lo- Report,

n. de vii.

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rcroy, . 175.

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ecle, ii.

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rmen- nd ix, 417. roy, . 173.

* Parmentier, ibid.

* Parmentier, ibid. p. 415.

† Scheele, ii. 52.

‡ Parmentier, ibid. p. 416.

|| Ibid.

¶ Scheele, ii. 54.

remainder of the curd time to precipitate, is decanted off, almoſt as colourleſs as water, and ſcarcely any of the peculiar taſte of milk can be diſtinguiſhed in it. If it be now ſlowly evaporated, it depoſites at laſt a number of white coloured cryſtals, which are *ſugar of milk*. Towards the end of the evaporation, ſome cryſtals of muriat of potaſs and of muriat of lime make their appearance.[*] According to Scheele, it contains alſo a little phoſphat of lime.[†]

After the ſalts have been obtained from whey, what remains concretes into a jelly on cooling.[‡] Hence it follows, that whey alſo contains *gelatine*. Whey, then, is compoſed of water, ſugar of milk, gelatine, muriat of potaſs, and muriat of lime. The other ſalts, which are ſometimes found in it, are only accidentally preſent.

If whey be allowed to remain for ſome time, it becomes ſour, owing to the formation of a peculiar acid known by the name of *lactic acid*. It is to this property of whey that we are to aſcribe the acidity which milk contracts; for neither curd nor cream, perfectly freed from ſerum, ſeem ſuſceptible of acquiring acid properties. Hence the reaſon, alſo, that milk, after it becomes ſour, always coagulates. Boiled milk has the property of continuing longer ſweet; but it is ſingular enough, that it runs ſooner to putrefaction than ordinary milk.[*]

276 Vinegar obtained from milk.

The acid of milk differs conſiderably from the acetous; yet vinegar may be obtained from milk by a very ſimple proceſs. If to ſomewhat more than 8 lbs. troy of milk, ſix ſpoonfuls of alcohol be added, and the mixture well corked be expoſed to a heat ſufficient to ſupport fermentation (provided attention be paid to allow the carbonic acid gas to eſcape from time to time), the whey, in about a month, will be found converted into vinegar.[†]

277 Milk undergoes fermentation.

Milk is almoſt the only animal ſubſtance which may be made to undergo the vinous fermentation, and to afford a liquor reſembling wine or beer, from which alcohol may be ſeparated by diſtillation. This ſingular fact ſeems to have been firſt diſcovered by the Tartars; they obtain all their ſpirituous liquors from mares milk. It has been aſcertained, that milk is incapable of being converted into wine till it has become ſour; after this, nothing is neceſſary but to place it in the proper temperature, the fermentation begins of its own accord, and continues till the formation of wine be completed.[‡] Scheele had obſerved, that milk was capable of fermenting, and that a great quantity of carbonic acid gas was extricated from it during this fermentation.[||] But he did not ſuſpect, that the reſult of this fermentation was the formation of an intoxicating liquor ſimilar to wine.

When milk is diſtilled by the heat of a water bath, there comes over water, having the peculiar odour of milk; which putrefies, and conſequently contains, beſides mere water, ſome of the other conſtituent parts of milk. After ſome time, the milk coagulates,[¶] as always happens when hot albumen acquires a certain degree of concentration. There remains behind a thick unctuous yellowiſh white ſubſtance, to which Hoffman gave the name of *franchiſann*. This ſubſtance, when the fire is increaſed, yields at firſt a tranſparent liquid, which becomes gradually more coloured; ſome very fluid oil comes over, then ammonia, an acid, and at laſt a very thick black oil. Towards the end of the proceſs carbonated hydrogen gas is diſengaged.[*] There remains in the retort a coal which contains carbonat of potaſs, muriat of potaſs, and phoſphat of lime, and ſometimes magneſia, iron, and muriat of ſoda.[†]

278 Its comp nent par

Thus we ſee, that cows milk is compoſed of the following ingredients.

1. Water,
2. Oil,
3. Albumen,
4. Gelatine,
5. Sugar of milk,
6. Muriat of lime,
7. Muriat of potaſs,
8. Sulphur.

The milk of all other animals, as far as it has hitherto been examined, conſiſts nearly of the ſame ingredients; but there is a very great difference in their proportion.

279 Woman milk.

WOMAN'S MILK has a much ſweeter taſte than cows milk. When allowed to remain at reſt for a ſufficient time, a cream gathers on its ſurface. This cream is more abundant than in cows milk, and its colour is uſually much whiter. After it is ſeparated, the milk is exceedingly thin, and has the appearance rather of whey, with a bluiſh white colour, than of creamed milk. None of the methods by which cows milk is coagulated ſucceed in producing the coagulation of woman's milk.[*] It is certain, however, that it contains curd; for if it be boiled, pellicles form on its ſurface, which have all the properties of curd.[†] Its not coagulating, therefore, muſt be attributed to the great quantity of water with which the curd is diluted.

Though the cream be churned ever ſo long, no butter can be obtained from it; but if, after being agitated for ſome hours, it be allowed to remain at reſt for a day or two, it ſeparates into two parts; a fluid which occupies the inferior part of the veſſel, pellucid, and colourleſs, like water, and a thick white unctuous fluid, which ſwims on the ſurface. The lowermoſt fluid contains ſugar of milk and ſome curd; the uppermoſt does not differ from cream except in conſiſtence. The oily part of the cream, then, cannot be ſeparated by agitation from the curd.[‡] This cream contains a greater portion of curd than the cream of cows milk.[*]

When this milk, after the curd is ſeparated from it, is ſlowly evaporated, it yields cryſtals of ſugar of milk, and of muriat of ſoda. The quantity of ſugar is rather greater than in cow's milk. According to Haller, the ſugar obtained from cow's milk is to that obtained from an equal quantity of woman's milk as 35 : 58, and ſometimes as 37 : 67, and in all the intermediate ratios.

280 Its pecu liarities.

Thus it appears, that woman's milk differs from that of cows in three particulars.

1. It contains a much ſmaller quantity of curd.
2. Its oil is ſo intimately combined with its curd, that it does not yield butter.
3. It contains rather more ſugar of milk.

Parmentier and Deyeux aſcertained, that the quantity of curd in woman's milk increaſes in proportion to the time after delivery.[||] Nearly the ſame thing has been obſerved with reſpect to cow's milk.

281 Aſſes m

ASSES MILK has a very ſtrong reſemblance to human milk: it has nearly the ſame colour, ſmell, and conſiſtence. When left at reſt for a ſufficient time, a cream forms upon its ſurface, but by no means in ſuch abundance as in woman's milk. This cream, by very long agitation, yields a butter, which is always ſoft, white, and taſteleſs; and, what is ſingular, very readily mixes again with the butter milk; but it may be again ſeparated

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[*] Parmentier, p. 417.

[†] Scheele, ii. 61.

[‡] Rouelle.

[*] Parmentier, ibid. p. 343.

[†] Scheele, ii. 68.

[‡] Parmentier, ibid. p. 365.

[||] Scheele, ii. 66.

[¶] Bouquet.

[*] Parme tier, ibid. 368.

[†] Mem. Med. P 1787, p 607.

[*] Clarke Iriſh. Tr ii. 175.

[†] Parme tier, ibid 419.

[‡] Ibid.

[*] Ibid.

[||] Ibid. 420.

rated by agitation, while the veſſel, which contains it, is plunged in cold water. Creamed aſſes milk is thin, and has an agreeable ſweetiſh taſte. Alcohol and acids ſeparate from it a little curd, which has but a ſmall degree of conſiſtence. The ſerum yields ſugar of milk and muriat of lime.*

*Parmen-
, p. 423.

282
pecu-
rities.

Aſſes milk therefore differs from cows milk in three particulars.

1. Its cream is leſs abundant and more inſipid.
2. It contains leſs curd.
3. It contains more ſugar of milk: the proportion is 35 : 80.

283
ats milk.

GOATS MILK, if we except its conſiſtence, which is greater, does not differ much from cows milk. Like that milk, it throws up abundance of cream, from which butter is eaſily obtained. The creamed milk coagulates juſt as cows milk, and yields a greater quantity of curd. Its whey contains ſugar of milk, muriat of lime, and muriat of ſoda.†

bid. p.
5.

284
es milk.

EWES MILK reſembles almoſt preciſely that of the cow. Its cream is rather more abundant, and yields a butter which never acquires the conſiſtence of butter from cows milk. Its curd has a fat and viſcid appearance, and is not without difficulty made to aſſume the conſiſtence of the curd of cows milk. It makes excellent cheeſe.‡

bid. p.
8.

285
ares
lk.

MARES MILK is thinner than that of the cow, but ſcarcely ſo thin as human milk. Its cream cannot be converted into butter by agitation. The creamed milk coagulates preciſely as cows milk, but the curd is not ſo abundant. The ſerum contains ſugar of milk, ſulphat of lime, and muriat of lime.‖

bid. p.
t.

SECT. IX. *Of SALIVA.*

THE fluid ſecreted in the mouth, which flows in conſiderable quantity during a repaſt, is known by the name of *ſaliva*. No accurate analyſis has hitherto been made of it, though it poſſeſſes ſome very ſingular properties.

286
operties
ſaliva.

It is a limpid fluid like water, but much more viſcid: it has neither ſmell nor taſte.

Its ſpecific gravity, according to Hamberger, is 1.0167.* When agitated, it froths like all other adheſive liquids; indeed it is uſually mixed with air, and has the appearance of froth.

It neither mixes readily with water nor oil;† but by trituration in a mortar, it may be mixed ſo with water as to paſs through a filter.‡ It has a great affinity for oxygen, abſorbs it readily from the air, and gives it out again to other bodies.§ Hence the reaſon why gold or ſilver, triturated with ſaliva in a mortar, is oxydated, as Dutenner has obſerved; and why the killing of mercury by oils is much facilitated by ſpitting into the mixture.¶ Hence alſo, in all probability, the reaſon that ſaliva is a uſeful application to ſores of the ſkin. Dogs, and ſeveral other animals, have conſtantly recourſe to this remedy, and with much advantage.

Saliva is coagulated by oxy-muriat of mercury, by alcohol, and by nitre.* Therefore, in all probability, it contains albumen and gelatine, or ſome analogous ſubſtances.

When 100 parts of ſaliva are diſtilled, there come over 80 parts of water nearly pure, then a little carbonat of ammonia, ſome oil, and an acid, which perhaps is the pruſſic. The reſiduum amounts to about 1.56 parts, and is compoſed of muriat of ſoda and phoſphat of lime.†

*Haller's
yſ. vi.

†*Varceſſus,*
ller, ibid.
54.

‡*ordyce on*
eſt. p.

§*Fourcroy,*
n. de
m.
iii. 262.

¶*Ibid.*

**Haller's*
yſ. vi.

287
Tartar of
the teeth.

The *tartar* of the teeth, which is a cruſt depoſited from ſaliva, conſiſts, as Fourcroy has aſcertained, of phoſphat of lime.

288
Pancreatic
juice.

The PANCREATIC JUICE has never been examined with much attention; but it does not appear, from the experiments that have been made, to differ much from ſaliva.

† *Verheyen,*
Textor,
Nuck, &c.
as quoted
by Haller,
Phyſiol. vi.
55.

SECT. X. *Of BILE.*

BILE is a liquid of a yellowiſh green colour, an unctuous feel, and bitter taſte, is ſecreted by the liver; and in moſt animals conſiderable quantities of it are uſually found collected in the gall bladder.

Great attention has been paid to this liquid by phyſicians; becauſe the ancients were accuſtomed to aſcribe a very great number of diſeaſes, and even affections of the mind, to its agency. The moſt accurate chemical analyſis of it which has hitherto appeared is that of Mr Cadet, which was publiſhed in the Memoirs of the French Academy of Sciences for the year 1767. Several important obſervations had been previouſly made on it by Boyle, Boerhaave, Verheyen, Ramſay, and Baglivi; and ſome facts have ſince been added to our chemical knowledge of bile by Maclurg and Fourcroy. The experiments have chiefly been confined to the bile of oxen, known in this country by the name of *gall*; becauſe it is moſt eaſily procured in large quantities.

289
Properties
of bile.

The ſpecific gravity of bile ſeems to vary, like that of all other animal fluids. According to Hartmann, it is 1.027.* When ſtrongly agitated, it lathers like ſoap; and for this reaſon, as well as from a medical theory concerning its uſe, it has been often called an *animal ſoap*.

* *Haller's*
Phyſ. vi.
546.

It mixes readily with water in any proportion, and aſſumes a yellow colour: but it refuſes to unite with oil when the two fluids are agitated together; the inſtant that they are left at reſt, the oil ſeparates and ſwims on the ſurface.†

† *Ramſay,*
Theſaur.
Med. Edin.
ii. 459.

When muriatic acid is poured upon bile, let it be ever ſo freſh, an odour of ſulphurated hydrogen gas is conſtantly exhaled.‡ When on 100 parts of ox bile four parts of ſtrong muriatic acid are poured, the whole inſtantly coagulates; but in ſome hours the greater part becomes again fluid; and when paſſed through the filter it leaves 0.26 of a white matter, which has all the properties of albumen.§ This matter was detected by Ramſay; who found that it could be precipitated from bile by alcohol, acetous acid, ſulphat of potaſs, and muriat of ſoda.* Cadet aſcertained, that 100 parts of ox bile contain about 0.52 of albumen. It is precipitated in a ſtate of purity by oxy-muriatic acid, provided that acid be not employed in exceſs.†

Maclurg,
p. 10.

290
Its component parts.

‡ *Cadet,*
Mem. Par.
1767, p.
340.

§ *Ibid.*

* *Theſaur.*
Edin. ii.
460.

† *Fourcroy,*
Ann. de
Chim. vii.
176.

The muriatic acid ſolution, after the ſeparation of the albumen, has a fine graſs-green colour. When concentrated by ſome hours evaporation in a glaſs cucurbit on hot coals, it depoſites a very copious precipitate, and loſes almoſt the whole of its green colour. By longer evaporation, a new precipitate, ſimilar to the firſt, appears, and the remaining liquid aſſumes the colour of beer. This precipitate poſſeſſes all the properties of the *reſin of bile*. In its moiſt ſtate it amounts to 10.8 parts.‡ The ſame ſubſtances may be obtained from bile by nitric acid; but the reſin in that

‡ *Cadet, ibid.*

Bile, Biliary Calculi.

caſe has a yellow colour, and its properties are ſomewhat altered.*

If 100 parts of bile be gently evaporated to dryneſs by a very moderate heat, the dry maſs only weighs 10 parts, and has a browniſh black colour. When expoſed to a ſtrong heat in a crucible, this matter ſwells up, takes fire, and emits very thick fumes. The reſiduum amounts to 1.09. By lixiviation with water, 1.87 of cryſtallized ſoda may be obtained;† conſequently 100 parts of bile contain, according to Mr Kirwan's table, 0.403546 of pure ſoda. But it is evident that, by this method, part of the ſoda muſt have been evaporated; therefore 100 parts of bile contain more than 0.403546 of ſoda. Beſides the ſoda, there is found alſo a ſmall portion of muriat of ſoda.‡

Cadet found the reſiduum, after the ſeparation of the ſalts, of a black colour: it gave ſome traces of iron. He alſo obtained a calcareous ſalt from bile, which he conſidered as a ſulphat; but it is more than probable that it was phoſphat of lime.

Cadet alſo obtained from bile, by evaporating the muriatic acid ſolution after the ſeparation of the reſin, a ſalt which cryſtallized in trapeziums; it had a ſweetiſh taſte, and was conſidered by him as analogous to ſugar of milk.*

Thus we ſee that bile contains the following ingredients:

1. Water,	5. A ſweetiſh ſalt,
2. Reſin,	6. Muriat of ſoda,
3. Albumen,	7. Phoſphat of lime,
4. Soda,	8. Iron.

The proportion of theſe ingredients has by no means been aſcertained. The preſence of iron has been denied in bile, becauſe it gives no blue precipitate with pruſſic alkali, and becauſe tincture of nut-galls does not give it a black colour.† But theſe reaſons are inſufficient to overturn the experiment of Cadet, who actually found it in bile.

When four parts of vinegar and five of bile are mixed together, the mixture has a ſweet taſte, and does not coagulate milk. The lactic acid has preciſely the ſame effect as vinegar.‡

When bile is diſtilled in a water bath, it affords a tranſparent watery liquor, which contracts a pretty ſtrong odour, not unlike that of muſk or amber, eſpecially if the bile has been kept for ſome days before it is ſubmitted to diſtillation.§ The reſiduum is of a deep browniſh green; it attracts moiſture from the air, and diſſolves readily in water. When diſtilled in a retort, it affords a watery liquor of a yellowiſh colour, and impregnated with alkali, oil, carbonat of ammonia, carbonic acid, and hydrogen gas. The coaly reſiduum is eaſily incinerated.* Bile, expoſed to a temperature between 65° and 85°, ſoon loſes its colour and viſcidity, acquires a nauſeous ſmell, and depoſites whitiſh mucilaginous flakes. After the putrefaction has made conſiderable progreſs, its ſmell becomes ſweet, and reſembles amber.† If bile be heated, and ſlightly concentrated by evaporation, it may be kept for many months without alteration.‡

SECT. XI. *Of Biliary Calculi.*

Biliary Ca culi.

HARD bodies ſometimes form in the gall bladder, or in the duct through which the bile paſſes into the inteſtinal canal, and ſtop up the paſſage altogether. Theſe concretions have got the name of *biliary calculi* or *gall-ſtones*. As they are found in the midſt of bile, and as the ſubſtances of which they are compoſed muſt be derived from the bile, it is proper to give an account of them here, becauſe their properties cannot fail to throw ſome additional light on the nature of bile itſelf.

291 Biliary ca culi of three kind

Biliary calculi, all of them at leaſt which have been hitherto examined with attention, may be divided into three claſſes.

1. The firſt kind comprehends thoſe which have a white colour, and a cryſtallized, ſhining, lamellated ſtructure.

2. The ſecond is dark coloured, and has preciſely the appearance of inſpiſſated bile. Both theſe kinds are combuſtible.

3. The third kind comprehends thoſe gall ſtones which do not flame, but gradually waſte away at a red heat.

We ſhall take a view of each of theſe kinds of biliary calculi in their order. For the greater part of the chemical knowledge which has been hitherto acquired of them, the world is chiefly indebted to Mr Fourcroy.

292 Propertie of the fir

1. The firſt ſpecies of biliary calculi was pointed out for the firſt time by Halier, in a diſſertation publiſhed in 1749. Walther afterwards added ſeveral new facts; and at laſt it was accurately deſcribed by Vicq d'Azyr.* It is almoſt always of an oval ſhape, ſometimes as large as a pigeon's egg, but commonly about the ſize of a ſparrow's; and for the moſt part only one calculus (when of this ſpecies) is found in the gall bladder at a time. It has a white colour; and when broken, preſents cryſtalline plates or ſtriæ, brilliant and white like mica, and having a ſoft greaſy feel. Sometimes its colour is yellow or greeniſh; and it has conſtantly a nucleus of inſpiſſated bile.†

Its ſpecific gravity is lower than that of water: Gren found the ſpecific gravity of one 0.803.‡

When expoſed to a heat conſiderably greater than that of boiling water, this cryſtallized calculus ſoftens and melts, and cryſtallizes again when the temperature is lowered.§ It is altogether inſoluble in water; but hot alcohol diſſolves it with facility. Alcohol, of the temperature of 167°, diſſolves $\frac{1}{12}$ of its weight of this ſubſtance; but alcohol, at the temperature of 60°, ſcarcely diſſolves any of it.* As the alcohol cools, the matter is depoſited in brilliant plates reſembling talc or boracic acid.† It is ſoluble in oil of turpentine.‡ When melted, it has the appearance of oil, and exhales the odour of melted wax: when ſuddenly heated, it evaporates altogether in a thick ſmoke. It is ſoluble in pure alkalies, and the ſolution has all the properties of a ſoap. Nitric acid alſo diſſolves it; but it is precipitated unaltered by water.‡

This matter, which is evidently the ſame with the cryſtals which Cadet obtained from bile, and which he conſidered as analogous to ſugar of milk, has a ſtrong reſemblance to ſpermaceti. Like that ſubſtance, it is of an oily nature, and inflammable; but it differs from it in a variety of particulars.

Since it is contained in bile, it is not difficult to ſee how it may cryſtallize in the gall bladder if it happens to be more abundant than uſual; and the conſequence muſt

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* *Cadet, Ibid.* p. 343.

† *Ibid.* p. 350.

‡ *Ibid.*

* *Ibid.* p. 342.

† *Maclurg*, p. 56.

‡ *Ramſay, ibid.* p. 462.

§ *Fourcroy*, iii. 272.

* *Ibid.*

† *Ibid.*

‡ *Vauquelin.*

† *Fourcr Ann. de Chim.* iii 249.

‡ *Ann. de Chim.* v. 186.

§ *Fourcr ibid.* ii. 1

* *Ibid.* p. 180.

† *Ibid.* ii 256.

‡ *Gren, ibid.* v. 1

‡ *Fourcro ibid.* iii. 247.

muſt be a gall ſtone of this ſpecies. Fourcroy found a quantity of the ſame ſubſtance in the dried human liver.*

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2. The ſecond ſpecies of biliary calculus is of a round or polygonal ſhape, of a grey colour exteriorly, and brown within. It is formed of concentric layers of a matter which ſeems to be inſpiſſated bile; and there is uſually a nucleus of the white cryſtalline matter at the centre. For the moſt part there are many of this ſpecies of calculus in the gall-bladder together: indeed it is frequently filled with them. Their ſize is uſually much ſmaller than that of the laſt ſpecies.

This is the moſt common kind of gall ſtone. It may be conſidered as a mixture of inſpiſſated bile, and of the cryſtalline matter which forms the firſt ſpecies: and the appearance of calculi of this kind muſt vary conſiderably, according to the proportion of theſe ingredients.

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3. Concerning the third ſpecies of gall-ſtone, very little is known with accuracy. Dr Saunders tells us, that he has met with ſome gall-ſtones inſoluble both in alcohol and oil of turpentine; ſome which do not flame, but become red, and conſume to an aſh like a charcoal.† Haller quotes ſeveral examples of ſimilar calculi.‡

Gall-ſtones often occur in the inferior animals, particularly in cows and hogs; but the biliary concretions of theſe animals have not hitherto been examined with attention.

SECT. XII. *Of Tears.*

THAT peculiar fluid which is employed in lubricating the eye, and which is emitted in conſiderable quantities when we expreſs grief by weeping, is known by the name of *tears*. For an accurate analyſis of this fluid chemiſtry is indebted to Meſſrs Fourcroy and Vauquelin. Before their diſſertation, which was publiſhed in 1791, appeared, ſcarcely any thing was known about the nature of tears.

295
perties
ears.

The liquid called tears is tranſparent and colourleſs like water; it has ſcarcely any ſmell, but its taſte is always perceptibly ſalt. Its ſpecific gravity is ſomewhat greater than that of diſtilled water. It gives to paper, ſtained with the juice of the petals of mallows or violet, a permanently green colour, and therefore contains a fixed alkali.* It unites with water, whether cold or hot, in all proportions. Alkalies unite with it readily, and render it more fluid. The mineral acids produce no apparent change upon it.† Expoſed to the air, this liquid gradually evaporates, and becomes thicker. When nearly reduced to a ſtate of dryneſs, a number of cubic cryſtals form in the midſt of a kind of mucilage. Theſe cryſtals poſſeſs the properties of muriat of ſoda; only they tinge vegetable blues green, and therefore contain an exceſs of ſoda. The mucilaginous matter acquires a yellowiſh colour as it dries.‡

This liquid boils like water, excepting that a conſiderable froth collects on its ſurface. If it be kept a ſufficient time at the boiling temperature, $\frac{96}{100}$ parts of it evaporate in water; and there remain about .04 parts of a yellowiſh matter, which by diſtillation in a ſtrong heat yield water and a little oil: the reſiduum conſiſts of different ſaline matters.§

When alcohol is poured into this liquid, a mucilaginous matter is precipitated in the form of large white flakes. The alcohol leaves behind it when evaporated, traces of muriat of ſoda and ſoda. The reſiduum which remains behind, when inſpiſſated tears are burnt in the open air, exhibit ſome traces of phoſphat of lime and phoſphat of ſoda.‖

296
Component
parts.

Thus it appears that tears are compoſed of the following ingredients:

1. Water,
2. Mucilage,
3. Muriat of ſoda,
4. Soda,
5. Phoſphat of lime,
6. Phoſphat of ſoda.

The ſaline parts amount only to about 0.01 of the whole, or probably not ſo much.

The *mucilage* contained in the tears has the property of abſorbing oxygen gradually from the atmoſphere, and of becoming thick and viſcid, and of a yellow colour. It is then inſoluble in water, and remains long ſuſpended in it without alteration. When a ſufficient quantity of oxy-muriatic acid is poured into tears, a yellow flaky precipitate appears abſolutely ſimilar to this inſpiſſated mucilage. The oxy-muriatic acid loſes its peculiar odour; hence it is evident that it has given out oxygen to the mucilage. The property which this mucilage has of abſorbing oxygen, and of acquiring new qualities, explains the changes which take place in tears which are expoſed for a long time to the action of the atmoſphere, as is the caſe in thoſe perſons who labour under a fiſtula lachrymalis.*

297
Mucus of
the noſe.

The MUCUS of the noſe has alſo been examined by Fourcroy and Vauquelin. They found it compoſed of preciſely the ſame ingredients with the tears. As this fluid is more expoſed to the action of the air than the tears, in moſt caſes its mucilage has undergone leſs or more of that change which is the conſequence of the abſorption of oxygen. Hence the reaſon of the greater viſcidity and conſiſtence of the mucus of the noſe: hence alſo the great conſiſtence which it acquires during colds, where the action of the atmoſphere is aſſiſted by the increaſed action of the parts.†

SECT. XIII. *Of Sinovia.*

WITHIN the capſular ligament of the different joints of the body, there is contained a peculiar liquid, intended evidently to lubricate the parts, and to facilitate their motion. This liquid is known among anatomiſts by the name of *ſinovia*.

Whether it be the ſame in different animals, or even in all the different joints of the ſame animal, has not been determined; as no accurate analyſis of the ſinovia of different animals has been attempted. The only analyſis of ſinovia which has hitherto appeared is that by Mr Margueron, which was publiſhed in the 14th volume of the *Annales de Chimie*. He made uſe of ſinovia obtained from the joints of the lower extremities of oxen.

298
Sinovia of
the ox.

The ſinovia of the ox, when it has juſt flowed from the joint, is a viſcid ſemi-tranſparent fluid, of a greeniſh white colour, and a ſmell not unlike frog ſpawn. It very ſoon acquires the conſiſtence of jelly; and this happens equally whether it be kept in a cold or a hot temperature, whether it be expoſed to the air or excluded from it. This conſiſtence does not continue long; the ſinovia ſoon recovers again its fluidity, and at the ſame time depoſites a thready-like matter.*

299
Its proper-
ties.

Sinovia mixes readily with water, and imparts to that liquid a great deal of viſcidity. The mixture frothes when agitated; becomes milky when boiled, and

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urcroy,
p. 126.

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67.

urcroy
Vau-
n, Jour.
'hyſ.
x. 256.
id. p.

id. p.

id.

‖ Fourcroy and Vauquelin, Jour. de Phyſ. p. 259.

* Ibid. p. 257.

† Ibid. p. 259.

* Margueron, Ann. de Chim. xiv. 124.

and depoſites ſome pellicles on the ſides of the diſh; but its viſcidity is not diminiſhed.†

300
Its component parts.

When alcohol is poured into ſinovia, a white ſubſtance precipitates, which has all the properties of albumen. One hundred parts of ſinovia contain 4.52 of albumen. The liquid ſtill continues as viſcid as ever; but if acetous acid be poured into it, the viſcidity diſappears altogether, the liquid becomes tranſparent, and depoſites a quantity of matter in white threads, which poſſeſſes the following properties:

1. It has the colour, ſmell, taſte, and elaſticity of vegetable gluten.

2. It is ſoluble in concentrated acids and pure alkalies.

3. It is ſoluble in cold water, the ſolution froths; acids and alcohol precipitate the fibrous matter in flakes. One hundred parts of ſinovia contain 11.86 of this matter.‡

When the liquid, after theſe ſubſtances have been ſeparated from it, is concentrated by evaporation, it depoſites cryſtals of acetite of ſoda. Sinovia, therefore, contains *ſoda*. Margueron found that 100 parts of ſinovia contained about 0.71 of ſoda.

When ſtrong ſulphuric, muriatic, nitric, acetic, or ſulphurous acid is poured into ſinovia, a number of white flakes precipitate at firſt, but they are ſoon rediſſolved, and the viſcidity of the liquid continues. When theſe acids are diluted with five times their weight of water, they diminiſh the tranſparency of ſinovia, but not its viſcidity; but when they are ſo much diluted that their acid taſte is juſt perceptible, they precipitate the peculiar thready matter, and the viſcidity of the ſinovia diſappears.§

When ſinovia is expoſed to a dry atmoſphere it gradually evaporates, and a ſcaly reſiduum remains, in which cubic cryſtals, and a white ſaline efflorecence, are apparent. The cubic cryſtals are muriat of ſoda. One hundred parts of ſinovia contain about 1.75 of this ſalt. The ſaline efflorefcence is carbonat of ſoda.‖

Sinovia ſoon putrefies in a moiſt atmoſphere, and during the putrefaction ammonia is exhaled. When ſinovia is diſtilled in a retort there comes over, firſt water, which ſoon putrefies; then water containing ammonia; then empyreumatic oil and carbonat of ammonia. From the reſiduum muriat and carbonat of ſoda may be extracted by lixiviation. The coal contains ſome phoſphat of lime.¶

From the analyſis of Mr Margueron it appears that ſinovia is compoſed of the following ingredients:

11.86	fibrous matter,
4.52	albumen,
1.75	muriat of ſoda,
.71	ſoda,
.70	phoſphat of lime (N),
80.57	water,
100.00.	

SECT. XIV. *Of Semen.*

The peculiar liquid ſecreted in the teſtes of males, and deſtined for the impregnation of females, is known by the name of *ſemen*. The human ſemen alone has hitherto been ſubjected to chemical analyſis. Nothing is known concerning the ſeminal fluid of other animals. Vauquelin publiſhed an analyſis of the human ſemen in 1791.

301
Properti
of ſemen

Semen, when newly ejected, is evidently a mixture of two different ſubſtances: the one, fluid and milky, which is ſuppoſed to be ſecreted by the proſtate gland; the other, which is conſidered as the true ſecretion of the teſtes, is a thick mucilaginous ſubſtance, in which numerous white ſhining filaments may be diſcovered.* It has a ſlight diſagreeable odour, an acrid irritating taſte, and its ſpecific gravity is greater than that of water. When rubbed in a mortar it becomes frothy, and of the conſiſtence of pomatum, in conſequence of its enveloping a great number of air bubbles. It converts paper ſtained with the bloſſoms of mallows or violets to a green colour, and conſequently contains an alkali.†

As the liquid cools, the mucilaginous part becomes tranſparent, and acquires greater conſiſtency; but in about twenty minutes after its emiſſion, the whole becomes perfectly liquid. This liquefaction is not owing to the abſorption of moiſture from the air, for it loſes inſtead of acquiring weight during its expoſure to the atmoſphere; nor is it owing to the action of the air, for it takes place equally in cloſe veſſels.‡

Semen is inſoluble in water before this ſpontaneous liquefaction, but afterwards it diſſolves readily in it. When alcohol or oxy-muriatic acid is poured into this ſolution, a number of white flakes are precipitated.§ Concentrated alkalies facilitate its combination with water. Acids readily diſſolve the ſemen, and the ſolution is not decompoſed by alkalies; neither indeed is the alkaline ſolution decompoſed by acids.‖

Lime diſengages no ammonia from freſh ſemen; but after that fluid has remained for ſome time in a moiſt and warm atmoſphere, lime ſeparates a great quantity from it. Conſequently ammonia is formed during the expoſure of ſemen to air.¶

302
Its comp
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When oxy-muriatic acid is poured into ſemen, a number of white flakes precipitate, and the acid loſes its peculiar odour. Theſe flakes are inſoluble in water, and even in acids. If the quantity of acid be ſufficient, the ſemen acquires a yellow colour. Thus it appears that ſemen contains a mucilaginous ſubſtance, analogous to that of the tears, which coagulates by abſorbing oxygen. Mr Vauquelin obtained from 100 parts of ſemen ſix parts of this mucilage.

When ſemen is expoſed to the air about the temperature of 60°, it becomes gradually covered with a tranſparent pellicle, and in three or four days depoſites ſmall tranſparent cryſtals, often croſſing each other in ſuch a manner as to repreſent the ſpokes of a wheel. Theſe cryſtals, when viewed through a microſcope, appear to be four-ſided priſms, terminated by very long four-ſided pyramids. They may be ſeparated by diluting the liquid with water, and decanting it off. They have all the properties of phoſphat of lime.* If, after the appearance of theſe cryſtals, the ſemen be ſtill allowed to remain expoſed to the atmoſphere, the pellicle on

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† Margueron, Ann. de Chim. xiv. 126.

‡ Ibid. p. 126—130.

§ Ibid. p. 127.

‖ Ibid. 125.

¶ Ibid. 128.

* Vauquelin, A de Chim. 64.

† Ibid. p 65.

‡ Ibid. p. 66.

§ Ibid. p 70.

‖ Ibid. p 71.

¶ Ibid. p 71.

* Ibid. p 67 and

(N) Mr Hatchett found only 0.208 of phoſphat of lime in the ſinovia which he examined. He found, however, traces of ſome other phoſphat; probably phoſphat of ſoda. *Phil. Tranſ.* 1799, p. 246.

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Am-
ios.

on its ſurface gradually thickens, and a number of white round bodies appear on different parts of it. Theſe bodies alſo are phoſphat of lime, prevented from cryſtallizing regularly by the too rapid abſtraction of moiſture. Mr Vauquelin found that 100 parts of ſemen contain three parts of phoſphat of lime.† If at this period of the evaporation the air becomes moiſt, other cryſtals appear in the ſemen, which have the properties of carbonat of ſoda. The evaporation does not go on to complete exſiccation, unleſs at the temperature of 77°, and when the air is very dry. When all the moiſture is evaporated, the ſemen has loſt 0.9 of its weight, the reſiduum is ſemi-tranſparent like horn, and brittle.‡

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, Ann.
im. p.

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When ſemen is kept in very moiſt air, at the temperature of about 77°, it acquires a yellow colour, like that of the yolk of an egg; its taſte becomes acid, it exhales the odour of putrid fiſh, and its ſurface is covered with abundance of the byſſus ſeptica.§

d.

When dried ſemen is expoſed to heat in a crucible, it melts, acquires a brown colour, and exhales a yellow fume, having the odour of burnt horn. When the heat is raiſed, the matter ſwells, becomes black, and gives out a ſtrong odour of ammonia. When the odour of ammonia diſappears, if the matter be lixiviated with water, an alkaline ſolution may be obtained, which, by evaporation, yields cryſtals of carbonat of ſoda. Mr Vauquelin found that 100 parts of ſemen contain one part of ſoda.¶ If the reſiduum be incinerated, there will remain only a quantity of white aſhes, conſiſting of phoſphat of lime.

id. p.

Thus it appears that ſemen is compoſed of the following ingredients:

90 water,
6 mucilage,
3 phoſphat of lime,
1 ſoda,

100

SECT. XV. *Liquor of the Amnios.*

THE fœtus in the uterus is enveloped in a peculiar membranous covering, to which anatomiſts have given the name of *amnios*. Within this amnios there is a liquid, diſtinguiſhed by the name of the *liquor of the amnios*, which ſurrounds the fœtus on every part. This liquid, as might have been expected, is very different in different animals, at leaſt the liquor amnii in women and in cows, which alone have hitherto been analyſed, have not the ſmalleſt reſemblance to each other. Theſe two liquids have been lately analyſed by Vauquelin and Buniva, and the reſult of their analyſis has been publiſhed in the 33d volume of the *Annales de Chimie*.

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1. The liquor of the amnios of women is a fluid of a ſlightly milky colour, a weak but pleaſant odour, and a ſaltiſh taſte. The white colour is owing to a curdy matter ſuſpended in it, for it may be obtained quite tranſparent by filtration.*

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xxxiii.

Its ſpecific gravity is 1.005. It gives a green colour to the tincture of violets, and yet it reddens very decidedly the tincture of turnſol. Theſe two properties would indicate at once the preſence of an acid and of an alkali. It froths conſiderably when agitated. On the application of heat it becomes opaque, and has then a great reſemblance to milk diluted with a large quantity of water. At the ſame time it exhales the odour of boiled white of egg.†

Liquor of the Amnios.

Acids render it more tranſparent. Alkalies precipitate an animal matter in ſmall flakes. Alcohol likewiſe produces a flaky precipitate, which, when collected and dried, becomes tranſparent, and very like glue. The infuſion of nut-galls produces a very copious brown coloured precipitate. Nitrat of ſilver occaſions a white precipitate, which is inſoluble in nitric acid, and conſequently is muriat of ſilver.†

† *Ann. de Chim.* xxxiii. 271.

† *Ibid.*

When ſlowly evaporated it becomes ſlightly milky, a tranſparent pellicle forms on its ſurface, and it leaves a reſiduum which does not exceed 0.012 of the whole. By lixiviating this reſiduum, and evaporating the ley, cryſtals of muriat and carbonat of ſoda, may be obtained. The remainder, when incinerated, exhales a fetid and ammoniacal odour, reſembling that of burning horn; the aſhes conſiſt of a ſmall quantity of carbonat of ſoda, and of phoſphat and carbonat of lime.‡

‡ *Ibid*, p. 272.

Thus we ſee that the liquor of the human amnios is compoſed of about

$$\begin{array}{ll} 98.8 & \text{water,} \\ 1.2 & \left\{\begin{array}{l}\text{albumen,} \\ \text{muriat of ſoda, ſoda,} \\ \text{phoſphat of lime, lime,}\end{array}\right. \\ \hline 100.0 & \end{array}$$

304
Curdy matter depoſited on the fœtus.

While the fœtus is in the uterus, a curdy-like matter is depoſited on the ſurface of its ſkin, and in particular parts of its body. This matter is often found collected in conſiderable quantities. It is evidently depoſited from the liquor of the amnios; and conſequently the knowledge of its peculiar nature muſt throw conſiderable light upon the properties and uſe of that liquor. For an analyſis of this ſubſtance we are alſo indebted to Vauquelin and Buniva.

Its colour is white and brilliant: it has a ſoft feel, and very much reſembles newly prepared ſoap. It is inſoluble in water, alcohol, and oils. Pure alkalies diſſolve part of it, and form with it a kind of ſoap. On burning coals it decrepitates like a ſalt, becomes dry and black, exhales vapours which have the odour of empyreumatic oil, and leaves a reſiduum which is very difficultly reduced to aſhes. When heated in a platinum crucible it decrepitates, lets an oil exſude, curls up like horn, and leaves a reſiduum, conſiſting chiefly of carbonat of lime.‡

‡ *Ibid*, p. 274.

Theſe properties ſhew that this matter is different from every one of the component parts of the liquor of the amnios, and that it has a great reſemblance to the *fat*. It is probable, as Vauquelin and Buniva have conjectured, that it is formed from the albumen of that liquid, which has undergone ſome unknown changes. It has been long known, that the parts of a fœtus which has lain for ſome time after it has been deprived of life in the uterus, are ſometimes converted into a kind of fatty matter. It is evident that this ſubſtance, after it is depoſited upon the ſkin of the fœtus, muſt preſerve it in a great meaſure from being acted upon by the liquor of the amnios.

305
Liquor of the amnios of the cow.

2. The liquor of the amnios of the cow has a viſcidity ſimilar to mucilage of gum arabic, a browniſh red colour, an acid and bitter taſte, and a peculiar odour, not unlike that of ſome vegetable extracts. Its ſpecific gravity is 1.028. It reddens the tincture of turnſol, and

Liquor of the Amnios.

and therefore contains an acid. Muriat of barytes cauſes a very abundant precipitate, which renders it probable that it contains ſulphuric acid. Alcohol ſeparates from it a great quantity of a reddiſh coloured matter.§

§ *Ann. de Chim.* xxxiii. p. 275.

306
Its component parts.

When this liquid is evaporated, a thick frothy ſcum gathers on the ſurface, which is eaſily ſeparated, and in which ſome white acid-taſted cryſtals may be diſcovered. By continuing the evaporation, the matter becomes thick, and viſcid, and has very much the look of honey. Alcohol boiled upon this thick matter, and filtered off, depoſites upon cooling brilliant needle-formed cryſtals nearly an inch in length. Theſe cryſtals may be obtained in abundance by evaporating the liquor of the amnios to a fourth part of its bulk, and then allowing it to cool. The cryſtals ſoon make their appearance. They may be ſeparated and purified by waſhing them in a ſmall quantity of cold water. Theſe cryſtals have the properties of an acid.§

§ *Ibid*, p. 276.

If after the ſeparation of this acid the liquor of the amnios be evaporated to the conſiſtence of a ſyrup, large tranſparent cryſtals appear in it, which have all the properties of ſulphat of ſoda. The liquid of the amnios of cows contains a conſiderable quantity of this ſalt.

Thus it appears that the liquor of the amnios of cows contains the following ingredients:

1. Water,
2. A peculiar animal matter,
3. A peculiar acid,
4. Sulphat of ſoda.

307
Nature of the animal matter.

The animal matter poſſeſſes the following properties: It has a reddiſh brown colour, and a peculiar taſte; it is very ſoluble in water, but inſoluble in alcohol, which has the property of ſeparating it from water. When expoſed to a ſtrong heat it ſwells, exhales firſt the odour of burning gum, then of empyreumatic oil and of ammonia, and at laſt the peculiar odour of pruſſic acid becomes very conſpicuous. It differs from gelatine in the viſcidity which it communicates to water, in not forming a jelly when concentrated, and in not being precipitated by tan. It muſt be therefore ranked among the very undefined and inaccurate claſs of *animal mucilages*.

When burnt, it leaves a very large coal, which is readily incinerated, and leaves a little white aſhes, compoſed of phoſphat of magneſia, and a very ſmall proportion of phoſphat of lime.‖

‖ *Ibid*, p. 278.

308
Amniotic acid.

The acid ſubſtance is of a white and brilliant colour; its taſte has a very ſlight degree of ſourneſs; it reddens the tincture of turnſol; it is ſcarcely ſoluble in cold water, but very readily in hot water, from which it ſeparates in long needles as the ſolution cools. It is ſoluble alſo in alcohol, eſpecially when aſſiſted by heat. It combines readily with pure alkalies, and forms a ſubſtance which is very ſoluble in water. The other acids decompoſe this compound; and the acid of the liquor of the amnios is precipitated in a white cryſtalline powder. This acid does not decompoſe the alkaline carbonats at the temperature of the atmoſphere, but it does ſo when aſſiſted by heat. It does not alter ſolutions of ſilver, lead, or mercury, in nitric acid. When expoſed to a ſtrong heat, it froths and exhales an odour of ammonia and of pruſſic acid. The properties are ſufficient to ſhew that it is different from every other acid. Vauquelin and Boniva have given it the name of *amniotic acid*. It approaches neareſt to the ſaccholactic and the *uric* acids; but the ſachlactic acid does not furniſh ammonia by diſtillation like the amniotic. The uric acid is not ſo ſoluble in hot water as the amniotic, it does not cryſtallize in white brilliant needles, and it is inſoluble in boiling alcohol; in both which reſpects it differs completely from amniotic acid.*

Urine

* *Ann. d Chim.*xx p. 279.

SECT. XVI. *Of URINE.*

309
Urine.

No animal ſubſtance has attracted more attention than urine, both on account of its ſuppoſed connection with various diſeaſes, and on account of the very ſingular products which have been obtained from it. Mr Boyle, and the other chemiſts who were his contemporaries, were induced to attend particularly to this liquid, by the diſcovery of a method of obtaining phoſphorus from it. Boerhaave, Haller, Haupt, Margraf, Pott, Rouelle, Prouſt, and Klaproth, ſucceſſively improved the method of obtaining the phoſphoric ſalts from urine, or added ſomething to our knowledge of the component parts of theſe ſalts. Scheele added greatly to our knowledge of urine by detecting ſeveral new ſubſtances in it which had not been ſuſpected. Cruickſhank has given us a very valuable paper on urine in the ſecond edition of *Rollo's Diabetes*; and Fourcroy and Vauquelin have lately publiſhed the moſt complete analyſis of it which has hitherto appeared.

Freſh urine is a liquid of a peculiar aromatic odour, an orange colour, of greater or leſs intenſity, and an acrid ſaline taſte.

Its ſpecific gravity varies from 1.005 to 1.033.*

* Cruic ſhank, P Mag. ii 240.

310
Contain phoſpha lime,

1. It reddens paper ſtained with turnſol and with the juice of radiſhes, and therefore contains an acid.

2. If a ſolution of ammonia be poured into freſh urine, a white powder precipitates, which has the properties of phoſphat of lime. The preſence of this ſubſtance in urine was firſt diſcovered by Scheele.† If lime water be poured into urine, phoſphat of lime precipitates in greater abundance than when ammonia is uſed; conſequently the acid which urine contains is the phoſphoric. Thus we ſee that the phoſphat of lime is kept diſſolved in urine by an exceſs of acid. This alſo was firſt diſcovered by Scheele.‡ This ſubſtance is moſt abundant in the urine of the ſick. Berthollet has obſerved, that the urine of gouty people is leſs acid than that of people in perfect health. The average quantity of phoſphat of lime in healthy urine is, as Cruickſhank has aſcertained, about $\frac{1}{700}$ of the weight of the urine.§

† Scheel 208.

‡ *Ibid.*

§ *Phil. Mag.* i 241.

31
Phoſph of mag neſia,

3. If the phoſphat of lime precipitated from urine be examined, a little magneſia will be found mixed with it. Fourcroy and Vauquelin have aſcertained that this is owing to a little phoſphat of magneſia which urine contains, and which is decompoſed by the alkali or lime employed to precipitate the phoſphat of lime.¶

¶ *Ann. Chim.* 66.

31
Uric a

4. When freſh urine cools, it often lets fall a brick coloured precipitate, which Scheele firſt aſcertained to be cryſtals of uric acid. All urine contains this acid, even when no ſenſible precipitate appears when it cools. For if a ſufficient quantity of clear and freſh urine be evaporated to $\frac{1}{12}$ of its weight, a ſubtle powder precipitates to the bottom, and attaches itſelf in part very firmly to the veſſel. This part may be diſſolved in pure alkali, and precipitated again by acetous acid. It exhibits all the properties of uric acid.* The quantity of uric acid in urine is very various. During intermittent

* *Sch*ee 207.

termittent fevers it is depoſited very copiouſly, and has been long known to phyſicians under the name of *lateritious ſediment*. This ſediment always makes its appearance at the criſis of fevers. In gouty people, the ſame ſediment appears in equal abundance towards the end of a paroxyſm of the diſeaſe (P). And if this ſediment ſuddenly diſappears after it has begun to be depoſited, a freſh attack may be expected.*

5. If freſh urine be evaporated to the conſiſtence of a ſyrup, and muriatic acid be then poured into it, a precipitate appears which poſſeſſes the properties of benzoic acid. Scheele firſt diſcovered the preſence of benzoic acid in urine. He evaporated it to dryneſs, ſeparated the ſaline part, and applied heat to the reſiduum. The benzoic acid was ſublimed, and found cryſtallized in the receiver. The method which we have given is much eaſier; it was firſt propoſed by Fourcroy and Vauquelin.† By it very conſiderable quantities of benzoic acid may be obtained from the urine of horſes and cows, where it is much more abundant than in human urine. In human urine it varies from $\frac{1}{1000}$ to $\frac{1}{10000}$ of the whole.§

6. When an infuſion of tan is dropt into urine, a white precipitate appears, having the properties of the combination of tan and albumen, or gelatine. Urine, therefore, contains albumen and gelatine. Theſe ſubſtances had been ſuſpected to be in urine, but their preſence was firſt demonſtrated by Seguin, who diſcovered the above method of detecting them. Their quantity in healthy urine is very ſmall. Cruickſhank found that the precipitate afforded by tan in healthy urine amounted to $\frac{1}{240}$th part of the weight of the urine.‡ It is to theſe ſubſtances that the appearance of the *cloud*, as it is called, or the mucilaginous matter, which is ſometimes depoſited as the urine cools, is owing. It is probable that healthy urine contains only gelatine and not albumen, though the quantity is too ſmall to admit of accurate examination; but in many diſeaſes the quantity of theſe matters is very much increaſed. The urine of dropſical people often contains ſo much albumen, that it coagulates not only on the addition of acids, but even on the application of heat.§ In all caſes of impaired digeſtion, the albuminous and gelatinous part of urine is much increaſed. This forms one of the moſt conſpicuous and important diſtinctions between the urine of thoſe who enjoy good and bad health.‖

7. If urine be evaporated by a ſlow fire to the conſiſtence of a thick ſyrup, it aſſumes a deep brown colour, and exhales a fetid ammoniacal odour. When allowed to cool, it concretes into a maſs of cryſtals, compoſed of all the component parts of urine. If four times its weight of alcohol be poured upon this maſs, at intervals, and a ſlight heat be applied, the greateſt part of it is diſſolved. The alcohol, which has acquired a brown colour, is to be decanted off, and diſtilled in a crucible in a ſand heat, till the mixture has boiled for ſome time, and acquired the conſiſtence of a ſyrup. By this time the whole of the alcohol has paſſed off, and the matter, on cooling, cryſtallizes in quadrangular plates which interſect each other. This ſubſtance is *urea*, which compoſes $\frac{19}{20}$ of the urine, provided the watery part be excluded. To this ſubſtance the taſte, ſmell, and colour of urine are owing. It is a ſubſtance which characterizes urine, and conſtitutes it what it is, and to which the greater part of the very ſingular phenomena of urine are to be aſcribed.

The colour of urine depends upon the urea; the greater the quantity, the deeper is the colour. It may be detected by evaporating urine to the conſiſtence of a ſyrup, and pouring into it concentrated nitric acid. Immediately a great number of white ſhining cryſtals appear in the form of plates, very much reſembling cryſtallized boracic acid. Theſe cryſtals are urea combined with nitric acid.

The quantity of urea varies exceedingly in different urines. In the urine voided ſoon after a meal, very little of it is to be found, and ſcarcely any at all in that which hyſterical patients void during a paroxyſm.

316
Muriat of ſoda,

8. If urine be ſlowly evaporated to the conſiſtence of a ſyrup, a number of cryſtals make their appearance in it. Two of theſe are remarkable by their form: one of them conſiſts of ſmall regular octahedrons; which, when examined, are found to poſſeſs the properties of muriat of ſoda. Urine, therefore, contains muriat of ſoda. It is well known that muriat of ſoda cryſtallizes in cubes; the ſingular modification of its form in urine is owing to the action of urea. It has been long known that urine ſaturated with muriat of ſoda depoſites that ſalt in regular octahedrons.

317
Muriat of ammonia,

9. Another of the ſalts which appear during the evaporation of urine has the form of regular cubes. This ſalt has the properties of muriat of ammonia. Now the uſual form of the cryſtals of muriat of ammonia is the octahedron. The change of its form in urine is produced alſo by urea.

318
Phoſphat of ammonia and of ſoda,

10. The ſaline reſiduum which remains after the ſeparation of urea from cryſtallized urine by means of alcohol, has been long known under the names of fuſible ſalt of urine and microcoſmic ſalt. Various methods of obtaining it have been given by chemiſts from Boerhaave, who firſt publiſhed a proceſs, to Rouelle and Chaulnes, who gave the method juſt mentioned. If this ſaline maſs be diſſolved in a ſufficient quantity of hot water, and allowed to cryſtallize ſpontaneouſly in a cloſe veſſel, two ſets of cryſtals are gradually depoſited. The lowermoſt ſet has the figure of flat rhomboidal priſms; the uppermoſt, on the contrary, has the form of rectangular tables. Theſe two may be eaſily ſeparated by expoſing them for ſome time to a dry atmoſphere. The rectangular tables effloreſce and fall to powder, but the rhomboidal priſms remain unaltered.

When theſe ſalts are examined, they are found to have the properties of phoſphats. The rhomboidal priſms conſiſt of phoſphat of ammonia united to a little phoſphat of ſoda; the rectangular tables, on the contrary,

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(P) The concretions which ſometimes make their appearance in gouty joints have been found to conſiſt chiefly of uric acid. This ſingular coincidence deſerves the attention of phyſiologiſts: it cannot fail, ſooner or later, to throw light, not only upon gout, but upon ſome of the animal functions.

trary, are phoſphat of ſoda united to a ſmall quantity of phoſphat of ammonia. Urine, then, contains phoſphat of ſoda and phoſphat of ammonia.

Thus we have found that urine contains the twelve following ſubſtances:

1. Water,
2. Phoſphoric acid,
3. Phoſphat of lime,
4. Phoſphat of magneſia,
5. Uric acid,
6. Benzoic acid,
7. Gelatine and albumen,
8. Urea,
9. Muriat of ſoda,
10. Muriat of ammonia,
11. Phoſphat of ſoda,
12. Phoſphat of ammonia.

319
Sometimes other ſalts.

Theſe are the only ſubſtances which are conſtantly found in healthy urine;* but it contains alſo occaſionally other ſubſtances. Very often muriat of potaſs may be diſtinguiſhed among the cryſtals which form during its evaporation. The preſence of this ſalt may always be detected by dropping cautiouſly ſome tartarous acid into urine. If it contains muriat of potaſs, there will precipitate a little tartar, which may eaſily be recogniſed by its properties.*

Urine ſometimes alſo contains ſulphat of ſoda, and even ſulphat of lime. The preſence of theſe ſalts may be aſcertained by pouring into urine a ſolution of muriat of barytes, a copious white precipitate appears, conſiſting of the barytes combined with phoſphoric acid, and with ſulphuric acid, if any be preſent. This precipitate muſt be treated with a ſufficient quantity of muriatic acid. The phoſphat of barytes is diſſolved, but the ſulphat of barytes remains unaltered.†

320
Putrefaction of urine.

No ſubſtance putrefies ſooner, or exhales a more deteſtable odour during its ſpontaneous decompoſition, than urine; but there is a very great difference in this reſpect in different urines. In ſome, putrefaction takes place almoſt inſtantaneouſly as ſoon as it is voided; in others, ſcarcely any change appears for a number of days. Fourcroy and Vauquelin have aſcertained that this difference depends on the quantity of gelatine and albumen which urine contains. When there is very little of theſe ſubſtances preſent, urine remains long unchanged; on the contrary, the greater the quantity of gelatine or albumen, the ſooner does putrefaction commence. The putrefaction of urine, therefore, is, in ſome degree, the teſt of the health of the perſon who has voided it; for a ſuperabundance of gelatine in urine always indicates ſome defect in the power of digeſtion.*

The rapid putrefaction of urine, then, is owing to the action of gelatine on urea. We have ſeen already the facility with which that ſingular ſubſtance is decompoſed, and that the new products into which it is changed are, ammonia, carbonic acid, and acetous acid. Accordingly, the putrefaction of urine is announced by an ammoniacal ſmell. Mucilaginous flakes are depoſited, conſiſting of part of the gelatinous matter. The phoſphoric acid is ſaturated with ammonia, and the phoſphat of lime, in conſequence, is precipitated. Ammonia combines with the phoſphat of magneſia, forms with it a triple ſalt, which cryſtallizes upon the ſides of the veſſel in the form of white cryſtals, compoſed of ſix ſided priſms, terminated by ſix-ſided pyramids. The uric and benzoic acids are ſaturated with ammonia; the acetous acid, and the carbonic acid, which are the products of the decompoſition of the urea, are alſo ſaturated with ammonia, and notwithſtanding the quantity which exhales, the production of this ſubſtance is ſo abundant, that there is a quantity of unſaturated alkali in the liquid. Putrefied urine, therefore, contains chiefly the following ſubſtances, moſt of which are the products of putrefaction:

Ammonia,
Carbonat of ammonia,
Phoſphat of ammonia,
Phoſphat of magneſia and ammonia,
Urat of ammonia,
Acetite of ammonia,
Benzoat of ammonia,
Muriat of ſoda,
Muriat of ammonia;

Beſides the precipitated gelatine and phoſphat of lime.*

The diſtillation of urine produces almoſt the ſame changes; for the heat of boiling water is ſufficient to decompoſe urea, and to convert it into ammonia, carbonic and acetous acids. Accordingly, when urine is diſtilled, there comes over water, containing ammonia diſſolved in it, and carbonat of ammonia in cryſtals. The acids contained in urine are ſaturated with ammonia, and the gelatine and phoſphat of lime precipitate.†

Such are the properties of the human urine. The urine of other animals has not hitherto been examined with equal care; but it is certain that it differs very conſiderably from that of men. The urine of cows and horſes, and of all ruminating animals, for inſtance, contains carbonat of lime, without any mixture of phoſphat of lime.‡ It contains alſo a much greater proportion of benzoic acid than that of man.

SECT. XVII. *Of the* URINARY CALCULUS.

IT is well known that concretions not unfrequently form in the bladder, or the other urinary organs, and occaſion one of the moſt diſmal diſeaſes to which the human ſpecies is liable.

3
Urina
calcul

Theſe concretions were diſtinguiſhed by the name of *calculi*, from a ſuppoſition that they are of a ſtony nature. They have long attracted the attention of phyſicians. Chemiſtry had no ſooner made its way into medicine than it began to exerciſe its ingenuity upon the urinary calculus; and various theories were given of their nature and origin. According to Paracelſus, who gave them the ridiculous name of *duelech*, urinary calculi were intermediate between tartar and ſtone, and compoſed of an *animal reſin*. Van Helmont pronounced them anomalous coagulations, the offspring of the ſalts of urine, and of a volatile earthy ſpirit, produced at once, and deſtitute of any viſcid matter.§ Boyle extracted from them, by diſtillation, oil, and a great quantity of volatile ſalt. Boerhaave ſuppoſed them compounds of oil and volatile ſalts. Hales extracted from them a prodigious quantity of air. He gave them the name of *animal tartar*, pointed out ſeveral circumſtances in which they reſemble common tartar, and made many experiments to find a ſolvent of them.* Drs Whytt and Alſton pointed out alkalies as ſolvents of calculi. It was an attempt to diſcover a more perfect ſolvent that induced Dr Black to make theſe experiments which terminated in the diſcovery of the nature of the alkaline carbonats.

3
Analy
by Sc

Such was the ſtate of the chemical analyſis of calculus, when, in 1776, Scheele publiſhed a diſſertation on the ſubject in the *Stockholm Tranſactions*; which was ſucceeded by ſome remarks of Mr Bergmann. Theſe illuſtrious

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* *Fourcroy and Vauquelin, Ann. de Chim.* xxxi. 69.

* *Cruickſhank, Phil. Mag.* ii. 241.

† *Fourcroy, Ann. de Chim.* vii. 183.

* *Ann. de Chim.* xxxi. 61.

* *Ann*
Chim. 70.

† *Ibid*

‡ *Vau*
ibid. x
4.

§ *De*
oſi, c.

* *Veg*
Stat. i
189.

nary culus.

illuſtrious chemiſts completely removed the uncertainty which had hitherto hung over the ſubject, and aſcertained the nature of the calculi which they examined. Since that time conſiderable additional light has been thrown upon the nature of theſe concretions by the labours of Auſtin, Pearſon, and, above all, of Fourcroy and Vauquelin, who have lately analyſed above 300 calculi, and aſcertained the preſence of ſeveral new ſubſtances which had not been ſuſpected. The ſubſtances hitherto diſcovered in urinary calculi are the following:

23 com- at

1. Uric acid,
2. Urat of ammonia,
3. Phoſphat of lime (q),
4. Phoſphat of magneſia-and-ammonia,
5. Oxalat of lime,
6. Silica,
7. An animal matter.

24 acid.

1. The greater number of calculi conſiſt of uric acid. All thoſe analyſed by Scheele were compoſed of it entirely. Of 300 calculi analyſed by Dr Pearſon, ſcarcely one was found which did not contain a conſiderable quantity of it, and the greater number manifeſtly were formed chiefly of it. Fourcroy and Vauquelin found it alſo in the greater number of the 300 calculi which they analyſed.

The preſence of this acid may eaſily be aſcertained by the following properties: A ſolution of potaſs or ſoda diſſolves it readily, and it is precipitated by the weakeſt acids. The precipitate is ſoluble in nitric acid, the ſolution is of a pink colour, and tinges the ſkin red.*

rcroy, de xxxii.

25 of am- .

2. Urat of ammonia is eaſily detected by its rapid ſolubility in fixed alkaline leys, and the odour of ammonia which is perceived during the ſolution. It is not ſo often preſent in urinary calculi as the laſt mentioned ſubſtance. No calculus has hitherto been found compoſed of it alone, except the very ſmall polygonal calculi, ſeveral of which ſometimes exiſt in the bladder together.

It is moſt uſually in thin layers, alternating with ſome other ſubſtance, very eaſily reduced to powder, and of the colour of ground coffee.†

. 218.

26 phat nc.

3. Phoſphat of lime is white, without luſtre, fiery, friable, ſtains the hands, paper, and cloth. It has very much the appearance of chalk, breaks under the forceps, is inſipid, and inſoluble in water. It is ſoluble in nitric, muriatic, and acetous acids, and is again precipitated by ammonia, fixed alkalies, and oxalic acid.

It is never alone in calculi. It is intimately mixed with a gelatinous matter, which remains under the form of a membrane when the earthy part is diſſolved by very diluted acids.‡

27 phat gne- d-am- .

4. Phoſphat of magneſia-and-ammonia occurs in white, ſemitranſparent, lameller layers; ſometimes it is cryſtallized on the ſurface of the calculi in priſms, or what are called *dog-tooth* cryſtals. It has a weak ſweetiſh taſte, it is ſomewhat ſoluble in water, and very ſoluble in acids, though greatly diluted. Fixed alkalies decompoſe it.

It never forms entire calculi. Sometimes it is mixed with phoſphat of lime, and ſometimes layers of it cover uric acid or oxalat of lime. It is mixed with the ſame gelatinous matter as phoſphat of lime.‡

Urinary Calculus.

‡ *Fourcroy, Ann. de Chim.* xxxii. 219.

328 Oxalat of lime.

5. Oxalat of lime is found in certain calculi, which, from the inequality of their ſurface, have got the name of *moriform* or *mulberry-ſhaped* calculi. It is never alone, but combined with a peculiar animal matter, and forming with it a very hard calculus, of a grey colour, difficult to ſaw aſunder, admitting a poliſh like ivory, exhaling, when ſawed, an odour like that of ſemen. Inſoluble and indecompoſible by alkalies; ſoluble in very diluted nitric acid, but ſlowly, and with difficulty. It may be decompoſed by the carbonats of potaſs and ſoda. When burnt, it leaves behind a quantity of pure lime, which may be eaſily recogniſed by its properties.*

* *Ibid.* 220.

329 Silica.

6. Silica has only been found in two inſtances by Fourcroy and Vauquelin, though they analyſed 300 calculi. No other chemiſt has obſerved it. It muſt therefore be conſidered as a very uncommon ingredient of theſe concretions. In the two inſtances in which it occurred, it was mixed with uric acid and the two phoſphats above mentioned.†

† *Ibid.* 221.

330 Animal matters.

7. *Animal matter* appears to compoſe the cement which binds the different particles of the calculus together, and in all probability it is the cauſe which influences its formation. It is different in different calculi. Sometimes it has the appearance of gelatine or albumen, at other times it reſembles urea. It deſerves a more accurate inveſtigation.‡

‡ *Ibid.*

No general deſcription of the different calculi has hitherto appeared; but Fourcroy and Vauquelin are at preſent occupied with that ſubject. They propoſe to claſſify them according to their compoſition; to point out their different ſpecies and varieties; to give a method of detecting them by their appearance; to analyſe the animal matter by which they are cemented; and to apply all the preſent chemical knowledge of the ſubject in the inveſtigation of the cauſe, the ſymptoms, and the cure, of that dreadful diſeaſe which the urinary calculi produce. As their labour is already very far advanced, it would be unneceſſary for us to attempt any claſſification of calculi. Indeed every attempt of that kind, by any perſon who has not had an opportunity of analyſing a very great number of calculi, muſt be ſo exceedingly imperfect as ſcarcely to be of any uſe.

We ſhall ſatisfy ourſelves with the following remarks, deduced almoſt entirely from the obſervations which theſe celebrated chemiſts have already publiſhed.

331 Method of diſſolving the calculi.

Many calculi conſiſt entirely, or almoſt entirely, of uric acid. The animal matter, which ſerves as a cement to theſe calculi, appears to be urea. Calculi of this kind may be diſſolved by injecting into the bladder ſolutions of pure potaſs or ſoda, ſo much diluted as not to act upon the bladder itſelf. The gritty ſubſtance, which many perſons threatened with the ſtone diſcharge along with their urine, which has been called *gravel*, conſiſts almoſt conſtantly of uric acid. It may therefore ſerve as an indication that the ſubſequent ſtone, if any ſuch form, is probably compoſed of uric acid.

The two phoſphats, mixed together, ſometimes compoſe calculi. Theſe calculi are very brittle, and gene-

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(q) Brugnatelli found alſo phoſphat of lime, with exceſs of acid, in calculi. See *Ann. de Chim.* xxxii. 183.

Urinary Calculus.

rally break in pieces during the extraction. Such calculi may be diſſolved by injecting into the bladder muriatic acid, ſo much diluted as ſcarcely to have any taſte of acid.

The phoſphats never form the nucleus of a calculus. They have never been found covered with a layer of uric acid, but they often cover that acid. Hence it would ſeem that the exiſtence of any extraneous matter in the bladder diſpoſes theſe phoſphats to cryſtallize. When extraneous bodies are accidentally introduced into the bladder, and allowed to lodge there, they are conſtantly covered with a coat of phoſphat of ammonia and magneſia, or of the two phoſphats mixed.

As the phoſphat of ammonia and magneſia is not an ingredient of freſh urine, but formed during its putrefaction, when it exiſts in calculi, it would ſeem to indicate a commencement of putrefaction during the time that the urine lodges in the bladder. But putrefaction does not take place ſpeedily in urine, unleſs where there is an exceſs of albumen and gelatine; conſequently we have reaſon to ſuppoſe, that theſe ſubſtances are morbidly abundant in the urine of thoſe patients who are afflicted with calculi conſiſting of the phoſphats: hence alſo we may conclude, that their digeſtion is imperfect. It will no doubt be objected, that dropſical people are not peculiarly ſubject to calculi; but their urine is only morbidly albuminous when the diſeaſe is beginning to diſappear, and then there ſeems to be a deficiency of urea; at leaſt their urine has not been obſerved to putrefy with uncommon rapidity. Beſides, there ſeems to be ſome animal matter preſent, which ſerves as a cement to the phoſphat in all caſes where calculi form.

Urat of ammonia is only found alone in the very ſmall polygenous calculi which exiſt, ſeveral together, in the bladder. In other caſes it is mixed with uric acid. It ſometimes alternates with uric acid or with the phoſphats. It is diſſolved by the ſame ſubſtance that acts as a ſolvent of uric acid.

Oxalat of lime often forms the nucleus of calculi compoſed of layers of uric acid or of the phoſphats. It forms thoſe irregular calculi which are called *moriform*. Theſe calculi are the hardeſt and the moſt difficult of ſolution. A very much diluted nitric acid diſſolves them but very ſlowly. As oxalic acid does not exiſt in urine, ſome morbid change muſt take place in the urine when ſuch calculi are depoſited. Brugnatelli's diſcovery of the inſtantaneous converſion of uric acid into oxalic acid by oxy muriatic acid, which has been confirmed by the experiments of Fourcroy and Vauquelin, throws conſiderable light upon the formation of oxalic acid in urine, by ſhewing us that uric acid is probably the baſis of it; but in what manner the change is actually produced, it is not ſo eaſy to ſay.

Urinary Calculus.

332 Calculi o inferior animals.

The calculi found in the bladder of other animals have not been examined with the ſame care. Some of them, however, have been ſubjected to an accurate analyſis. No uric acid has ever been found in any of them. Fourcroy found a calculus extracted from the kidney of a horſe compoſed of three parts of carbonat of lime, and one part phoſphat of lime.* Dr Pearſon examined a urinary calculus of a horſe; it was compoſed of phoſphat of lime and phoſphat of ammonia. Brugnatelli found a calculus extracted from the bladder of a ſow, which was exceedingly hard, compoſed of pure carbonat of lime, incloſing a ſoft nucleus of a fœtid and urinous odour.† Bartholdi examined another calculus of a pig, the ſpecific gravity of which was 1,0300. It conſiſted of phoſphat of lime.‡ Dr Pearſon found a calculus taken from the bladder of a dog compoſed of phoſphat of lime, phoſphat of ammonia, and an animal matter. He found the urinary calculus of a rabbit, of the ſpecific gravity 2, compoſed of carbonat of lime and ſome animal matter.||

* *Ann. de Chim.* xvi 95.

† *Ibid.* xxxii. 18

‡ *Ibid.* 18

|| *Phil. M* ii. 134.

The compoſition of the different animal concretions hitherto examined may be ſeen in the following table.

Horſe.	1. Carbonat of lime and phoſphat of lime.*	* *Fourcro*
	2. Phoſph. of lime and phoſph. of ammonia †	† *Pearſon*
	3. Carbon. of lime and animal matter.†	
Sow.	1. Carbon. of lime and an animal nucleus.‡	‡ *Brugnat*
	2. Phoſphat of lime.¶	¶ *Bartho*
Dog.	Phoſphat of lime, and of ammonia, and animal matter.†	
Rabbit.	Carbonat of lime and animal matter.†	† *Pearſon*

We have now given an account of all thoſe ſecretions which have been attentively examined by chemiſts. The remainder have been hitherto neglected; partly owing to the difficulty of procuring them, and partly on account of the multiplicity of other objects which occupied the attention of chemical philoſophers (R). It remains for us now to examine by what proceſſes theſe different ſecretions are formed, how the conſtant waſte of living bodies is repaired, and how the organs themſelves are nouriſhed and preſerved. This ſhall form the ſubject of the following chapter.

CHAP. III. OF THE FUNCTIONS OF ANIMALS.

The intention of the two laſt chapters was to exhibit a view of the different ſubſtances which enter into the compoſition of animals, as far as the preſent limited ſtate of our knowledge puts it in our power. But were our enquiries concerning animals confined to the mere ingredients of which their bodies are compoſed, even ſuppoſing the analyſis as complete as poſſible, our knowledge of the nature and properties of animals would be imperfect indeed.

How are theſe ſubſtances arranged? How are they produced?

(R) The chief of theſe ſecretions are the following:

1. Cerumen, or ear-wax, is at firſt nearly liquid, and of a whitiſh colour. It gradually acquires conſiſtence. Its taſte is very bitter. Said to be inſoluble in alcohol; but ſoluble in hot water. Does not become rancid by keeping.
2. The humours of the eye.
3. The milky liquor, ſecreted by the thyroid gland.
4. Mucus of the lungs, inteſtinal canal, &c.
5. Smegma of the areola of the breaſts, glans penis, vagina, ſubcutaneous glands, &c.
6. Marrow.

produced? What purpoſes do they ſerve? What are the diſtinguiſhing properties of animals, and the laws by which they are regulated?

333 imals emble etables. Animals reſemble vegetables in the complexneſs of their ſtructure. Like them, they are machines nicely adapted for particular purpoſes, conſtituting one whole, and continually performing an infinite number of the moſt delicate proceſſes. But neither an account of the ſtructure of animals, nor of the properties which diſtinguiſh them from other beings, will be expected here. Theſe have been already treated of ſufficiently in the articles ANATOMY and PHYSIOLOGY *(Encycl.)*, to which we beg leave to refer the reader. We mean only, in the preſent chapter, to take a view of thoſe proceſſes which are concerned in the *production* of animal ſubſtances, which alone properly belong to chemiſtry. The other functions are regulated by laws of a very different nature, which have no reſemblance or analogy to the laws of chemiſtry or mechanics.

334 uire l. 1. Every body knows that animals require food, and that they die ſooner or later if food be withheld from them. There is indeed a very great difference in different animals, with regard to the quantity of food which they require, and the time which they can paſs without it. In general, this difference depends upon the activity of the animal. Thoſe which are moſt active require moſt, and thoſe which move leaſt require leaſt food.

The cauſe of this is alſo well known; the bodies of animals do not remain ſtationary, they are conſtantly waſting; and the waſte is generally proportional to the activity of the animal. It is evident, then, that the body muſt receive, from time to time, new ſupplies, in place of what has been carried off. Hence the uſe of food, which anſwers this purpoſe.

335 ature. 2. We are much better acquainted with the food of animals than of vegetables. It conſiſts of almoſt all the animal and vegetable ſubſtances which have been treated of in the former part of this article; for there are but very few of them which ſome animal or other does not uſe as food. Man uſes as food chiefly the muſcles of animals, the ſeeds of certain graſſes, and a variety of vegetable fruits. Almoſt all the inferior animals have particular ſubſtances on which they feed excluſively. Some of them feed on animals, others on vegetables. Man has a greater range; he can feed on a very great number of ſubſtances. To enumerate theſe ſubſtances would be uſeleſs; as we are not able to point out with accuracy what it is which renders one ſubſtance more nouriſhing than another.

Many ſubſtances do not ſerve as nouriſhment at all; and not a few, inſtead of nouriſhing, deſtroy life. Theſe laſt are called *poiſons*. Some poiſons act chemically, by decompoſing the animal body. The action of others is not ſo well underſtood.

336 verted chyme 3. The food is introduced into the body by the mouth, and almoſt all animals reduce it to a kind of pulpy conſiſtence. In man and many other animals this is done in the mouth by means of teeth, and the ſaliva with which it is there mixed; but many other animals grind their food in a different manner. See PHYSIOLOGY, *(Encycl.)* After the food has been thus ground, it is introduced into the ſtomach, where it is ſubjected to new changes. The ſtomach is a ſtrong ſoft bag, of different forms in different animals: in man it has ſome reſemblance to the bag of a *bag-pipe*. In this organ the food is converted into a ſoft pap, which has no reſemblance to the food when firſt introduced. This pap has been called *chyme*.

4. Since chyme poſſeſſes new properties, it is evident that the food has undergone ſome changes in the ſtomach, and that the ingredients of which it was compoſed have entered into new combinations. Now, in what manner have theſe changes been produced?

At firſt they were aſcribed to the mechanical action of the ſtomach. The food, it was ſaid, was ſtill farther triturated in that organ; and being long agitated backwards and forwards in it, was at laſt reduced to a pulp. But this opinion, upon examination, was found not to be true. The experiments of Stevens, Reaumur, and Spallanzani, demonſtrated, that the formation of chyme is not owing to trituration; for on incloſing different kinds of food in metallic tubes and balls full of holes, in ſuch a manner as to ſcreen them from the mechanical action of the ſtomach, they found, that theſe ſubſtances, after having remained a ſufficient time in the ſtomach, were converted into chyme, juſt as if they had not been incloſed in ſuch tubes. Indeed, the opinion was untenable, even independent of theſe deciſive experiments, the moment it was perceived that chyme differed entirely from the food which had been taken; that is to ſay, that if the ſame food were triturated mechanically out of the body, and reduced to pap of preciſely the ſame conſiſtence with chyme, it would not poſſeſs the ſame properties with chyme; for whenever this fact was known, it could not but be evident that the food had undergone changes in its compoſition.

The change of food into chyme, therefore, was aſcribed by many to *fermentation*. This opinion is indeed very ancient, and it has had many zealous ſupporters among the moderns. When the word *fermentation* was applied to the change produced on the food in the ſtomach, the nature of the proceſs called fermentation was altogether unknown. The appearances, indeed, which take place during that proceſs, had been deſcribed, and the progreſs and the reſult of it were known. Chemiſts had even divided fermentations into different claſſes; but no attempt had been made to explain the cauſe of fermentation, or to trace the changes which take place during its continuance. All that could be meant, then, by ſaying that the converſion of food into chyme in the ſtomach was owing to fermentation, was merely, that the unknown cauſe which acted during the converſion of vegetable ſubſtances into wine or acid, or during their putrefaction, acted alſo during the converſion of the food into chyme, and that the reſult in both caſes was preciſely the ſame. Accordingly, the advocates for this opinion attempted to prove, that air was conſtantly generated in the ſtomach, and that an acid was conſtantly produced: for it was the vinous and acetous fermentations which were aſſigned by the greater number of phyſiologiſts as the cauſe of the formation of chyme. Some indeed attempted to prove, that it was produced by the putrefactive fermentation; but their number was inconſiderable, compared with thoſe who adopted the other opinion.

Our ideas reſpecting fermentation are now ſomewhat more preciſe. It ſignifies a ſlow decompoſition, which takes place when certain animal or vegetable ſubſtances are mixed together at a given temperature; and the conſequent production of particular compounds. If therefore the converſion of the food into chyme be owing to fermentation, it is evident that it is totally independent of the ſtomach any farther than as it ſupplies temperature; and that the food would be converted into chyme exactly in the ſame manner, if it were reduced to the ſame conſiſtence, and placed in the ſame temperature out of the body. But this is by no means the caſe; ſubſtances are reduced to the ſtate of chyme in a ſhort time in the ſtomach which would remain unaltered for weeks in the ſame temperature out of the body. This is the caſe with bones; which the experiments of Stevens and Spallanzani have ſhewn to be ſoon digeſted in the ſtomach of the dog. Further if the converſion of food into chyme were owing to fermentation, it ought to go on equally well in the ſtomach and œſophagus. Now, it was obſerved long ago by Ray and Boyle, that when voracious fiſh had ſwallowed animals too large to be contained in the ſtomach, that part only which was in the ſtomach was converted into chyme, while what was in the œſophagus remained entire; and this has been fully confirmed by ſubſequent obſervations.

Still farther, if the converſion were owing to fermentation, it ought always to take place equally well, provided the temperature be the ſame, whether the ſtomach be in a healthy ſtate or not. But it is well known, that this is not the caſe. The formation of chyme depends very much on the ſtate of the ſtomach. When that organ is diſeaſed, digeſtion is conſtantly ill performed. In theſe caſes, indeed, fermentation ſometimes appears, and produces flatulence, acid eructations, &c. which are the well-known ſymptoms of indigeſtion. Theſe facts have been long known; they are totally incompatible with the ſuppoſition, that the formation of chyme is owing to fermentation. Accordingly that opinion has been for ſome time abandoned, by all thoſe at leaſt who have taken the trouble to examine the ſubject.

337
By the action of the gaſtric juice.

The formation of chyme, then, is owing to the ſtomach; and it has been concluded, from the experiments of Stevens, Reaumur, Spallanzani, Scopoli, Brugnatelli, Carimini, &c. that its formation is brought about by the action of a particular liquid ſecreted by the ſtomach, and for that reaſon called *gaſtric juice*.

That it is owing to the action of a liquid, is evident; becauſe if pieces of food be incloſed in cloſe tubes, they paſs through the ſtomach without any farther alteration than would have taken place at the ſame temperature out of the body: but if the tubes be perforated with ſmall holes, the food is converted into chyme.

This liquid does not act indiſcriminately upon all ſubſtances: For if grains of corn be put into a perforated tube, and a granivorous bird be made to ſwallow it, the corn will remain the uſual time in the ſtomach without alteration; whereas if the huſk of the grain be previouſly taken off, the whole of it will be converted into chyme. It is well known, too, that many ſubſtances paſs unaltered through the inteſtines of animals, and conſequently are not acted upon by the gaſtric juice. This is the caſe frequently with grains of oats when they have been ſwallowed by horſes entire with their huſks on. This is the caſe alſo with the ſeeds of apples, &c. when ſwallowed entire by man; yet theſe very ſubſtances, if they have been previouſly ground ſufficiently by the teeth, are digeſted. It appears, therefore, that it is chiefly the huſk or outſide of theſe ſubſtances which reſiſts the action of the gaſtric juice. We ſee alſo, that trituration greatly facilitates the converſion of food into chyme.

338
Nature of gaſtric juice.

The gaſtric juice is not the ſame in all animals; for many animals cannot digeſt the food on which others live. The *conium maculatum* (hemlock), for inſtance, is a poiſon to man inſtead of food, yet the goat often feeds upon it. Many animals, as ſheep, live wholly upon vegetables; and if they are made to feed on animals, their ſtomachs will not digeſt them: others, again, as the eagle, feed wholly on animal ſubſtances, and cannot digeſt vegetables.

The gaſtric juice does not continue always of the ſame nature, even in the ſame animal: it changes gradually, according to circumſtances. Graminivorous animals may be brought to live on animal food; and after they had been accuſtomed to this for ſome time, their ſtomachs become incapable of digeſting vegetables. On the other hand, thoſe animals which naturally digeſt nothing but animal food may be brought to digeſt vegetables.

What is the nature of the gaſtric juice, which poſſeſſes theſe ſingular properties? It is evidently different in different animals; but it is a very difficult taſk, if not an impoſſible one, to obtain it in a ſtate of purity. Various attempts have indeed been made by very ingenious philoſophers to procure it; but their analyſis of it is ſufficient to ſhew us, that they have never obtained it in a ſtate of purity.

The methods which have been uſed to procure gaſtric juice are, *firſt*, to kill the animal whoſe gaſtric juice is to be examined after it has faſted for ſome time. By this method, Spallanzani collected 37 ſpoonfuls from the two firſt ſtomachs of a ſheep. It was of a green colour, undoubtedly owing to the graſs which the animal had eaten. He found alſo half a ſpoonful in the ſtomach of ſome young crows which he killed before they had left their neſt.

Small tubes of metal, pierced with holes, and containing a dry ſponge, have been ſwallowed by animals; and when vomited up, the liquid imbibed by the ſponge is ſqueezed out. By this method, Spallanzani collected 481 grains of gaſtric juice from the ſtomachs of five crows.

A *third* method conſiſts in exciting vomiting in the morning, when the ſtomach is without food. Spallanzani tried this method twice upon himſelf, and collected one of the times 1 oz. 32 gr. of liquid; but the pain was ſo great, that he did not think proper to try the experiment a third time. Mr Goſſe, however, who could excite vomiting whenever he thought proper by ſwallowing air, has employed that method to collect gaſtric juice.

Spallanzani has obſerved, that eagles throw up every morning a quantity of liquid, which he conſiders as gaſtric juice; and he has availed himſelf of this to collect it in conſiderable quantities.

It is almoſt unneceſſary to remark how imperfect theſe different methods are, and how far every concluſion drawn from the examination of ſuch juices muſt deviate from the truth. It is impoſſible that the gaſtric juice, obtained by any one of theſe proceſſes, can be pure; becauſe in the ſtomach it muſt be conſtantly

mixed

mixed with large quantities of ſaliva, mucus, bile, food, &c. It may be queſtioned, indeed, whether any gaſtric juice at all can be obtained by theſe methods: for as the intention of the gaſtric juice is to convert the food into chyme, in all probability it is only ſecreted, or at leaſt thrown into the ſtomach when food is preſent.

We need not be ſurpriſed, then, at the contradictory accounts concerning its nature, given us by thoſe philoſophers who have attempted to examine it; as theſe relate not ſo much to the gaſtric juice, as to the different ſubſtances found in the ſtomach. The idea that the gaſtric juice can be obtained by vomiting, or that it is thrown up ſpontaneouſly by ſome animals, is, to ſay the leaſt of it, very far from being probable.

According to Brugnatelli, the gaſtric juice of carnivorous animals, as hawks, kites, &c. has an acid and reſinous odour, is very bitter, and not at all watery; and is compoſed of an uncombined acid, a reſin, an animal ſubſtance, and a ſmall quantity of muriat of ſoda.* The gaſtric juice of herbivorous animals, on the contrary, as goats, ſheep, &c. is very watery, a little muddy, has a bitter ſaltiſh taſte, and contains ammonia, an animal extract, and a pretty large quantity of muriat of ſoda.† Mr Carminati found the ſame ingredients; but he ſuppoſes that the ammonia had been formed by the putrefaction of a part of their food, and that in reality the gaſtric juice of theſe animals is of an acid nature.‡

The accounts which have been given of the gaſtric juice of man are ſo various, that it is not worth while to tranſcribe them. Sometimes it has been found of an acid nature, at other times not. The experiments of Spallanzani are ſufficient to ſhew, that this acidity is not owing to the gaſtric juice, but to the food. He never found any acidity in the gaſtric juice of birds of prey, nor of ſerpents, frogs, and fiſhes. Crows gave an acidulous gaſtric juice only when fed on grain; and he found that the ſame obſervation holds with reſpect to dogs, herbivorous animals, and domeſtic fowls. Carnivorous birds threw up pieces of ſhells and coral without alteration; but theſe ſubſtances were ſenſibly diminiſhed in the ſtomachs of hens, even when incloſed in perforated tubes. Spallanzani himſelf ſwallowed calcareous ſubſtances incloſed in tubes; and when he fed on vegetables and fruits, they were ſometimes altered and a little diminiſhed in weight, juſt as if they had been put into weak vinegar; but when he uſed only animal food, they came out untouched. According to this philoſopher, whoſe experiments have been by far the moſt numerous, the gaſtric juice is naturally neither acid nor alkaline. When poured on the carbonat of potaſs, it cauſes no efferveſcence.

Such are the reſults of the experiments on the juices taken from the ſtomach of animals. No concluſion can be drawn from them reſpecting the nature of the gaſtric juice. But from the experiments which have been made on the digeſtion of the ſtomach, eſpecially by Spallanzani, the following facts are eſtabliſhed.

The gaſtric juice attacks the ſurfaces of bodies, unites to the particles of them which it carries off, and cannot be ſeparated from them by filtration. It operates with more energy and rapidity the more the food is divided, and its action is increaſed by a warm temperature. The food is not merely reduced to very minute parts; its taſte and ſmell are quite changed; its ſenſible properties are deſtroyed, and it acquires new and very different ones. This juice does not act as a ferment; ſo far from it, that it is a powerful antiſeptic, and even reſtores fleſh already putrefied. There is not the ſmalleſt appearance of ſuch a proceſs; indeed, when the juice is renewed frequently, as in the ſtomach, ſubſtances diſſolve in it with a rapidity which excludes all idea of fermentation. Only a few air bubbles make their eſcape, which adhere to the alimentary matter, and buoy it up to the top, and which are probably extricated by the heat of the ſolution.

With reſpect to the ſubſtances contained in the ſtomach, only two facts have been perfectly aſcertained: The firſt is, that the juice contained in the ſtomach of oxen, calves, ſheep, invariably contains uncombined phoſphoric acid, as Macquart and Vauquelin have demonſtrated: The ſecond, that the juice contained in the ſtomach, and even the inner coat of the ſtomach itſelf, has the property of coagulating milk and the ſerum of blood. Dr Young found, that ſeven grains of the inner coat of a calf's ſtomach, infuſed in water, gave a liquid which coagulated more than 100 ounces of milk; that is to ſay, more than 6857 times its own weight; and yet, in all probability, its weight was not much diminiſhed.

What the ſubſtance is which poſſeſſes this coagulating property, has not yet been aſcertained; but it is evidently not very ſoluble in water: for the inſide of a calf's ſtomach, after being ſteeped in water for ſix hours, and then well waſhed with water, ſtill furniſhes a liquor on infuſion which coagulates milk:* And Dr Young found, that a piece of the inner coat of the ſtomach, after being previouſly waſhed with water, and then with a diluted ſolution of carbonat of potaſs, ſtill afforded a liquid which coagulated milk and ſerum.

It is evident, from theſe facts, that this coagulating ſubſtance, whatever it is, acts very powerfully; and that it is ſcarcely poſſible to ſeparate it completely from the ſtomach. But we know at preſent too little of the nature of coagulation to be able to draw any inference from theſe facts. An almoſt imperceptible quantity of ſome ſubſtances ſeems to be ſufficient to coagulate milk. For Mr Vaillant mentions in his Travels in Africa, that a porcelain diſh which he procured, and which had lain for ſome years at the bottom of the ſea, poſſeſſed, in conſequence, the property of coagulating milk when put into it; yet it communicated no taſte to the milk, and did not differ in appearance from other cups.

It is probable that the ſaliva is of ſervice in the converſion of food into chyme as well as the gaſtric juice. It evidently ſerves to dilute the food; and probably it may be ſerviceable alſo, by communicating oxygen.

339
Chyme converted into chyle and excrement.

5. The chyme, thus formed, paſſes from the ſtomach into the inteſtines, where it is ſubjected to new changes, and at laſt converted into two very different ſubſtances, chyle and excrementitious matter.

6. The *chyle* is a white coloured liquid, very much reſembling milk. It is exceedingly difficult to collect it in any conſiderable quantity, and for that reaſon it has never been accurately analyſed. We know only in general that it reſembles milk; containing, like it, an albuminous part capable of being coagulated, a ſerum, and globules which have a reſemblance to cream.† It contains alſo different ſalts; and, according to ſome, a ſubſtance ſcarcely differing from the ſugar of milk. It is probable alſo that it contains iron; but if ſo, it muſt be

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* *Young.*

† *Fordyce on Digeſtion*, 121.

be in the ſtate of a white oxyd; for an infuſion of nut galls does not alter the colour of chyle.‡

6. Concerning the proceſs by which chyle is formed from chyme, ſcarcely any thing is known. It does not appear that the chyme is preciſely the ſame in all animals; for thoſe which are herbivorous have a greater length of inteſtine than thoſe which are carnivorous. It is certain that the formation of the chyle is brought about by a chemical change, although we cannot ſay preciſely what that change is, or what the agents are by which it is produced. But that the change is chemical, is evident, becauſe the chyle is entirely different, both in its properties and appearance, from the chyme. The chyme, by the action of the inteſtines, is ſeparated into two parts, chyle and excrement: the firſt of which is abſorbed by a number of ſmall veſſels called *lacteals*; the ſecond is puſhed along the inteſtinal canal, and at laſt thrown out of the body altogether.

After the chyme has been converted into chyle and excrement, although theſe two ſubſtances remain mixed together, it does not appear that they are able to decompoſe each other; for perſons have been known ſeldom or never to emit any excrementitious matter *per anum* for years. In theſe, not only the chyle, but the excrementitious matter alſo, was abſorbed by the lacteals; and the excrement was afterwards thrown out of the body by other outlets, particularly by the ſkin: in conſequence of which, thoſe perſons have conſtantly that particular odour about them which diſtinguiſhes excrement. Now in theſe perſons, it is evident that the chyle and excrement, though mixed together, and even abſorbed together, did not act on each other; becauſe theſe perſons have been known to enjoy good health for years, which could not have been the caſe had the chyle been deſtroyed.

340 Uſe of bile.

7. It has been ſuppoſed by ſome that the decompoſition of the chyme, and the formation of chyle, is produced by the agency of the bile, which is poured out abundantly, and mixed with the chyme, ſoon after its entrance into the inteſtines. If this theory were true, no chyle could be formed whenever any accident prevented the bile from paſſing into the inteſtinal canal: but this is obviouſly not true; for frequent inſtances have occurred of perſons labouring under jaundice from the bile ducts being ſtopped, either by gallſtones or ſome other cauſe, ſo completely, that no bile could paſs into the inteſtines; yet theſe perſons have lived for a conſiderable time in that ſtate. Conſequently digeſtion, and therefore the formation of chyle, muſt be poſſible, independent of bile.

The principal uſe of the bile ſeems to be to ſeparate the excrement from the chyle, after both have been formed, and to produce the evacuation of the excrement out of the body. It is probable that theſe ſubſtances would remain mixed together, and that they would perhaps even be partly abſorbed together, were it not for the bile, which ſeems to combine with the excrement, and by this combination to facilitate its ſeparation from the chyle, and thus to prevent its abſorption. It alſo ſtimulates the inteſtinal canal, and cauſes it to evacuate its contents ſooner than it otherwiſe would do; for when there is a deficiency of bile, the body is conſtantly coſtive.

341 Of the excrementitious matter.

8. The excrement, then, which is evacuated *per anum*, conſiſts of all that part of the food and chyme which was not converted into chyle, entirely altered however from its original ſtate, partly by the decompoſition which it underwent in the ſtomach and inteſtines, and partly by its combination with bile. Accordingly we find in it many ſubſtances which did not exiſt at all in the food. Thus in the dung of cows and horſes there is found a very conſiderable quantity of benzoic acid. The excrements of animals have not yet been ſubjected to an accurate analyſis, though ſuch an analyſis would throw much light upon the nature of digeſtion. For if we knew accurately the ſubſtances which were taken into the body as food, and all the new ſubſtances which were formed by digeſtion; that is to ſay, the component parts of chyle and of excrement, and the variation which different kinds of food produce in the excrement, it would be a very conſiderable ſtep towards aſcertaining preciſely the changes produced on food by digeſtion, or, which is the ſame thing, towards aſcertaining exactly the phenomena of digeſtion. The only analyſis which has hitherto been made on human excrement is that of Homberg; and as it conſiſted merely in ſubjecting it to diſtillation, it is needleſs to give an account of it. Of late, as Mr Fourcroy informs us, the ſubject has been reſumed in France, and we may ſoon expect ſome very curious and important additions to our knowledge.

34 Excre of fow

Mr Vauquelin has already publiſhed an analyſis of the fixed parts of the excrements of fowls, and a compariſon of them with the fixed parts of the food; from which ſome very curious conſequences may be deduced.

He found that a hen devoured in ten days 11111.843 grains troy of oats. Theſe contained

136.509 gr. of phoſphat of lime,
219.548 ſilica,

356.057

During theſe ten days ſhe layed four eggs; the ſhells of which contained 98.776 gr. phoſphat of lime, and 453.417 gr. carbonat of lime. The excrements emitted during theſe ten days contained 175.529 gr. phoſphat of lime, 58.494 gr. of carbonate of lime, and 185.266 gr. of ſilica. Conſequently the fixed parts thrown out of the ſyſtem during theſe ten days amounted to

	Grains.	
	274.305	phoſphat of lime,
	511.911	carbonat of lime,
	185 266	ſilica,
Given out	971.482	
Taken in	356.057	
	615.425	

Conſequently the quantity of fixed matter given out of the ſyſtem in ten days exceeded the quantity taken in by 615.425 grains.

The ſilica taken in amounted to	219.548 gr.
That given out was only	185.266 gr.
Remains	34.282

Conſequently there diſappeared 34.282 grains of ſilica.

The phoſphat of lime taken in was	136.509 gr.
That given out was	274.305 gr.
	137.796

Conſequently

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‡ Fordyce on Digeſtion, 122.

Conſequently there muſt have been formed, by digeſtion in this fowl, no leſs than 137.796 grains of phoſphat of lime, beſides 511.911 grains of carbonat. Conſequently lime (and perhaps alſo phoſphorus) is not a ſimple ſubſtance, but a compound, and formed of ingredients which exiſt in oat-ſeed, water, or air, the only ſubſtance to which the fowl had acceſs. Silica may enter into its compoſition, as a part of the ſilica had diſappeared; but if ſo, it muſt be combined with a great quantity of ſome other ſubſtance.*

Theſe conſequences are too important to be admitted without a very rigorous examination. The experiment muſt be repeated frequently, and we muſt be abſolutely certain that the hen has no acceſs to any calcareous earth, and that ſhe has not diminiſhed in weight; becauſe in that caſe ſome of the calcareous earth, of which part of her body is compoſed, may have been employed. This rigour is the more neceſſary, as it ſeems pretty evident, from experiments made long ago, that *ſome* birds at leaſt, cannot produce eggs unleſs they have acceſs to calcareous earth. Dr Fordyce found, that if the canary bird was not ſupplied with lime at the time of her laying, ſhe frequently died, from her eggs not coming forward properly.† He divided a number of theſe birds at the time of their laying eggs into two parties: to the one he gave a piece of old mortar, which the little animals ſwallowed greedily; they laid their eggs as uſual, and all of them lived: whereas many of the other party, which were ſupplied with no lime, died.‡

9. The inteſtines ſeldom or never are deſtitute of gaſes, which ſeem to be evolved during the proceſs of digeſtion; and may therefore, in part, be conſidered as excrementitious matter. The only perſon who has examined theſe gaſes with care, is Mr Jurine of Geneva. The reſult of his analyſis is as follows. He found in the ſtomach and inteſtines of a man who had been frozen to death, carbonic acid gas, oxygen gas, hydrogen gas, and azotic gas. The quantity of carbonic acid was greateſt in the ſtomach, and it diminiſhed gradually as the canal receded from the ſtomach; the proportion of oxygen gas was conſiderable in the ſtomach, ſmaller in the ſmall inteſtines, and ſtill ſmaller in the great inteſtines; the hydrogen and azotic gaſes, on the contrary, were leaſt abundant in the ſtomach, more abundant in the ſmall inteſtines, and moſt abundant in the larger inteſtines; the hydrogen gas was moſt abundant in the ſmall inteſtines. It is well known that the flatus diſcharged *per anum* is commonly carbonated hydrogen gas; ſometimes alſo it ſeems to hold ſulphur, or even phoſphorus in ſolution.§

10. The chyle, after it has been abſorbed by the lacteals, is carried by them into a pretty large veſſel, known by the name of *thoracic duct*. Into the ſame veſſel likewiſe is diſcharged a tranſparent fluid, conveyed by a ſet of veſſels which ariſe from all the cavities of the body. Theſe veſſels are called *lymphatics*, and the fluid which they convey is called *lymph*. In the thoracic duct, then, the chyle and the lymph are mixed together.

Very little is known concerning the nature of the *lymph*, as it is ſcarcely poſſible to collect it in any quantity. It is colourleſs, has ſome viſcidity, and is ſaid to be ſpecifically heavier than water. It is ſaid to be coagulable by heat; if ſo, it contains albumen; and, from its appearance, it probably contains gelatine. Its quantity is certainly conſiderable, for the lymphatics are very numerous.

345 And conveyed to the heart and lungs.

11. The chyle and lymph being thus mixed together, are conveyed directly into the blood veſſels. The effect produced by their union in the thoracic duct is not known, but neither the colour nor external properties of the chyle is altered. In man, and many other animals, the thoracic duct enters at the junction of the left ſubclavian and carotid veins, and the chyle is conveyed directly to the heart, mixed with the blood, which already exiſts in the blood veſſels. From the heart, the blood and chyle thus mixed together are propelled into the lungs, where they undergo farther changes.

346 Reſpiration

12. The abſolute neceſſity of *reſpiration*, or of ſome thing analogous, is known to every one; and few are ignorant that in man, and hot blooded animals, the organ by which reſpiration is performed is the lungs. For a deſcription of the reſpiratory organs, we refer to the article ANATOMY, *Encycl.* and the reader will find an account of the manner in which that function is performed in the article PHYSIOLOGY, *Encycl.* But what are the changes produced upon the blood and the chyle by reſpiration? What purpoſes does it ſerve to the animal? How comes it to be ſo indiſpenſably neceſſary for its exiſtence? Theſe are queſtions which can only be anſwered by a careful examination of the phenomena of reſpiration.

347 Requires oxygen gas.

It has been long known that an animal can only breathe a certain quantity of air for a limited time, after which it becomes the moſt deadly poiſon, and produces ſuffocation as effectually as the moſt noxious gas, or a total abſence of air. It was ſuſpected long ago that this change is owing to the abſorption of a part of the air; and Mayow made a number of very ingenious experiments in order to prove the fact. Dr Prieſtley and Mr Scheele demonſtrated, that the quantity of oxygen gas in atmoſpheric air is diminiſhed; and Lavoiſier demonſtrated, in 1776, that a quantity of carbonic acid gas, which did not previouſly exiſt in it, was found in air after it had been for ſome time reſpired. It was afterwards proved by Lavoiſier, and many other philoſophers, who confirmed and extended his facts, that no animal can live in air totally deſtitute of oxygen. Even fiſh, which do not ſenſibly reſpire, die very ſoon, if the water in which they live be deprived of oxygen gas. Frogs which can ſuſpend their reſpiration at pleaſure, die in about forty minutes, if the water in which they have been confined be covered over with oil.* Inſects and worms, as Vauquelin has proved, exhibit preciſely the ſame phenomena. They require oxygen gas as well as other animals, and die like them if they be deprived of it. They diminiſh the quantity of the oxygen gas in which they live, and give out, by reſpiration, the very ſame products as other animals. Worms, which are more retentive of life than moſt other animals, or at leaſt not ſo much affected by poiſonous gaſes, abſorb every particle of the oxygen gas contained in the air in which they are confined before they die. Mr Vauquelin's experiments were made on the gryllus viridiſſimus, the limax flavus, and helix pomatia.†

348 Changes produced by it.

The changes which take place during reſpiration are the following:

1. Part of the oxygen gas reſpired diſappears.

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* Carradori, Ann. de Chim. xxix. 171.

† Ann. de Chim. xii. 278.

2. Carbonic acid gas is emitted.
3. Water is emitted in the ſtate of vapour.

The firſt point is to aſcertain exactly the amount of theſe changes. Though a great many experiments have been made on this ſubject by different philoſophers, the greateſt confidence ought to be put in thoſe of Lavoiſier, both on account of his uncommon accuracy, and on account of the very complete apparatus which he always employed.

He put a guinea pig into 708.989 grains troy of oxygen, and after the animal had breathed the gas for an hour, he took it out. He found that the oxygen

gas now amounted only to	592.253 gr.
Conſequently there had diſappeared	116 736
The carbonic acid gas formed was	130.472
This was compoſed of about	94.234
oxygen, and	36.238

of carbon. Conſequently ſuppoſing, as Mr Lavoiſier did, that the oxygen abſorbed had been employed in the formation of the carbonic acid gas, there ſtill remained to be accounted for 22.502 grains of oxygen which had diſappeared. He ſuppoſed that this had been employed in the formation of water, a quantity of which had appeared. If ſo, the water formed muſt have amounted to 26.429 grains; which was compoſed of 3.927 hydrogen, the reſt oxygen.[*]

Since the water emitted was not actually aſcertained, this experiment can only be conſidered as an approximation to the truth. Accordingly that very ingenious philoſopher contrived an apparatus to aſcertain the quantity of oxygen gas abſorbed by man, and the quantity of carbonic acid gas and water emitted by him during reſpiration. This apparatus he had conſtructed at an expence at leaſt equal to L.500 ſterling. The experiments were completed, and he was preparing them for publication, when, on the 8th of May 1794, he was beheaded by order of Robeſpierre, after having in vain requeſted a fortnight's delay to put his papers in order for the preſs. Thus periſhed, in the 51ſt year of his age, the man who, if he had lived a few years longer, promiſed fair to become the rival of Newton himſelf. Chemiſtry, as a ſcience, is deeply indebted to him. He ſaved it from that confuſion into which the thoughtleſs ardour of many of his contemporaries were plunging it headlong: he arranged and connected and ſimplified and explained the multitude of inſulated facts, which had been accumulating with unexampled celerity; and which, had it not been for his happy arranging genius, might have retarded, inſtead of advanced, the progreſs of the ſcience. He reduced all the facts under a few ſimple heads, and thus made them eaſily remembered and eaſily claſſified. In a few years more, perhaps, he would have traced theſe general principles to their ſources, eſtabliſhed the ſcience on the completeſt induction, and paved for his ſucceſſors a road as unerring as that which Sir Iſaac Newton formed in mechanical philoſophy.

Mr Lavoiſier's experiments have never been publiſhed, but fortunately Mr de la Place has given us the reſult of them.[†] He informs us that it was as follows: A man, at an average, conſumes, in twenty-four hours, by reſpiration, 32 48437 ounces troy of oxygen gas; that is to ſay, that a quantity of oxygen gas, equal to that weight, diſappears from the air which he reſpires in twenty-four hours; that he gives out by reſpiration, in the ſame time, 15.73 oz. troy of carbonic acid gas, and 28.55 of water in the ſtate of vapour.

Total	44.28	*Oxygen.*
The carbonic acid gas is compoſed of		$10.48\dot{6}$
and 5.243 carbon. The water of		24.2675
and 4.2825 hydrogen.		
Total of the oxygen emitted		$34.7541\dot{6}$
Total abſorbed		32.48437
So that there is		$2.369791\dot{6}$

ounces of oxygen emitted more than is abſorbed by reſpiration. Thus it appears that, by reſpiration, the abſolute quantity of oxygen in the blood is diminiſhed.

Dr Menzies found that a man, at a medium, draws in at every reſpiration 43.77 cubic inches of air, and that $\frac{1}{20}$th of that quantity diſappears. Conſequently, according to him, at every reſpiration 2.1885 cubic inches of oxygen gas are conſumed. Now 2.1885 cubic inches of that gas amount to 0 68669 gr. troy. Suppoſing, with Hales, that a man makes 1200 reſpirations in an hour, the quantity of oxygen gas conſumed in an hour, will amount to 824.028 grains, and in 24 hours to 19776.672 grains, or 41.2014 ounces troy. This quantity exceeds that found by Lavoiſier conſiderably; but the allowance of oxygen for every reſpiration is rather too great. Indeed, from the nature of Dr Menzies's apparatus, it was ſcarce poſſible to meaſure it accurately.

The quantity of water given out by reſpiration, as determined by Hales, amounts in a day to 20.4 oz.;[*] but his method was not ſuſceptible of great accuracy. We may therefore, on the whole, conſider Lavoiſier's determination as by far the neareſt to the truth of any that has been given.

There is, however, a very ſingular anomaly, which becomes apparent when we compare his experiments on the reſpiration of the guinea-pig with thoſe on the reſpiration of man.

The guinea-pig conſumed in 24 hours	5.8368 oz.
troy of oxygen gas, and emitted	6.5236 oz.
of carbonic acid gas. Man, on the other hand, conſumes in the ſame time	32 48437 oz.
of oxygen gas, and emits only	15.73 oz. of

carbonic acid gas. The oxygen gas conſumed by the pig is to the carbonic gas emitted as 1.00 : 1.12; whereas in man it is as 1.000 : 0.484. If we could depend upon the accuracy of each of theſe experiments, they would prove, beyond a doubt, that the changes produced by the reſpiration of the pig are different, at leaſt in degree, from thoſe produced in man; but it is more than probable that ſome miſtake has crept into one or other of the experiments. We have more reaſon to ſuſpect the firſt, as it was made before 1778, at a time when a great many circumſtances, neceſſary to inſure accuracy, were unknown to Lavoiſier.

Such are the ſubſtances imbibed and emitted during reſpiration. It ſtill remains for us to determine what are the changes which it produces on the blood.

It has been long known that the blood which flows in the veins is of a dark reddiſh purple colour, whereas the arterial blood is of a florid ſcarlet colour. Lower obſerved that the colour of the veinous blood was converted into that of arterial during its paſſage through the

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[*] *Ann. de Chim.* v. 261.

[†] *La Place's Eloge.*

[*] *Vege Stat.* ii 327.

the lungs. No chyle can be diſtinguiſhed by its white colour in the blood after it has paſſed through the lungs. The changes, then, which take place upon the appearance of the blood are two: *1ſt*, It acquires a florid red colour: *2d*, The chyle totally diſappears. Now to what are theſe changes owing?

Lower himſelf knew that the change was produced by the air, and Mayow attempted to prove that it was by abſorbing a part of the air. But it was not till Dr Prieſtley diſcovered that veinous blood acquires a ſcarlet colour when put in contact with oxygen gas, and arterial blood a dark red colour when put in contact with hydrogen gas, or, which is the ſame thing, that oxygen gas inſtantly gives veinous blood the colour of arterial; and hydrogen, on the contrary, gives arterial blood the colour of veinous blood: it was not till then that philoſophers began to attempt any thing like an explanation of the phenomena of reſpiration. Two explanations have been given; one or other of which muſt be true.

49 hypo- s to ex- theſe ges.

The firſt is, that the oxygen of the air, which diſappears, combines with a quantity of carbon and hydrogen given out by the blood in the lungs, and forms with it carbonic acid gas and water in vapour, which are thrown out along with the air expired.

The ſecond is, that the oxygen gas, which diſappears, combines with the blood as it paſſes thro' the lungs; and that, at the inſtant of this combination, there is ſet free from the blood a quantity of carbonic acid gas and of water, which are thrown out along with the air expired.

The firſt of theſe theories was originally formed by Lavoiſier and it was embraced by La Place, Crawford, Gren, and Girtanner, with a ſmall variation. Indeed it does not differ, except in detail, from the original hypotheſis of Dr Prieſtley, that the uſe of reſpiration is to rid the blood of phlogiſton; for if we ſubſtitute carbon and hydrogen for phlogiſton, the two theories preciſely agree. Mr Lavoiſier attempted not to prove its truth; he only tried to ſhew that the oxygen abſorbed correſponds exactly with the quantity of oxygen contained in the carbonic acid and the water emitted. This coincidence his own experiments have ſhewn not to hold; conſequently the theory is entirely deſtitute of proof, as far as the proof depends upon this coincidence.

The other hypotheſis was propoſed by Mr de la Grange, and afterwards ſupported and illuſtrated by Mr Haſſenfratz.

150 ſts of ration ined.

In order to diſcover what the real effects of reſpiration are, let us endeavour to ſtate accurately the phenomena as far as poſſible.

In the *firſt* place, we are certain, from the experiments of Prieſtley, Girtanner, and Haſſenfratz, that when veinous blood is expoſed to oxygen gas confined over it, the blood inſtantly aſſumes a ſcarlet colour, and the gas is diminiſhed in bulk; therefore part of the gas has been abſorbed. We may conſider it as certain, then, that when the colour of veinous blood is changed into arterial, ſome oxygen gas is abſorbed.‡

In the *ſecond* place, no chyle can be diſcovered in the blood after it has paſſed through the lungs. Therefore the *white colour* of the chyle at leaſt, is deſtroyed by reſpiration, and it aſſumes a red colour. Now if the red colour of the blood be owing to iron, as many have ſuppoſed, this change of colour is a demonſtration that oxygen has combined with the iron; for we have ſeen already, that iron, if it exiſts in chyle, as it probably does, is in the ſtate of a white oxyd. Conſequently, when converted into a red oxyd, it muſt abſorb oxygen. Even though iron be not the colouring matter of the blood, it would ſtill be probable that the change of colour of the chyle depends on the fixation of oxygen; for Berthollet and Fourcroy have ſhewn that in ſeveral inſtances ſubſtances acquire a red colour by that proceſs.

We may conſider it as proved, then, that oxygen enters the blood as it paſſes through the lungs.

In the *third* place, when arterial blood is put in contact with azotic gas or carbonic acid gas, it gradually aſſumes the dark colour of veinous blood, as Dr Prieſtley found.* The ſame philoſopher alſo obſerved that arterial blood acquired the colour of veinous blood when placed in vacuo.† Conſequently this alteration of colour is owing to ſome change which takes place in the blood itſelf, independent of any external agent.

The arterial blood becomes much more rapidly and deeply dark coloured when it is left in contact with hydrogen gas placed above it.‡ We muſt ſuppoſe therefore that the preſence of this gas accelerates and increaſes the change, which would have taken place upon the blood without any external agent.

If arterial blood be left in contact with oxygen gas, it gradually aſſumes the ſame dark colour which it would have acquired in vacuo, or in contact with hydrogen; and after this change oxygen can no longer reſtore its ſcarlet colour.§ Therefore it is only upon a part of the blood that the oxygen acts; and after this part has undergone the change which occaſions the dark colour, the blood loſes the power of being affected by oxygen.

Mr Haſſenfratz poured into veinous blood a quantity of oxy-muriatic acid; the blood was inſtantly decompoſed, and aſſumed a deep and almoſt black colour. When he poured common muriatic acid into blood, the colour was not altered.|| Now oxy-muriatic acid has the property of giving out its oxygen readily; conſequently the black colour was owing to the inſtant combination of a part of the blood with oxygen.

The facts therefore lead us to conclude, with La Grange and Haſſenfratz, that during reſpiration the oxygen, which diſappears, enters the blood; that during the circulation this oxygen combines with a certain part of the blood; and that the veinous colour is owing to this new combination. We muſt conclude, too, that the ſubſtance which cauſes this dark colour leaves the blood during its circulation thro' the lungs, otherwiſe it could not be capable of aſſuming the florid colour. Now we know what the ſubſtances are which are emitted during reſpiration; they are water and carbonic acid gas. It muſt be to the gradual combination of oxygen, then, during the circulation, with hydrogen and carbon, that the colour of veinous blood is owing. And ſince the ſame combination takes place every time that the blood paſſes through the lungs, we muſt conclude, that it is only a part of the hydrogen and carbon which is acted upon each time. Let us now attempt, with theſe data, to form ſome notion of the decompoſition which goes on during the circulation of the blood.

351 Contributes to the formation of blood.

It is probable that during a conſiderable part of the day, there is a conſtant influx of chyle into the blood and we are certain that lymph is conſtantly flowing into

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‡ n. de v. vii.

* *Prieſtley*, iii. 363.

† *Ibid*, and *Ann. de Chim.* ix. 269.

‡ *Fourcroy*, *Ann. de Chim.* vii. 149.

§ *Ibid.* ix. 268.

|| *Ibid.*

to it. Now it appears, from the moſt accurate obſervations hitherto made, that neither chyle nor lymph contain fibrina, which forms a very conſpicuous part of the blood. This fibrina is employed to ſupply the waſte of the muſcles, the moſt active parts of the body, and therefore, in all probability, requiring the moſt frequent ſupply. Nor can it be doubted that it is employed for other uſeful purpoſes. The quantity of fibrina in the blood, then, muſt be conſtantly diminiſhing, and therefore new fibrina muſt be conſtantly formed. But the only ſubſtances out of which it can be formed are the chyle and lymph, neither of which contain it. There muſt therefore be a continual decompoſition of the chyle and lymph going on in the bloodveſſels, and a continual new formation of fibrina. Other ſubſtances alſo may be formed; but we are certain that this *muſt* be formed there, becauſe it does not exiſt previouſly. Now, one great end of reſpiration muſt undoubtedly be to aſſiſt this decompoſition of chyle and complete formation of blood.

It follows, from the experiments of Fourcroy formerly enumerated, that fibrina contains more azot, and leſs hydrogen and carbon, than any of the other ingredients of the blood, and conſequently alſo than any of the ingredients of the chyle. In what manner the chyle, or a part of it, is converted into fibrina, it is impoſſible to ſay: we are not ſufficiently acquainted with the ſubject to be able to explain the proceſs. But we can ſee at leaſt, that carbon and hydrogen muſt be abſtracted from that part of the chyle which is to be converted into fibrina: And we know, that theſe ſubſtances are actually thrown out by reſpiration. We may conclude, then, that *one* uſe of the oxygen abſorbed is, to abſtract a quantity of carbon and hydrogen from a part of the chyle by compound affinity, in ſuch proportions, that the remainder becomes fibrina: therefore one end of reſpiration is to form fibrina. Doubtleſs the other ingredients of the blood are alſo new modified, though we know too little of the ſubject to throw any light upon it.

552
Produces animal heat;

13. But the complete formation of blood is not the only advantage gained by reſpiration: the *temperature* of all animals depends upon it. It has been long known, that thoſe animals which do not breathe have a temperature but very little ſuperior to the medium in which they live. This is the caſe with fiſhes and many inſects. Man, on the contrary, and quadrupeds which breathe, have a temperature conſiderably higher than the atmoſphere: that of man is 98°. Birds, who breathe in proportion a ſtill greater quantity of air than man, have a temperature equal to 103° or 104°. It has been proved, that the temperature of all animals is proportional to the quantity of air which they breathe in a given time.

Theſe facts are ſufficient to demonſtrate, that the heat of animals depends upon reſpiration. But it was not till Dr Black's doctrine of latent heat became known to the world, that any explanation of the cauſe of the temperature of breathing animals was attempted. That illuſtrious philoſopher, whoſe diſcoveries form the baſis upon which all the ſcientific part of chemiſtry has been reared, ſaw at once the light which his doctrine of latent heat threw upon this part of phyſiology, and he applied it very early to explain the temperature of animals.

According to him, part of the latent heat of the air inſpired becomes ſenſible; and of courſe, the temperature of the lungs, and the blood that paſſes through them, muſt be raiſed; and the blood, thus heated, communicates its heat to the whole body. This opinion was ingenious, but it was liable to an unanſwerable objection: for if it were true, the temperature of the body ought to be greateſt in the lungs, and to diminiſh gradually as the diſtance from the lungs increaſes; which is not true. The theory, in conſequence, was abandoned even by Dr Black himſelf; at leaſt he made no attempt to ſupport it.

Lavoiſier and Crawford, who conſidered all the changes operated by reſpiration as taking place in the lungs, accounted for the origin of the animal heat almoſt preciſely in the ſame manner with Dr Black. According to them, the oxygen gas of the air combines in the lungs with the hydrogen and carbon emitted by the blood. During this combination, the oxygen gives out a great quantity of caloric, with which it had been combined; and this caloric is not only ſufficient to ſupport the temperature of the body, but alſo to carry off the new formed water in the ſtate of vapour, and to raiſe conſiderably the temperature of the air inſpired. According to theſe philoſophers, then, the whole of the caloric which ſupports the temperature of the body is evolved in the lungs. Their theory accordingly was liable to the ſame objection with Dr Black's; but they obviated it in the following manner: Dr Crawford found, that the ſpecific caloric of arterial blood was 1.0300, while that of veinous blood was only 0.8928. Hence he concluded, that the inſtant veinous blood is changed into arterial blood, its ſpecific caloric increaſes; conſequently it requires an additional quantity of caloric to keep its temperature as high as it had been while veinous blood. This addition is ſo great, that the whole new caloric evolved is employed: therefore the temperature of the lungs muſt neceſſarily remain the ſame as that of the reſt of the body. During the circulation, arterial blood is gradually converted into veinous; conſequently its ſpecific caloric diminiſhes, and it muſt give out heat. This is the reaſon that the temperature of the extreme parts of the body does not diminiſh.

This explanation is certainly ingenious; but it is not quite ſatisfactory; for the difference in the ſpecific caloric, granting it to be accurate, is too ſmall to account for the great quantity of heat which muſt be evolved. It is evident that it muſt fall to the ground altogether, provided, as we have ſeen reaſon to ſuppoſe, the carbonic acid gas and water be not formed in the lungs, but during the circulation.

Since the oxygen enters the blood, and combines with it in the ſtate of gas, it is evident that it will only part at firſt with ſome of its caloric; and this portion is chiefly employed in carrying off the carbonic acid gas and the water. For the reaſon that the carbonic acid leaves the blood at the inſtant that the oxygen gas enters it, ſeems to be this: The oxygen gas combines with the blood, and part of its caloric unites at the ſame inſtant to the carbonic acid, and converts it into gas: another portion converts the water into vapour. The reſt of the caloric is evolved during the circulation when the oxygen combines with hydrogen and carbon, and forms water and carbonic acid gas. The quantity of caloric evolved in the lungs ſeems not only ſufficient to carry off the carbonic acid and water, which the dimi-

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nution of the ſpecific caloric (if it really take place) muſt facilitate; but it ſeems alſo to raiſe the temperature of the blood a little higher than it was before. For Mr John Hunter conſtantly found, that the heat of the heart in animals was a degree higher than any other part of the body which he examined. Now this could ſcarcely happen, unleſs the temperature of the blood were ſomewhat raiſed during reſpiration.

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Thus we have ſeen two uſes which reſpiration ſeems to ſerve. The firſt is the completion of blood by the formation of fibrina; the ſecond is the maintaining of the temperature of the body at a particular ſtandard, notwithſtanding the heat which it is continually giving out to the colder ſurrounding bodies. But there is a third purpoſe, which explains why the animal is killed ſo ſuddenly when reſpiration is ſtopped. The circulation of the blood is abſolutely neceſſary for the continuance of life. Now the blood is circulated in a great meaſure by the alternate contractions of the heart. It is neceſſary that the heart ſhould contract regularly, otherwiſe the circulation could not go on. But the heart is ſtimulated to contract by the blood: and unleſs blood be made to undergo the change produced by reſpiration, it ceaſes almoſt inſtantaneouſly to ſtimulate. As the blood receives oxygen in the lungs, we may conclude that the preſence of oxygen is neceſſary to its ſtimulating power.*

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14. Thus we have reaſon to ſuppoſe, that chyle and lymph are converted into blood during the circulation; and that the oxygen gas ſupplied by reſpiration is one of the principal agents in this change. But beſides the lungs and arteries, there is another organ, the ſole uſe of which is alſo to produce ſome change or other in the blood which renders it more complete, and more proper for the various purpoſes to which it is applied. This organ is the *kidney*.

For the ſtructure of the kidneys, which in man and quadrupeds are two in number, we refer to ANATOMY, *Encycl.* A very great proportion of blood paſſes through them; indeed, we have every reaſon to conclude, that the whole of the blood paſſes through them very frequently.

Theſe organs ſeparate the urine from the blood, to be afterwards evacuated without being applied to any purpoſe uſeful to the animal.

The kidneys are abſolutely neceſſary for the continuance of the life of the animal; for it dies very ſpeedily when they become by diſeaſe unfit to perform their functions; therefore the change which they produce in the blood is a change neceſſary for qualifying it to anſwer the purpoſes for which it is intended.

As the urine is immediately excreted, it is evident that the change which the kidneys perform is intended ſolely for the ſake of the blood. It is not merely the abſtraction of a quantity of water and of ſalts, accumulated in the blood, which the kidney performs. A chemical change is certainly produced, either upon the whole blood, or at leaſt on ſome important part of it; for there are two ſubſtances found in the urine which do not exiſt in the blood. Theſe two ſubſtances are urea and uric acid. They are formed, therefore, in the kidneys; and as they are thrown out, after being formed, without being applied to any uſeful purpoſe, they are certainly not formed in the kidneys for their own ſake. Some part of the blood, then, muſt be decompoſed in the kidney, and a new ſubſtance, or new ſubſtances, muſt be formed; and the urea and uric acid muſt be formed at the ſame time, in conſequence of the combined action of the affinities which produce the change on the blood; and being uſeleſs, they are thrown out, together with a quantity of water and ſalts, which in all probability, were uſeful in bringing about the changes which take place in the arteries and in the kidneys, but which are no longer of any ſervice after theſe changes are brought about.

Functions
of Animals.

The changes operated upon the blood in the kidneys are hitherto altogether unknown; but they muſt be important.

Provided the method of analyſing animal ſubſtances were ſo far perfected as to admit of accurate concluſions, conſiderable light might be thrown upon this ſubject, by analyſing with care a portion of blood from the emulgent vein and artery ſeparately, and aſcertaining preciſely in what particulars they differ from each other.

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15. Thus we have ſeen that the principal changes which the blood undergoes, as far at leaſt as we are at preſent acquainted with them, take place in the lungs, in the kidneys, and in the arteries. In the lungs, a quantity of water and carbonic acid gas is emitted from the blood, and in the kidney the urine is formed and ſeparated from it. There ſeems alſo to be ſomething thrown out from the blood during its circulation in the arteries, at leaſt through thoſe veſſels which are near the ſurface of the body: For it is a fact, that certain ſubſtances are conſtantly emitted from the ſkins of animals. Theſe ſubſtances are known in general by the name of *perſpirable matter*, or *perſpiration*. They have a great reſemblance to what is emitted in the lungs; which renders it probable, that they are both owing to the ſame cauſe; namely, to the decompoſition produced in the blood by the effects of reſpiration. They conſiſt chiefly of water in a ſtate of vapour, carbon, and oil.

356
Emit aqueous vapour,

The quantity of aqueous vapour differs very conſiderably, according to circumſtances. It has been ſhewn to be greateſt in hot weather, and in hot climates, and after great exerciſe; and its relation to the quantity of urine has been long known. When the aqueous vapour perſpired is great, the quantity of urine is ſmall, and *vice verſa*.

The moſt accurate experiments on this matter that we have ſeen are thoſe of Mr Cruickſhank. He put his hand into a glaſs veſſel, and luted its mouth at his wriſt by means of a bladder. The interior ſurface of the veſſel became gradually dim, and drops of water trickled down. By keeping his hand in this manner for an hour, he collected 30 grains of a liquid, which poſſeſſed all the properties of pure water.* On repeating the ſame experiment at nine in the evening (thermometer 62°), he collected only 12 grains. The mean of theſe is 21 grains. But as the hand is more expoſed than the trunk of the body, it is reaſonable to ſuppoſe that the perſpiration from it is greater than that from the hand. Let us therefore take 30 grains per hour as the mean; and let us ſuppoſe, with Mr Cruikſhank, that the hand is $\frac{1}{60}$th of the ſurface of the body. The perſpiration in an hour would amount to 1800 grains, and in 24 hours to 43200 grains, or 7 pounds 6 ounces troy.

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* anner, de xxxix.

* *On Inſenſible Perſpiration*, p. 68.

He repeated the experiment again after hard exerciſe, and collected in an hour 48 grains of water.* He found alſo, that this aqueous vapour pervaded his ſtocking without difficulty; and that it made its way through a ſhamoy leather glove, and even through a leather boot, though in much ſmaller quantity than when the leg wanted that covering.†

It is not difficult to ſee why the quantity of watery vapour diminiſhes with cold. When the ſurface of the body is expoſed to a cold temperature, the capacity of the cutaneous veſſels diminiſhes, and conſequently the quantity which flows through them muſt decreaſe.

When the temperature, on the other hand, is much increaſed, either by being expoſed to a hot atmoſphere, or by violent exerciſe, the perſpired vapour not only increaſes in quantity, but even appears in a liquid form. This is known by the name of *ſweat*. In what manner ſweat is produced, is not at preſent known; but we can ſee a very important ſervice which it performs to the animal.

No ſooner is it thrown upon the ſurface of the ſkin than it begins to evaporate. But the change into vapour requires heat; accordingly a quantity of heat is abſorbed, and the temperature of the animal is lowered. This is the reaſon that animals can endure to remain for ſome time in a much higher temperature without injury than could have been ſuppoſed.

The experiments of Tillet, and the ſtill more deciſive experiments of Fordyce and his aſſociates, are well known. Theſe gentlemen remained a conſiderable time in a temperature exceeding the boiling point of water.

357 Carbon,

Beſides water, it cannot be doubted that *carbon* is alſo emitted from the ſkin; but in what ſtate, the experiments hitherto made do not enable us to decide. Mr Cruikſhank found, that the air of the glaſs veſſel in which his hand and foot had been confined for an hour, contained carbonic acid gas; for a candle burned dimly in it, and it rendered lime-water turbid.* And Mr Jurine found, that air which had remained for ſome time in contact with the ſkin, conſiſted almoſt entirely of carbonic acid gas.† The ſame concluſion may be drawn from the experiments of Ingenhouſz and Milly.‡

Now it is evident, that the carbonic acid gas which appeared during Mr Cruikſhank's experiment, did not previouſly exiſt in the glaſs veſſel; conſequently it muſt have either been tranſmitted ready formed through the ſkin, or formed during the experiment by the abſorption of oxygen gas, and the conſequent emiſſion of carbonic acid gas. The experiments of Mr Jurine do not allow us to ſuppoſe the firſt of theſe to be true; for he found, that the quantity of air allowed to remain in contact with the ſkin did not increaſe. Conſequently the appearance of the carbonic acid gas muſt be owing, either to the emiſſion of carbon, which forms carbonic acid gas by combining with the oxygen gas of the air, or to the abſorption of oxygen gas, and the ſubſequent emiſſion of carbonic acid gas; preciſely in the ſame manner, and for the ſame reaſon, that theſe ſubſtances are emitted by the lungs. The laſt is the more probable opinion; but the experiments hitherto made do not enable us to decide.

358 And an oily matter.

Beſides water and carbon, or carbonic acid gas, the ſkin emits alſo a particular odorous ſubſtance. That every animal has a peculiar ſmell, is well known: the dog can diſcover his maſter, and even trace him to a diſtance by the ſcent. A dog, chained ſome hours after his maſter had ſet out on a journey of ſome hundred miles, followed his footſteps by the ſmell, and found him on the third day in the midſt of a crowd.* But it is needleſs to multiply inſtances of this fact; they are too well known to every one. Now this ſmell muſt be owing to ſome peculiar matter which is conſtantly emitted; and this matter muſt differ ſomewhat either in quantity or ſome other property, as we ſee that the dog eaſily diſtinguiſhes the individual by means of it. Mr Cruikſhank has made it probable that this matter is an oily ſubſtance; or at leaſt that there is an oily ſubſtance emitted by the ſkin. He wore repeatedly, night and day for a month, the ſame veſt of fleecy hoſiery during the hotteſt part of the ſummer. At the end of this time he always found a oily ſubſtance accumulated in conſiderable maſſes on the nap of the inner ſurface of the veſt, in the form of black tears. When rubbed on paper, it makes it tranſparent, and hardens on it like greaſe. It burns with a white flame, and leaves behind it a charry reſiduum.†

It has been ſuppoſed that the ſkin has the property of *abſorbing moiſture* from the air; but this opinion has not been confirmed by experiments, but rather the contrary.

359 Whether the ſkin abſorbs moiſture,

The chief arguments in favour of the abſorption of the ſkin, have been drawn from the quantity of moiſture diſcharged by urine being, in ſome caſes, not only greater than the whole drink of the patient, but even than the whole of his drink and food. But it ought to be remembered that, in diabetes, the diſeaſe here alluded to, the weight of the body is continually diminiſhing, and therefore part of it muſt be conſtantly thrown off. Beſides, it is ſcarcely poſſible in that diſeaſe to get an accurate account of the food ſwallowed by the patients; and in thoſe caſes where very accurate accounts have been kept, and where deception was not ſo much practiſed, the urine was found not to exceed the quantity of drink.* In a caſe of diabetes, related with much accuracy by Dr Gerard, the patient was bathed regularly during the early part of the diſeaſe in warm water, and afterwards in cold water: he was weighed before and after bathing, and no ſenſible difference was ever found in his weight.† Conſequently, in that caſe, the quantity abſorbed, if any, muſt have been very ſmall.

It is well known, that thirſt is much alleviated by cold bathing. By this plan, Captain Bligh kept his men cool and in good health during their very extraordinary voyage acroſs the South Sea. This has been conſidered as owing to the abſorption of water by the ſkin. But Dr Currie had a patient who was waſting faſt for want of nouriſhment, a tumor in the œſophagus preventing the poſſibility of taking food, and whoſe thirſt was always alleviated by bathing; yet no ſenſible increaſe of weight, but rather the contrary, was perceived after bathing. It does not appear, then, that in either of theſe caſes water was abſorbed.

Farther, Seguin has ſhewn that the ſkin does not abſorb water during bathing, by a ſtill more complete experiment: He diſſolved ſome mercurial ſalt in water, and found that the mercury produced no effect upon a perſon that bathed in the water, provided no part of the

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* *On Inſenſible Perſpiration*, p. 70.

† *Ibid.* p. 82.

* *Ibid.* p. 70 and 81.

† *Enc. Meth. Med.* i. p. 515.

‡ *Ibid.* p. 511.

* *Cruikſhank*, ibi p. 93.

† *Ibid.* p. 92.

* See Rol *on Diabete*

† *Ibid*, ii. 75.

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the cuticle was injured; but upon rubbing off a portion of the cuticle, the mercurial ſolution was abſorbed, and the effects of the mercury became evident upon the body. Hence it follows irreſiſtibly, that water, at leaſt in the ſtate of *water*, is not abſorbed by the ſkin when the body is plunged into it, unleſs the cuticle be firſt removed.

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This may perhaps be conſidered as a complete proof that no ſuch thing as abſorption is performed by the ſkin; and that therefore the appearance of carbonic acid gas, which takes place when air is confined around the ſkin, muſt be owing to the emiſſion of carbon. But it ought to be conſidered, that although the ſkin cannot abſorb water, this is no proof that it cannot abſorb other ſubſtances; particularly, that it cannot abſorb oxygen gas, which is very different from water. It is well known, that water will not paſs through bladders, at leaſt for ſome time; yet Dr Prieſtley found that veinous blood acquired the colour of arterial blood from oxygen gas, as readily when theſe ſubſtances were ſeparated by a bladder as when they were in actual contact. He found, too, that when gaſes were confined in bladders, they gradually loſt their properties. It is clear from theſe facts, that oxygen gas can pervade bladders; and if it can pervade them, why may it not alſo pervade the cuticle? Nay, farther, we know from the experiments of Cruikſhank, that the vapour perſpired paſſes through leather, even when prepared ſo as to keep out moiſture, at leaſt for a certain time. It is poſſible, then, that water, when in the ſtate of vapour, or when diſſolved in air, may be abſorbed, although water, while in the ſtate of water, may be incapable of pervading the cuticle. The experiments, then, which have hitherto at leaſt been made upon the abſorption of the ſkin, are altogether inſufficient to prove that air and vapour cannot pervade the cuticle; provided at leaſt there be any facts to render the contrary ſuppoſition probable.

Now that there are ſuch facts cannot be denied. We ſhall not indeed produce the experiment of Van Mons as a fact of that kind, becauſe it is liable to objections, and at beſt is very undeciſive. Having a patient under his care who, from a wound in the throat, was incapable for ſeveral days of taking any nouriſhment, he kept him alive during that time, by applying to the ſkin in different parts of the body, ſeveral times a day, a ſponge dipt in wine or ſtrong ſoup.* A fact mentioned by Dr Watſon is much more important, and much more deciſive. A lad at Newmarket, who had been almoſt ſtarved in order to bring him down to ſuch a weight as would qualify him for running a horſe race, was weighed in the morning of the race day; he was weighed again juſt before the race began, and was found to have gained 30 ounces of weight ſince the morning; yet in the interval he had only taken a ſingle glaſs of wine. Here abſorption muſt have taken place, either by the ſkin, or lungs, or both. The difficulties in either caſe are the ſame; and whatever renders abſorption by one probable, will equally ſtrengthen the probability that abſorption takes place by the other (R).

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361
Blood ſupplies the waſte of the ſyſtem.

16. We have now ſeen the proceſs of digeſtion, and the formation of blood, as far at leaſt as we are acquainted with it. But to what purpoſes is this blood employed, which is formed with ſo much care, and for the formation of which ſo great an apparatus has been provided? It anſwers two purpoſes. The parts of which the body is compoſed, bones, muſcles, ligaments, membranes, &c. are continually changing. In youth they are increaſing in ſize and ſtrength, and in mature age they are continually acting, and conſequently continually liable to waſte and decay. They are often expoſed to accidents, which render them unfit for performing their various functions; and even when no ſuch accident happens, it ſeems neceſſary for the health of the ſyſtem that they ſhould be every now and then renewed. Materials therefore muſt be provided for repairing, increaſing, or renewing all the various organs of the body. Phoſphat of lime and gelatine for the bones, fibrina for the muſcles, albumen for the cartilages and membranes, &c. Accordingly all theſe ſubſtances are laid up in the blood; and they are drawn from that fluid as from a ſtorehouſe whenever they are required. The proceſs by which the different parts of the blood are made part of the various organs of the body is called *aſſimilation*.

362
Aſſimilation.

Over the nature of aſſimilation the thickeſt darkneſs ſtill hangs; there is no key to explain it, nothing to lead us to the knowledge of the inſtruments employed. Facts, however, have been accumulated in ſufficient numbers to put the exiſtence of the proceſs beyond the reach of doubt. The healing, indeed, of every fractured bone, and every wound of the body, is a proof of its exiſtence, and an inſtance of its action.

363
Every aſſimilating organ produces a peculiar change,

Every organ employed in aſſimilation has a peculiar office; and it always performs this office whenever it has materials to act upon, even when the performance of it is contrary to the intereſt of the animal. Thus the ſtomach always converts food into chyme, even when the food is of ſuch a nature that the proceſs of digeſtion will be retarded rather than promoted by the change. If warm milk, for inſtance, or warm blood, be thrown into the ſtomach, they are always decompoſed by that organ, and converted into chyme; yet theſe ſubſtances are much more nearly aſſimilated to the animal before the action of the ſtomach than after it. The ſame thing happens when we eat animal food.

364
And no other change.

On the other hand, a ſubſtance introduced into an organ employed in aſſimilation, if it has undergone preciſely the change which that organ is fitted to produce, is not acted upon by that organ, but paſſed on unaltered to the next aſſimilating organ. Thus it is the office of the inteſtines to convert chyme into chyle. Accordingly, whenever chyme is introduced into the inteſtines, they perform their office, and produce the uſual change; but if chyle itſelf be introduced into the inteſtines, it is abſorbed by the lacteals without alteration. The experiment, indeed, has not been tried with true chyle, becauſe it is ſcarce poſſible to procure it in ſufficient quantity; but when milk, which reſembles chyle pretty accurately, is thrown into the jejunum, it is abſorbed unchanged by the lacteals.*

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* Fordyce Digeſtion, p. 189.

(R) The Abbé Fontana alſo found, that after walking in moiſt air for an hour or two, he returned home ſome ounces heavier than he went out, notwithſtanding he had ſuffered conſiderable evacuation from a briſk purge purpoſely taken for the experiment. This increaſe, indeed, might be partly accounted for by the abſorption of moiſture by his clothes.

Again, the office of the blood veſſels, as aſſimilating organs, is to convert chyle into blood. Chyle, accordingly, cannot be introduced into the arteries without undergoing that change; but *blood* may be introduced from another animal without any injury, and conſequently without undergoing any change. This experiment was firſt made by Lower, and it has ſince been very often repeated.

Alſo, if a piece of freſh muſcular fleſh be applied to the muſcle of an animal, they adhere and incorporate without any change, as has been ſufficiently eſtabliſhed by the experiments of Mr J. Hunter. And Buvina has aſcertained, that freſh bone may, in the ſame manner, be engrafted on the bones of animals of the ſame or of different ſpecies.†

In ſhort, it ſeems to hold, at leaſt as far as experiments have hitherto been made, that foreign ſubſtances may be incorporated with thoſe of the body, provided they be preciſely of the ſame kind with thoſe to which they are added, whether fluid or ſolid. Thus chyle may be mixed with chyle, blood with blood, muſcle with muſcle, and bone with bone. The experiment has not been extended to the other animal ſubſtances, the nerves, for inſtance; but it is extremely probable that it would hold with reſpect to them alſo.

On the other hand, when ſubſtances are introduced into any part of the body which are not the ſame with that part, nor the ſame with the ſubſtance upon which that part acts; provided they cannot be thrown out readily, they deſtroy the part, and perhaps even the animal. Thus foreign ſubſtances introduced into the blood very ſoon prove fatal; and introduced into wounds of the fleſh or bones, they prevent theſe parts from healing.

365 Their power limited.

Although the different aſſimilating organs have the power of changing certain ſubſtances into others, and of throwing out the uſeleſs ingredients, yet this power is not abſolute, even when the ſubſtances on which they act are proper for undergoing the change which the organs produce. Thus the ſtomach converts food into chyme, the inteſtines chyme into chyle, and the ſubſtances which have not been converted into chyle are thrown out of the body. If there happen to be preſent in the ſtomach and inteſtines any ſubſtance which, though incapable of undergoing the changes, at leaſt, by the action of the ſtomach and inteſtines, yet has a ſtrong affinity, either for the whole chyme and chyle, or for ſome particular part of it, and no affinity for the ſubſtances which are thrown out, that ſubſtance paſſes along with the chyle, and in many caſes continues to remain chemically combined with the ſubſtance to which it is united in the ſtomach, even after that ſubſtance has been completely aſſimilated, and made a part of the body of the animal. Thus there is a ſtrong affinity between the colouring matter of madder and phoſphat of lime. Accordingly, when madder is taken into the ſtomach, it combines with the phoſphat of lime of the food, paſſes with it through the lacteals and blood veſſels, and is depoſited with it in the bones, as was proved by the experiments of Duhamel. In the ſame manner muſk, indigo, &c. when taken into the ſtomach, make their way into many of the ſecretions.

Theſe facts ſhew us, that aſſimilation is a chemical proceſs from beginning to end; that all the changes are produced according to the laws of chemiſtry; and that we can even derange the regularity of the proceſs by introducing ſubſtances whoſe mutual affinities are too ſtrong for the organs to overcome.

366 Aſſimil tion a c mical p ceſs;

It cannot be denied, then, that the aſſimilation of food conſiſts merely in a certain number of chemical decompoſitions which that food undergoes, and the conſequent formation of certain new compounds. But are the *agents* employed in aſſimilation merely chemical agents?

367 But the agent n chemic

We cannot produce any thing like theſe changes on the food out of the body, and therefore we muſt allow that they are the conſequence of the action of the animal organs. But this action, it may be ſaid, is merely the ſecretion of particular juices, which have the property of inducing the wiſhed for change upon the food; and this very change would be produced out of the body, provided we could procure theſe ſubſtances, and apply them in proper quantity to the food. If this ſuppoſition be true, the ſpecific action of the veſſels conſiſts in the ſecretion of certain ſubſtances; conſequently the cauſe of this ſecretion is the *real* agent in aſſimilation. Now, can the *cauſe* of this ſecretion be ſhewn to be merely a chemical agent? Certainly not. For in the ſtomach, where only this ſecretion can be ſhewn to exiſt, it is not always the ſame, but varies according to circumſtances. Thus eagles at firſt cannot digeſt grain, but they may be brought to do it by perſiſting in making them uſe it as food. On the contrary, a lamb cannot at firſt digeſt animal food, but habit will alſo give it this power. In this caſe, it is evident that the gaſtric juice changes according to circumſtances. Now this is ſo far from being a caſe of a chemical law, that it is abſolutely incompatible with every ſuch law. The agent in aſſimilation, then, is not a chemical agent, but one which acts upon different principles. It is true, indeed, that every ſtep in the proceſs is chemical; but the agent which regulates theſe chemical proceſſes, which prevents them from acting, except in particular circumſtances and on particular ſubſtances, and modifies this action according to circumſtances, is not a mere chemical agent, but endowed with very different properties.

The preſence and power of this agent will be ſtill more evident, if we conſider the immunity of the ſtomach of the living animal during the proceſs of digeſtion. The ſtomach of animals is as fit for food as any other ſubſtance. The gaſtric juice, therefore, muſt have the ſame power of acting on it, and of decompoſing it, that it has of acting on other ſubſtances; yet it is well known that the ſtomach is not affected by digeſtion while the animal retains life; though, as Mr Hunter aſcertained, the very gaſtric juice which the living ſtomach ſecretes often diſſolves the ſtomach itſelf after death. Now what is the power which prevents the gaſtric juice from acting on the ſtomach during life? Certainly neither a chemical nor mechanical agent, for theſe agents muſt ſtill retain the ſame power after death. We muſt, then, of neceſſity conclude, that there exiſts in the animal an agent very different from chemical and mechanical powers, ſince it controuls theſe powers according to its pleaſure. Theſe powers therefore in the living body are merely the ſervants of this ſuperior agent, which directs them ſo as to accompliſh always one particular end. This agent ſeems to regulate the chemical powers, chiefly by bringing only certain ſubſtances together which are to be decompoſed, and by keeping at a diſtance thoſe ſubſtances which would interfere with, or diminiſh, or ſpoil the product, or injure

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† Phil. Mag. vi. 308.

injure the organ. And we ſee that this ſeparation is always attended to even when the ſubſtances are apparently mixed together. For the very ſame products are not obtained which would be obtained by mixing the ſame ſubſtances together out of the body that are produced by mixing them in the body; conſequently all the ſubſtances are not left at full liberty to obey the laws of their mutual affinities. The ſuperior agent, however, is not able to exerciſe an unlimited authority over the chemical powers; ſometimes they are too ſtrong for it: ſome ſubſtances accordingly, as madder, make their way into the ſyſtem; while others, as arſenic, decompoſe and deſtroy the organs of the body themſelves.

But it is not in digeſtion alone that this ſuperior agent makes the moſt wonderful diſplay of its power; it is in the laſt part of aſſimilation that our admiration is moſt powerfully excited. How comes it that the preciſe ſubſtances wanted are always carried to every organ of the body? How comes it that fibrina is always regularly depoſited in the muſcles, and phoſphat of lime in the bones? And what is ſtill more unaccountable, how comes it that prodigious quantities of ſome one particular ſubſtance are formed and carried to a particular place in order to ſupply new wants which did not before exiſt? A bone, for example, becomes diſeaſed and unfit for the uſe of the animal; a new bone therefore is formed in its place, and the old one is carried off by the abſorbents. In order to form this new bone, large quantities of phoſphat of lime are depoſited in a place where the ſame quantity was not before neceſſary. Now, who informs this agent that an unuſual quantity of phoſphat of lime is neceſſary, and that it muſt be carried to that particular place? Or granting, as is moſt probable, that the phoſphat of lime of the old bone is partly employed for this purpoſe, who taught this agent that the old bone muſt be carried off, new modelled, and depoſited, and aſſimilated anew? The ſame wonders take place during the healing of every wound, and the renewing of every diſeaſed part.

Theſe operations are incompatible with the ſuppoſition that the body of animals is a mere chemical and mechanical machine; and demonſtrate the preſence of ſome agent beſides, which acts according to very different laws.

But neither in this caſe is the power of this agent over the chemical agents, which are employed, abſolute. We may prevent a fractured bone from healing by giving the patient large quantities of acids. And unleſs the materials for the new wanted ſubſtances be ſupplied by the food, they cannot, in many caſes, be formed at all. Thus the canary bird cannot complete her eggs unleſs ſhe be furniſhed with lime.

It is evident that the ſupreme agent of the animal body, whatever that agent may be, acts according to fixed laws; and that when theſe laws are oppoſed by thoſe which are more powerful, it cannot overcome them. Theſe laws clearly indicate deſign; and the agent has the power of modifying them ſomewhat according to circumſtances. Thus more phoſphat of lime is ſent to a limb which requires a new bone, and more lime than uſual is taken into the ſyſtem when the hen is laying eggs. Deſign and contingency are conſidered by us as infallible marks of conſciouſneſs and intelligence. That they are infallible marks of the agency of mind is certain; but that they are in all caſes the proofs of immediate conſciouſneſs and intelligence, as the Stahlians ſuppoſed, cannot be affirmed without running into inconſiſtencies. For we ourſelves are not conſcious of theſe operations which take place during *aſſimilation*.

To ſay that a being can act with deſign without intelligence, we allow to be a flat contradiction, becauſe deſign always implies intelligence. There muſt therefore be intelligence ſomewhere. But may not this intelligence exiſt, not in the agent, but in the being who formed the agent? And may not the whole of the deſign belong in reality to that being?

368
Nor material.

May not this agent, then, be material, and may not the whole of aſſimilation be performed by mere matter, acting according to laws given it by its maker? We anſwer, that what is called *matter*, or the ſubſtances enumerated in the firſt part of CHEMISTRY (*Suppl.*) act always according to certain attractions and repulſions, which are known by the name of mechanical and chemical laws.

The phenomena of aſſimilation are ſo far from being caſes of theſe laws, that they are abſolutely inconſiſtent with them, and contrary to them; conſequently the agent which preſides over *aſſimilation* is not *matter*. Concerning the nature of this ſubſtance it is not the buſineſs of this article to inquire; but as it poſſeſſes properties different from matter, and acts according to very different laws, it would be an abuſe of terms to call it *matter*.

369
Animal principle.

We would give it the name of *mind*, were it not that metaphyſicians have choſen to conſider intelligence as the eſſence of mind; whereas this ſubſtance may be conceived to act, and really does act, without intelligence. There is no reaſon, however, to ſuppoſe, with ſome, that there are two ſubſtances in animals: one poſſeſſed of conſciouſneſs as its eſſence, and therefore called *mind* or *ſoul* in man; another, deſtitute of conſciouſneſs, called the *living principle*, &c. employed in performing the different functions of aſſimilation, abſorption, &c. It is much more reaſonable to ſuppoſe, that in every animal and vegetable there is a peculiar ſubſtance, different from matter, to which their peculiar properties are owing; that this ſubſtance is different in every ſpecies of animal and vegetable; that it is capable of acting according to certain fixed laws which have been impoſed upon it by its Creator, and that theſe laws are of ſuch a nature that it acts in ſubſervience to a particular end; that this ſubſtance in plants is probably deſtitute of intelligence; that in man and other animals it poſſeſſes intelligence to a certain extent, but that this intelligence is not eſſential to its exiſtence nor to its activity; that it may be deprived of intelligence altogether, and afterwards recover it without altering its nature. Phyſiologiſts have given it the name of *living principle*, becauſe its preſence conſtitutes life. Perhaps it would be proper to diſtinguiſh that of animals by the name of *animal principle*. Upon what the intelligence of the animal principle depends, it is impoſſible to ſay; but it is evidently connected with the ſtate of the brain. During a trance, or an apoplectic fit, it has often been loſt for a time, and afterwards recovered.

370
Secretion.

17. Beſides aſſimilation, the blood is alſo employed in forming all the different ſecretions which are neceſſary for the purpoſes of the animal economy. Theſe have been enumerated in the laſt chapter. The proceſs is ſimilar to that of aſſimilation, and undoubtedly the agents in both caſes are the ſame; but we are

equally

Decompoſition of Animal Subſtances.

equally ignorant of the preciſe manner in which ſecretion is performed as we are of aſſimilation.

371 Animals at length die, and why.

18. After theſe functions have gone on for a certain time, which is longer or ſhorter according to the nature of the animal, the body gradually decays, at laſt all its functions ceaſe completely, and the animal dies. The cauſe of this muſt appear very extraordinary, when we conſider the power which the animal has of renewing decayed parts; for it cannot be doubted that death proceeds, in moſt caſes at leaſt, from the body becoming incapable of performing its function. But if we conſider that this power is limited, and that it muſt ceaſe altogether, when theſe parts of the ſyſtem begin to decay which are employed in preparing materials for future aſſimilation, our ſurpriſe will, in ſome meaſure, ceaſe. It is in theſe parts, in the organs of digeſtion and aſſimilation accordingly, that this decay uſually proves fatal. The decay in other parts deſtroys life only when the waſte is ſo rapid that it does not admit of repair.

What the reaſon is that the decay of the organs cauſes death, or, which is the ſame thing, cauſes the living principle either to ceaſe to act, or to leave the body altogether, it is perfectly impoſſible to ſay, becauſe we know too little of the nature of the living principle, and of the manner in which it is connected with the body. The laſt is evidently above the human underſtanding, but many of the properties of the living principle have been diſcovered: and were the facts already known properly arranged, and ſuch general concluſions drawn from them as their connection with each other fully warrant, a degree of light would be thrown upon the animal economy which thoſe, who have not attended to the ſubject, are not aware of.

No ſooner is the animal dead, than the chemical and mechanical agents, which were formerly ſervants, uſurp the ſupreme power, and ſoon decompoſe and deſtroy that very body which had been in a great meaſure reared by their means. But the changes which take place upon animal bodies after death, are too important, and too intimately connected with the ſubject of this article to be paſſed over ſlightly. They ſhall therefore form the ſubject of the next chapter.

CHAP. IV. OF THE DECOMPOSITION OF ANIMAL SUBSTANCES.

372 Decompoſition of animal ſubſtances expoſed to the air.

ALL the ſoft and the liquid parts of animals, when expoſed to a moderate temperature of ſixty-five degrees or more, paſs with more or leſs rapidity through the following changes. Their colour becomes paler, and their conſiſtence diminiſhes; if it be a ſolid part, ſuch as fleſh, it ſoftens, and a ſerous matter ſweats out, whoſe colour quickly changes; the texture of the part becomes relaxed, and its organization deſtroyed; it acquires a faint diſagreeable ſmell; the ſubſtance gradually ſinks down, and is diminiſhed in bulk; its ſmell becomes ſtronger and ammoniacal. If the ſubject be contained in a cloſe veſſel, the progreſs of putrefaction, at this ſtage, ſeems to ſlacken; no other ſmell but that of a pungent alkali is perceived; the matter effervеſces with acids, and converts ſyrup of violets to a green. But if the communication with the air be admitted, the urinous exhalation is diſſipated, and a peculiar putrid ſmell is ſpread around with a kind of impetuoſity; a ſmell of the moſt inſupportable kind, which laſts a long time, and pervades every place, affecting the bodies of living animals after the manner of a ferment, capable of altering the fluids: this ſmell is corrected, and as it were confined by ammonia. When the latter is volatilized, the putrefactive proceſs becomes active a ſecond time, and the ſubſtance ſuddenly ſwells up, becomes filled with bubbles of air, and ſoon after ſubſides again. Its colour changes, the fibrous texture of the fleſh being then ſcarcely diſtinguiſhable; and the whole is changed into a ſoft, brown, or greeniſh matter, of the conſiſtence of a poultice, whoſe ſmell is faint, nauſeous, and very active on the bodies of animals. The odorant principle gradually loſes its force; the fluid portion of the fleſh aſſumes a kind of conſiſtence, its colour becomes deeper, and it is finally reduced into a friable matter, rather deliqueſcent, which being rubbed between the fingers, breaks into a coarſe powder like earth. This is the laſt ſtate obſerved in the putrefaction of animal ſubſtances; they do not arrive at this term but at the end of a conſiderable time.†

373 Buried the cart

In carcaſes buried in the earth, putrefaction takes place much more ſlowly; but it is ſcarcely poſſible to obſerve its progreſs with accuracy. The abdomen is gradually dilated with elaſtic fluids which make their appearance in it, and at laſt it burſts and diſcharges a horribly fetid and noxious gas; at the ſame time a dark coloured liquid flows out. If the earth be very dry, and the heat conſiderable, the moiſture is often abſorbed ſo rapidly, that the carcaſe, inſtead of putrefying, dries, and is transformed into what is called a *mummy*.

374 When cumulat togethe

Such are the phenomena when dead bodies are left to putrefy ſeparately. But when great numbers of carcaſes are crowded together in one place, and are ſo abundant as to exclude the action of external air, and other foreign agents, their decompoſition is entirely the conſequence of the reciprocal action of their ingredients themſelves upon each other, and the reſult is very different. The body is not entirely diſſipated or converted into mould, but all the ſoft parts are found diminiſhed remarkably in ſize, and converted into a peculiar *ſaponaceous matter*. This ſingular change was firſt accurately obſerved in the year 1786.

375 Conver into a f naceou matter.

The burial ground of the Innocents in Paris having become noxious to thoſe who lived in its neighbourhood, on account of the diſagreeable and hurtful odour which it exhaled, it was found neceſſary to remove the carcaſes to another place. It had been uſual to dig very large pits in that burial ground, and to fill them with the carcaſes of the poorer ſort of people, each in its proper bier; and when they were quite full, to cover them with about a foot depth of earth, and to dig another ſimilar pit, and fill it in the ſame manner. Each pit held between 1000 and 1500 dead bodies. It was in removing the bodies from theſe pits that this ſaponaceous ſubſtance was found. The grave-diggers had aſcertained, by long experience, that about thirty years were required before all the bodies had undergone this change in its full extent.* Every part of the body acquired the properties of this ſubſtance. The inteſtines and viſcera of the thorax had completely diſappeared; but what is ſingular enough, the brain had loſt but little of its ſize or appearance, though it was alſo converted into the ſame ſubſtance.

376 Its pro ties.

This ſaponaceous matter was of a white colour, ſoft and unctuous to the touch, and melted, when heated, like

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† Fourcr

* Fourc Ann. d Chim. v 154.

ompo- of A- Sub- nces.

like tallow. It exhibited all the properties of a *ſoap*, containing, however, an exceſs of fatty matter. Fourcroy, who analyſed it, found that it was compoſed of a fatty matter combined with ammonia, and that it contained alſo ſome phoſphat of lime and ammonia. Diluted acids decompoſed it, and ſeparated the fatty matter; alkalies and lime, on the other hand, drove off the ammonia. When expoſed to the air, it gradually loſt its white colour; the ammonia, in a great meaſure, evaporated, and what remained had ſomething of the appearance of wax. It abſorbed water with great avidity, and did not part with it readily. Its white colour was owing to the preſence of that liquid. The oily matter, when ſeparated by means of a diluted acid, was concrete, and of a white colour, owing to the mixture of a quantity of water. When dried, it acquires a greyiſh brown colour, a lamellar and cryſtalline texture, like that of ſpermaceti; but if it has been rapidly dried it aſſumes the appearance of wax. It melts, when heated, to 126°; when properly purified, by paſſing it through a linen cloth while fluid, it has ſcarcely any ſmell. Alcohol does not act upon it while cold, but at the temperature of 120° it diſſolves it: when the ſolution cools, the fatty matter precipitates, and forms a gritty maſs. With alkalies it forms a ſoap; and when ſet on fire it burns preciſely like oil or fat, only that it exhales a more unpleaſant odour.†

77 iced run- wa-

Mr Smith Gibbes found the ſame ſubſtance in the pit into which animal matters are thrown at Oxford after diſſection. A ſmall ſtream of water conſtantly paſſes through this pit; a circumſtance which induced him to try whether animal muſcle expoſed to the action of a running ſtream underwent the ſame change. The experiment ſucceeded completely: he attempted, in conſequence, to render this ſubſtance, to which he gave the name of *ſpermaceti*, uſeful in thoſe manufactures which required tallow; but the fetid odour which it conſtantly exhales was an inſurmountable objection. Attempts were indeed made to get over it; but as we do not hear that Mr Smith Gibbes's ſpermaceti has been introduced into any manufacture, we have reaſon to conclude that none of theſe attempts ſucceeded.‡

Decompoſition of Animal Subſtances.

378 Theory of putrefaction imperfect.

Such are the phenomena of putrefaction, as far as they are at preſent known to chemiſts. Any attempt to explain the manner in which theſe changes take place, would be exceedingly imperfect indeed; not only becauſe we are ignorant of the ſtrength of the affinities of the different elementary parts of animal bodies for each other, but becauſe we do not even know the manner in which theſe elements are combined, and conſequently we cannot know by what particular forces theſe compounds are deſtroyed. We know only that a certain degree of heat, and the preſence of moiſture, are in all caſes neceſſary for the putrefactive proceſs; for animal bodies may be kept almoſt any length of time, without decompoſition, at the freezing temperature; and when dried quickly, and kept in that ſtate, they undergo no farther change.

PART III. OF DYEING.

MANKIND have in all periods of ſociety manifeſted a fondneſs for beautiful and gaudy colours. Naked ſavages at firſt applied them to their ſkin. This was the caſe with the Britons, and with the Gauls, too, in the time of Cæſar; it is even ſtill the practice in the South Sea iſlands, and many parts of America. When mankind had advanced ſo far towards civilization as to wear garments, they naturally transferred to them the colours which they admired. Hence the origin of *dyeing*; which is of ſuch antiquity, that it precedes the earlieſt records left us by profane authors. We ſee from the book of Geneſis the great progreſs which it had made in the time of the patriarchs.

9 n of g.

Dyeing ſeems to have originated in India, and to have ſpread gradually from that country to the weſt. The Indians were the inventors of the method of dyeing cotton and linen, which was not underſtood in Europe before the conqueſts of Alexander the Great. The Phenicians excelled in the art at a very early period. It was from them that the Jews purchaſed all the dyed ſtuffs deſcribed in Exodus. The Phenician dyers ſeem to have confined their art to wool: ſilk was unknown to them, and linen was uſually worn white. From them the art of dyeing paſſed to the Greeks and Romans.

During the fifth century, the Weſtern Empire was overturned by the northern nations, and with it the arts and ſciences, which had flouriſhed under the protection of the Romans, diſappeared. A few of the arts, indeed, were preſerved in Italy, but they were obſcured and degraded. By degrees, however, a ſpirit of induſtry began to revive in that country. Florence, Genoa, and Venice, becoming rich commercial cities, carried on a conſiderable intercourſe with the Grecian empire, where many of the arts had been preſerved. This intercourſe was much increaſed by the cruſades. The Italian cities became rich and powerful: the arts which diſtinguiſh civilized nations were cultivated with emulation, and dyeing, among others, was rapidly improved.

380 Its progreſs in modern Europe.

In the year 1429, the firſt treatiſe on dyeing made its appearance at Venice, under the name of *Moriegola del'arte de tentori*. Giovanne Ventura Roſetta collected, with great induſtry, all the proceſſes employed by the dyers of his time, and publiſhed them in 1548, under the title of *Plictho*.* For many years dyeing was almoſt excluſively confined to Italy; but it gradually made its way to France, the Low Countries, and to Britain. The miniſter Colbert, who employed his talents in extending the commerce and manufactures of France, paid particular attention to the art of *dyeing*. In the year 1672, he publiſhed a table of inſtructions, by which thoſe who practiſed the art were laid under ſeveral very improper reſtrictions. But the bad effects of theſe were in a good meaſure obviated by the judicious appointment of men of ſcience to ſuperintend the art. This plan, begun by Colbert, was continued by the French government. Accordingly, Dufay, Hellot, Macquer, and Berthollet, ſucceſſively filled the office. It is to this eſtabliſhment, and to exertions of the celebrated chemiſts who have filled it, that France is indebted for the improvements ſhe has made in the art of dyeing during the courſe of the 18th century. Under the direction of Dufay, a new table of regulations was publiſhed in 1737, which ſuperſeded that of Colbert.

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† croy, de viii.

‡ *Phil. Tranſ.* 1794 and 1795.

* *Berthollet on Dyeing*, i. 22.

Hellot, his ſucceſſor, publiſhed, in 1740, an excellent ſyſtem of dyeing wool; and Macquer in 1763 publiſhed his treatiſe on dyeing ſilk.

In Britain, though dyeing has been carried on for many years with great ſucceſs, very little progreſs was made in inveſtigating the theory of the art. The Royal Society, indeed, ſoon after its inſtitution, recommended it to ſome of its members; but as no treatiſe made its appearance in conſequence of this, it ſeems very ſoon to have loſt their attention. Lewis, many years after, publiſhed ſome very important remarks on dyeing; but they were confined to a few proceſſes. The Britiſh dyers ſatisfied themſelves with a tranſlation of Hellot. Such was the ſtate of the art when the article Dyeing in the *Encyclopædia* was drawn up. It conſiſts chiefly of an abſtract of Hellot's treatiſe. But within the laſt 30 years, the attention of men of ſcience has been very much turned to this complicated art. In Sweden has appeared the treatiſe of Scheffer, and Bergman's notes on it; in Germany, the experiments of Beckmann, Poerner, and Vogler, and the diſſertation of Francheville: in France, the treatiſes of D'Ambournay, D'Apligny, Hauſſmann, Chaptal, and, above all, of Berthollet; in this country, the ingenious remarks of Delaval, of Henry, and the valuable treatiſe of Dr Bancroft; beſides many other important eſſays. Theſe, together with the progreſs of the ſcience of chemiſtry, on which the theory of dyeing depends, have thrown ſo much new light upon the art, that we find ourſelves under the neceſſity of tracing the whole over again. We ſhall paſs over, however, very ſlightly thoſe parts of the art which have been ſufficiently explained in the article Dyeing, *Encycl.*

To underſtand the art of *dyeing*, we muſt be acquainted with the *ſubſtances* on which it is practiſed, with the nature of *colour*, and with the method of permanently changing the colour of bodies. Theſe three things we ſhall conſider in the three following chapters. In the firſt, we ſhall give an account of the ſubſtances of which garments are uſually made, with which alone the art of dyeing is concerned; in the ſecond, we ſhall inquire into the nature of colour; and in the third, explain the theory of dyeing, as far as it is at preſent underſtood. In ſome ſubſequent chapters, we ſhall give a general view of the proceſſes by which the different colours are given to ſtuffs.

CHAP. I. OF THE SUBSTANCES USED FOR CLOTHING.

381 Clothing

The ſubſtances commonly employed for clothing may be reduced to four; namely *wool*, *ſilk*, *cotton*, *linen*. As there is no name in the Engliſh language which includes all theſe ſubſtances, we ſhall take the liberty, in the remainder of this article, to uſe the word *cloth* for that purpoſe. They are all made into *cloth*, of ſome kind or other, before they can be uſeful as articles of *clothing*.

382 Conſiſts of wool,

1. Wool, as is well known, is the hair which covers the bodies of ſheep; it differs from common *hair* merely in fineneſs and ſoftneſs. It filaments poſſeſs a conſiderable degree of elaſticity; they may be drawn out beyond their uſual length, and afterwards recover their form when the external force is removed. The ſurface of wool and hair is by no means ſmooth: No inequality, indeed, can be perceived by a microſcope; nor is any reſiſtance felt when a hair is laid hold of in one hand, and drawn between the fingers of the other, from the *root* towards the *point*; but if it be drawn from the *point* towards the *root*, a reſiſtance is felt which did not take place before, a tremulous motion is perceived, and a noiſe may be diſtinguiſhed by the ear. If, after laying hold of a hair between the thumb and fore finger, we rub them againſt each other in the longitudinal direction of the hair, it acquires a progreſſive motion *towards the root*; the *point* gradually approaches the fingers, while the *root* recedes from them; ſo that the whole hair very ſoon paſſes through between the fingers.

Theſe obſervations, firſt made by Mr Monge, demonſtrate that the ſurface of hair and wool is compoſed, either of ſmall laminæ, placed over each other in a ſlanting direction from the root towards the point, like the ſcales of a fiſh—or of zones, placed one above another, as takes place in the horns of animals.*

On this ſtructure of the filaments of hair and wool depend the effects of *felting* and *fulling*. In both of theſe operations, the filaments are made, by an external force, to rub againſt each other; the poſition of their aſperities prevents them from moving, except in one direction: they are mutually entangled, and obliged to approach nearer each other. Hence the thickneſs which cloth acquires in the fulling mill. The filaments have undergone a certain degree of felting, and are interwoven like the fibres of a hat. The cloth is contracted both in length and breadth: it may be cut without being ſubject to ravel; nor is there any neceſſity for hemming the different pieces employed to make a garment. See Felting and Fulling, in this *Suppl.*

Wool is naturally covered with a kind of greaſe, which preſerves it from moths. This is always removed before the wool is dyed; becauſe its preſence is very prejudicial to the ſucceſs of that operation. The aſperities of the ſurface of woolly fibres would impede the converting of it into thread by ſpinning; but they are in a great meaſure covered, previous to that operation, by ſoaking the wool with oil. The oil muſt alſo be removed before the wool be dyed. This proceſs is called Scouring, which ſee in this *Suppl.*

We have already, in the ſecond part of this article, given an account of what is at preſent known concerning the compoſition of wool and hair. It would be foreign to the ſubject of this chapter, to deſcribe the method of *ſpinning* and *weaving* wool.

Wool is of different colours; but that which is white is preferred for making cloth; becauſe it anſwers better for the purpoſes of dyeing than any other kind.

38 Silk

2. Silk is a ſubſtance ſpun in fine threads by the *ſilk worm*. Its fibres are not ſcaly like thoſe of wool; neither have they the ſame elaſticity: but ſilk, in its natural ſtate, before it has undergone any preparation, has a conſiderable degree of ſtiffneſs and elaſticity. In this ſtate it is known by the name of *raw ſilk*. It is covered with a kind of gummy varniſh, which may be removed by ſcouring with ſoap. The ſcouring deprives it of its ſtiffneſs and elaſticity. Raw ſilk is of a yellow colour, owing to yellow reſinous matter with which it is naturally combined. We have given the method of ſeparating this matter, and alſo the gum, in the article Bleaching, *Supplement*.

Silk, before it is dyed, is always freed from its gum, and generally alſo from its reſin. It may be dyed with-

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* *Ann. d Chim.* vi 300.

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out the application of heat; which is not the caſe with wool.

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3. Cotton is a fine downy ſubſtance, contained in the pods of different ſpecies of goſſypium. The ſpecies from which the greater part of the cotton brought to Britain is taken is the *herbaceum*. The quantity imported annually into Britain is very great; in 1786 it amounted to 20 millions of pounds.‡ Cotton varies greatly, according to the plant on which it grows, and the climate where it is cultivated. The chief differences are in colour, and in the length, fineneſs, and ſtrength of the filaments.

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No aſperities can be diſcovered on the ſurface of theſe filaments; but Lewenhoeck obſerved, by means of a microſcope, that they are triangular, and have three ſharp edges. This is probably the reaſon of a well known fact, that cotton cloth, when applied by way of dreſſing, always irritates a ſore.

Some cottons are naturally white; others a fine light yellow, as thoſe of which nankeen is made; but moſt commonly cotton is of a dirty browniſh yellow colour, which muſt be removed before the ſtuff can be dyed. This is done by the proceſs of *bleaching*. The fibres of cotton, even after being bleached, retain almoſt always ſome lime and oxyd of iron, which muſt be removed before we attempt to dye the cotton; becauſe their preſence would ſpoil the colour. This is done by ſteeping the cotton for ſome time in water acidulated with ſulphuric acid.

Cotton, like ſilk, may be dyed without the aſſiſtance of heat. It is not nearly ſo eaſy to dye cotton any particular colour as it is to dye wool or ſilk. If wool and cotton be put into the ſame dyeing veſſel, the wool frequently acquires the wiſhed-for colour before the cotton has loſt any of its original whiteneſs.

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4. Lint, from which *linen* is made, is the inner bark of the *linum uſſitatiſſimum*, or *flax;* a plant too well known in this country to require any deſcription.

The flax, when ripe, is pulled and ſteeped for ſome days in water, in order to ſeparate the green coloured glutinous matter which adheres to the inner bark. This matter undergoes a degree of putrefaction; carbonic acid gas and hydrogen gas, are diſengaged:* it is decompoſed, and carried off by the water. If the water, in which the flax is ſteeped, be completely ſtagnant, the putrefaction is apt to go too far, and to injure the fibres of the lint; but in a running ſtream, it does not go far enough, ſo that the green matter ſtill continues to adhere to the lint. Flax, therefore, ſhould be ſteeped in water neither completely ſtagnant, nor flowing too freely, like a running ſtream.

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The flax is afterwards ſpread upon the graſs, and expoſed for ſome time to the air and ſun: this improves the colour of the lint, and renders the woody part ſo brittle, that it is eaſily ſeparated by the action of the lint mill. The ſubſequent operations, of *dreſſing*, *ſpinning*, *weaving*, and *bleaching*, do not belong to this article.

The fibres of lint have very little elaſticity. They appear to be quite ſmooth; for no aſperities can be perceived by the microſcope, nor detected by the feel; nor does linen irritate ſores, as is the caſe with cotton.

Linen may be dyed without the aſſiſtance of heat; but it is more difficult to give it permanent colours than even cotton.

Thus we have given a ſhort deſcription of wool, ſilk, cotton, and linen. The firſt two are animal ſubſtances; the two laſt vegetable. The animal contain much azot and hydrogen; the vegetable much carbon: The animal are readily deſtroyed by acids and alkalies; the vegetable withſtand the action of theſe ſubſtances better; even nitric acid does not readily deſtroy the texture of cotton. The animal ſubſtances are more eaſily dyed than the vegetable, and the colours which they receive are more permanent than thoſe given to cotton and linen by the ſame proceſſes.

Such are the properties of the cloths on which the art of dyeing is exerciſed. But what is the nature of theſe *colours* which it is the object of that art to communicate? We ſhall examine this ſubject in the following chapter.

Chap. II. Of Colours.

All viſible objects, as has been long ago ſufficiently eſtabliſhed, are ſeen by means of rays of light paſſing off from them in all directions, and partly entering the eye of the ſpectator.

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Colour produced by light.

1. For the theory of light and viſion we are indebted to Sir Iſaac Newton. He firſt demonſtrated, that light is compoſed of ſeven rays, differing from each other in refrangibility, and other properties. Each of theſe rays is diſtinguiſhed by its particular colour. Hence their names, red, orange, yellow, green, blue, indigo, violet. By mixing together theſe different rays, in various proportions, all the colours known may be obtained. Thus red and yellow conſtitute orange; yellow and blue conſtitute green; blue and red conſtitute purple, violet, aurora, &c. according to their proportions. When all the rays are mixed together, they form a white.

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Bodies reflect different rays.

2. Bodies differ very much from each other in their power of reflecting light. Some reflect it in vaſt quantity, as metals; others reflect but little, as charcoal. In general, the ſmoother the ſurface of a body is, the greater is the quantity of light which it reflects. Hence the effect of poliſhing in increaſing the brightneſs of bodies. But it is not in the quantity of the light reflected alone that bodies differ from each other; they differ alſo in the quality of the light which they reflect. Some bodies reflect one or more particular ſpecies of ray to the excluſion of the reſt. This is the reaſon that they appear to us of different colours. Thoſe bodies which reflect only red rays are red; theſe that reflect yellow rays are yellow; thoſe that reflect all the rays equally are white; thoſe that reflect too little to affect the eye are black. It is to the different combinations of rays reflected from the ſurface of bodies that all the different ſhades of colour are owing.

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Hence their different colours.

Colour, then, in *opaque* bodies, is owing to their diſpoſition to *reflect* certain rays of light, and to *abſorb* the reſt; in *tranſparent* bodies, to their diſpoſition to *tranſmit* certain rays, and to *abſorb* the others. But this ſubject has been diſcuſſed, at ſufficient length, in the article Optics, *Encycl.*; to which, therefore, we beg leave to refer the reader. Here we mean only to inquire into the *cauſe* of this diſpoſition of the particles of bodies.

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Newtonian theory to explain this difference

3. Sir Iſaac Newton, to whom we are indebted for the exiſtence of optics as a ſcience, made a ſet of experiments to aſcertain the changes of colour which thin plates of matter aſſume in conſequence of an increaſe or dimi-

diminution of their thickneſs. Theſe experiments were of a very delicate nature; but Newton conducted them with ſo much addreſs, and varied and repeated them with ſo much induſtry, that he was enabled to render them ſurpriſingly accurate.

Upon a large double convex lens of a 50 feet focus, he placed the plane ſurface of a planoconvex lens, and preſſed the lenſes ſlowly together. A circle, of a particular colour, appeared in the centre, where the two glaſſes touched each other. This circle gradually increaſed in diameter as the preſſure was augmented; and at laſt a new circle, of another colour, occupied the centre, while the firſt colour aſſumed the form of a circular ring. By increaſing the preſſure, a new coloured circle appeared in the centre, and the diameter of the other two increaſed. In this manner he proceeded, till he produced no leſs than 25 different coloured circular rings. Theſe he divided into ſeven orders, on account of the repetition of the ſame colour. They were as follows, reckoning from the central colour, which was always black.*

1. Black, blue, white, yellow, red.
2. Violet, blue, green, yellow, red.
3. Purple, blue, green, yellow, red.
4. Green, red.
5. Greeniſh blue, red.
6. Greeniſh blue, pale red.
7. Greeniſh blue, reddiſh white.

These different colours were occaſioned by the thin film of air between the two glaſſes. Now this film varies in thickneſs from the centre of the lens towards the circumference; that part of it which cauſes the black colour is thinneſt, and the other coloured circles are occaſioned by air gradually increaſing in thickneſs. Newton meaſured the *relative thickneſs* of the air which produced each of theſe coloured circles; and he found it as follows:†

1.	Black	1
	blue	$2\frac{2}{5}$
	white	$5\frac{1}{4}$
	yellow	$7\frac{1}{9}$
	red	$8\frac{1}{2}$
2.	Violet	$11\frac{1}{6}$
	blue	14
	green	$15\frac{1}{8}$
	yellow	$16\frac{2}{7}$
	red	$18\frac{1}{3}$
3.	Purple	21
	blue	$23\frac{2}{5}$
	green	$25\frac{1}{5}$
	yellow	$27\frac{1}{7}$
	red	31
4.	Green	35
	red	$40\frac{1}{3}$
5.	Gr. blue	46
	red	$52\frac{1}{2}$
6.	Gr. blue	$58\frac{3}{4}$
	red	65
7.	Gr. blue	71
	reddiſh white	77

The *abſolute* thickneſs of theſe films cannot be aſcertained, unleſs the diſtance between the two glaſſes, at that part where the black ſpot appears, were known. Now there is no method of meaſuring this diſtance; but it certainly is not greater than the thouſandth part of an inch.

He repeated theſe experiments with films of water, and even of glaſs, inſtead of air; and he found, that in theſe caſes the thickneſs of the films, reflecting any particular colour, was diminiſhed, and that this diminution was proportional to the denſity of the reflecting film.

From theſe experiments Sir Iſaac Newton concluded, that the diſpoſition of the particles of bodies to reflect or tranſmit particular rays depended upon their ſize and their denſity: and he even attempted to aſcertain the ſize, or at leaſt the thickneſs, of the particles of bodies from their colours. Thus a particle of matter, whoſe denſity is the ſame with that of glaſs which reflects a green of the third order, is of the thickneſs of $\frac{16\frac{1}{4}}{1000000}$ of an inch.*

In the year 1765, Mr Delaval publiſhed, in the Philoſophical Tranſactions, a very ingenious paper on the ſame ſubject. In this paper, he endeavours to prove, by experiment, that the colours of metallic bodies depend upon their denſity. He takes it for granted, at the ſame time, that the ſize of the particles of bodies is inverſely as the denſity of bodies. The denſeſt bodies, according to him, are red; the next in denſity, orange; the next, yellow; and ſo on, in the order of the refrangibility of the different rays. Some time after, the ſame ingenious gentleman, in his *Experimental Inquiry into the Cauſe of the Permanent Colours of Opaque Bodies*, extended his views to animal and vegetable ſubſtances, and endeavoured to prove the truth of Newton's theory by a very great number of experiments.

Such is a view of the opinion of Newton and Delaval reſpecting the cauſe of bodies reflecting or tranſmitting particular rays of light, as far at leaſt, as that theory relates to colour. They aſcribed this cauſe *ſolely* to the *ſize* and the *denſity* of the particles of bodies.

By *particles*, it is evident that nothing elſe can be meant than the *integrant particles* of bodies. Newton, indeed, does not expreſs himſelf preciſely in this language; but it is plain that nothing elſe could be his meaning. Mr Delaval undoubtedly is of that opinion.

According to the Newtonian theory of colour, then, it depends ſolely upon the *ſize* of the integrant particles of bodies whoſe denſity is the ſame; and upon the *ſize* and the *denſity* jointly of all bodies (T).

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It is evident that the truth of the Newtonian theory muſt depend upon its coincidence with what actually takes place in nature, and that therefore it can only be determined by experiment. Newton himſelf produced but very few experiments in ſupport of it; and though this deficiency was amply ſupplied by Mr Delaval, it is needleſs for us to adduce any of theſe here; becauſe, from the prodigious accumulation of chemical facts ſince theſe experiments were made, the very baſis upon which they ſtood has been deſtroyed, and conſequently all the evidence reſulting from them has been annihilated. They proceeded on the ſuppoſition, that acids render the particles of bodies *ſmaller*, and alkalies *larger* than they were before, without producing any other change whatever in the bodies on which they act. To attempt a refutation of this opinion at preſent would be unneceſſary, as it is well known not to be true.

Let us therefore compare the Newtonian theory of colour with thoſe chemical changes which we know for certain to alter the ſize of the particles of bodies, in order to ſee whether they coincide with it. If the theory be true, the two following conſequences muſt hold

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* Newton's Optics, 191. Clarke's edition.

† Ibid. p. 215.

* Newton's Optics, 2

(T) Newton, however, pointed out an exception to this law, concerning which Mr Delaval has been more explicit. Combuſtible bodies do not follow that law, but ſome other. Mr Delaval has ſuppoſed, that this deviation is owing to the preſence of phlogiſton.

hold in all caſes: 1. Every alteration in the ſize of the integrant particles of bodies muſt cauſe theſe particles to aſſume a different colour. 2. Every ſuch alteration muſt correſpond preciſely with the theory; that is to ſay, the new colour muſt be the very colour, and no other, which the theory makes to reſult from an increaſe or diminution of ſize.

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Now neither of theſe conſequences holds in fact. We have no method indeed of aſcertaining the ſizes of the integrant particles of bodies, nor of meaſuring the preciſe degree of augmentation or diminution which they ſuffer; but we can in many caſes aſcertain, whether any new matter has been added to a particle, or any matter abſtracted from it; and conſequently whether it has been augmented or diminiſhed; which is ſufficient for our preſent purpoſe.

For inſtance, whatever be the ſize of an integrant particle of gold, it cannot be denied that an integrant particle of oxyd of gold is greater; becauſe it contains an integrant particle of gold combined with at leaſt one integrant particle of oxygen. Now the colour both of gold and of its oxyd is yellow, which ought not to be the caſe, according to the Newtonian theory. In like manner, the amalgam of ſilver is white, preciſely the colour of ſilver and of mercury; yet an integrant particle of the amalgam muſt be larger than an integrant particle either of ſilver or of mercury. Many other inſtances beſides theſe will occur to every one, of changes in the ſize of the particles taking place without any change of colour. All theſe are incompatible with the Newtonian theory.

It may be ſaid, perhaps, in anſwer to this objection, that there are different orders of colours; that the ſame colour is reflected by particles of different ſizes; and that the increaſed particles, in the inſtances above alluded to, retain their former colour, becauſe the increment has been preciſely ſuch as to enable them to reflect the ſame colour in the next higher order.

This very anſwer is a complete proof that the Newtonian theory is not ſufficient to account for the colours of bodies; for if particles of *different* ſizes reflect the ſame colour, *ſize* certainly is not the only cauſe of this reflection.* There muſt be ſome other cauſe very different from ſize. Nor is this all; the moſt common colour which remains after an increaſe of the ſize of the integrant particles of bodies is white; yet white does not appear in any of the orders except the firſt, and therefore its permanence cannot be accounted for by any ſuppoſition compatible with the Newtonian theory.

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Colours,

Even when alterations in the colour of bodies accompany the increaſe or diminution of the ſize of their particles, theſe alterations ſeldom or never follow an order which correſponds with the theory. As for metals, it is ſelf-evident that their colour does not depend upon their denſity. Platinum is the denſeſt body known, and yet it is not red, as it ought to be, but white like tin; a metal which has little more than one third of the denſity of platinum.

The green oxyd of iron, when combined with pruſſic acid, becomes white; yet the ſize of its particles muſt be increaſed. Now this change of colour is incompatible with the theory; for according to it, every change from green to white ought to be accompanied by a diminution inſtead of an increaſe of ſize. A particle of indigo, which is naturally green, becomes blue by the addition of oxygen, which muſt increaſe its ſize. This change is alſo incompatible with the theory. But it is unneceſſary to accumulate inſtances, as they will naturally occur in ſufficient number to every one.

It follows irreſiſtibly from theſe facts, that the Newtonian theory is not ſufficient to explain the *cauſe* of colour; or what cauſes bodies to reflect or tranſmit certain rays, and to abſorb the reſt.

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Bodies owe their colour to their affinity for light.

4. We have endeavoured, in the article CHEMISTRY, *Suppl.* to ſhew, that bodies have a particular affinity for the rays of light; and that the phenomena of light depend entirely upon theſe affinities. Indeed this conſequence follows from the properties of light eſtabliſhed by Newton himſelf. We ſhall not repeat here the proofs upon which the exiſtence of theſe affinities is founded: the reader may eaſily ſatisfy himſelf by conſulting the article above referred to.

Every coloured body, then, has a certain *affinity for* ſome of the rays of light. Thoſe rays for which it has a ſtrong affinity are abſorbed by it and retained, and the other rays for which it has no affinity are either reflected to tranſmitted, according to the nature of the body and the direction of the incident ray. Thus a red body has an affinity for all the rays except the red; it abſorbs therefore the other ſix, and reflects only the red: a green body abſorbs all but the green rays, or perhaps the red and yellow: a black body has a ſtrong affinity for all the rays, and therefore abſorbs them all: while a white body, having no ſtrong affinity for any of the rays, reflects or tranſmits them all.

If affinity, as we have endeavoured to ſhew in the article CHEMISTRY, *Suppl.* be an attraction of the ſame nature with gravitation, and increaſing as the diſtance diminiſhes, it muſt depend upon the nature of the attracting particles. Now the only differences which we can conceive to exiſt between the particles of bodies, are differences in *ſize*, in *denſity*, and in *figure*. Changes in theſe three things will account for all the varieties of affinity. Now if affinity depends upon theſe three things, and if colour depends upon the affinity between the particles of bodies and the different rays of light as cannot be denied, it is clear that the cauſe of the colour of bodies may be ultimately reſolved into the ſize, denſity, and figure, of their particles. Newton's theory, then, was defective, becauſe he omitted the *figure* of the particles, and aſcribed the whole to variations in *ſize* and *denſity*.

When we ſay, then, that colour is owing to *affinity*, we do not contradict the opinion of Newton, as ſome philoſophers have ſuppoſed, but merely extend it: Newton was *not miſtaken* in ſaying, that colour depends upon the ſize and the denſity of the particles of bodies; his miſtake lay in ſuppoſing that it depends upon theſe *alone*.

393
Why bodies change their colour.

5. Since the colour of bodies depends upon their affinity for light, and ſince every body has a certain colour, becauſe it abſorbs and retains particular rays while it tranſmits or reflects the reſt, it is evident that every body muſt continue of its firſt colour till one of two things happen; either till it be ſaturated with the rays which it abſorbs, and of courſe ceaſe to abſorb any more, or till its particles change their nature, by being either decompoſed or combined with ſome new ſubſtance. We have no poſitive proof that the firſt

cauſe of change ever occurs, as many ſubſtances have been expoſed to the action of light for a very long time without any change of colour. The abſorbed light ſeems to make its eſcape, either in its own form, or in ſome unknown or unſuſpected one. The ſecond cauſe of change is very common: indeed its action may be detected in almoſt every caſe of alteration in the colour of bodies. The green oxyd of iron, by combining with oxygen, becomes red; and this red oxyd, when combined with pruſſic acid, aſſumes a blue colour, and with gallic acid a black colour. The cauſe of this change of colour, when the compoſition of a body changes, is obvious: every change of compoſition muſt alter the affinity, becauſe it muſt of neceſſity produce changes in the ſize, denſity, or figure of the particles, or perhaps in all of theſe. Now if the affinity of a body for other bodies be altered, it is natural to ſuppoſe that it will be altered alſo for light. Accordingly this happens in moſt inſtances. It does not, however, take place conſtantly, for very obvious reaſons. It may happen that the new denſity, ſize or figure of the altered body is ſuch, as to render it ſtill proper for attracting the very ſame rays of light which it formerly attracted. Juſt as iron, after being combined with a certain doſe of oxygen, is converted into green oxyd, which ſtill retains an affinity for oxygen.

It is evident from all this, that in moſt caſes the permanence of colour in bodies will depend upon the permanence of their compoſition, or on the degree of facility with which they are acted upon by thoſe bodies, to the agency of which they are expoſed.

394 Permanency of colour of great importance in dyeing.

In *dying*, the permanence of colour is of very great importance. Of what value is the beauty of a colour, provided that colour be fugitive or liable to change into ſome other. In all caſes, therefore, it is of conſequence to attend to the ſubſtances to which dyed cloth is expoſed, and to aſcertain their action upon every particular dyeing ingredient. Now the bodies to which dyed cloth is almoſt conſtantly expoſed are *air* and *light*; the combined action of which has ſo much influence, that very few dyes can reſiſt it.

395 How dyes loſe their colour.

It is evident that thoſe ſubſtances which have a ſtrong affinity for oxygen cannot retain their colour, provided they be able to take it from atmoſpheric air. Thus the green colour of green oxyd of iron and of indigo is not permanent, becauſe theſe ſubſtances readily abſorb oxygen from air. In order, then, that a colour can have any permanence, the coloured body muſt not have ſo great an affinity for oxygen as to be able to take it from air. Thoſe bodies have in general the moſt permanent colours which are already ſaturated with oxygen, and therefore not liable to abſorb more. Such is the caſe with red oxyd of iron.

All coloured bodies are compounds; ſome of thoſe only excepted which ſtill retain an affinity for oxygen. Coloured bodies, therefore, are compoſed of ſeveral ingredients; and in every coloured body, at leaſt *ſome* of the ingredients have a ſtrong affinity for oxygen. Now, before the colour of a body can be permanent, its ingredients muſt be combined together by ſo ſtrong affinities, that oxygen gas is unable to decompoſe it by combining with one or more of its ingredients and carrying it off. If this decompoſition take place at once, it is impoſſible for the colour of a body to have any permanence. If it takes place ſlowly, the colour of the body gradually decays. The action of oxygen gas upon bodies is much increaſed in particular circumſtances. Almoſt all coloured bodies are decompoſed by oxygen gas by the aſſiſtance of heat. Thus if wheat flour be expoſed to the heat of 448°, it loſes its white colour, and becomes firſt brown and then black. At this temperature it is decompoſed, and a part, or even the whole of its hydrogen, combining with oxygen, flies off. Cloth is ſcarcely ever expoſed to ſo high a temperature; but there are other circumſtances in which it may be placed which may have a ſimilar effect. Thus the action of light ſeems in ſome ſubſtances to be ſimilar to that of heat, and to facilitate the decompoſition of the coloured matter by the combination of ſome of its ingredients with oxygen.*

Coloured bodies, in order to have permanent colours, muſt not be liable to be decompoſed by other ſubſtances more than by oxygen. For inſtance, if they contain oxygen and hydrogen, theſe two bodies muſt not be liable to combine together and form water, nor muſt oxygen and carbon be liable to combine and form carbonic acid gas. Light ſeems to have a tendency to decompoſe many bodies in this manner, and even to carry off oxygen from them in the form of oxygen gas. Thus it renders the nitrat of ſilver black by carrying off part of its oxygen, and it reduces oxy-muriatic acid to common muriatic acid by the ſame means.

Theſe are the cauſes which induce a change in the colour of coloured bodies, as far as they have been traced; namely, the addition of oxygen, the abſtraction of oxygen, partial decompoſition by ſome one of their ingredients combining with oxygen, complete or partial decompoſition by the ingredients entering into new combinations with each other. The coloured matters uſed in dyeing are very liable to theſe changes, becauſe they are in general animal or vegetable ſubſtances of a very compound nature. Of courſe their ingredients have often no very ſtrong affinity for each other, and therefore are very liable to decompoſition; and every one of the ingredients has in general a very ſtrong affinity for oxygen. This renders the choice of proper colouring matters for dyeing a very important point. In order to have permanency, they muſt not be liable to the above changes, not to mention their being able alſo to withſtand the action of ſoap, acids, alkalies, and every other ſubſtance to which dyed cloth may be expoſed.

39 Meth aſcert ing th manen dyes.

It becomes therefore a point of ſome conſequence to be able to aſcertain whether cloth dyed of any particular colour be permanently dyed or not. The proper method of aſcertaining this is by actually expoſing ſuch cloth to the ſun and air; becauſe as theſe are the agents to which it is to be expoſed, and which have the moſt powerful action, it is clear, that if it withſtand them, the colour muſt be conſidered as permanent. But this is a tedious proceſs. Berthollet propoſed expoſing ſuch cloth to the action of oxy-muriatic acid; thoſe colours that withſtand it being conſidered as permanent. This method anſwers in many caſes: but it is not always to be depended on; for it deſtroys ſome permanent colours very ſpeedily, and does not alter others which are very fading.* But we ſhall have occaſion to reſume this ſubject afterwards.

39 Diviſi colour

Dyers divide colours into two claſſes; namely, *ſimple* and *compound*. The ſimple colours are thoſe which cannot

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* Bert on Dye i. 45.

* Ban i. 49.

cannot be produced by the mixture of other colours. They are in number four.

1. Blue, 3. Red,
2. Yellow, 4. Black.

Some add a fifth, *brown;* but it may be produced by combining two others.

The compound colours are thoſe which are produced by mixing together any two ſimple colours in various proportions. They conſtitute all the colours except the four ſimple and their various ſhades.

Thus we have examined the nature of colours; but we have ſtill to explain the method of giving permanent colours to cloth. This ſhall be the ſubject of the next chapter.

CHAP. III. OF DYEING IN GENERAL.

FROM the theory of colour laid down in the laſt chapter, it follows, that permanent alterations in the colour of cloth can only be induced two ways; either by producing a chemical change in the cloth, or by covering its fibres with ſome ſubſtance which poſſeſſes the wiſhed-for colour. Recourſe can ſeldom or never be had to the firſt method, becauſe it is hardly poſſible to produce a chemical change in the fibres of cloth without ſpoiling its texture and rendering it uſeleſs. The dyer, therefore, when he wiſhes to give a new colour to cloth, has always recourſe to the ſecond method.

98 tuffs

1. The ſubſtances employed for this purpoſe are called *colouring matters*, or *dye ſtuffs*. They are for the moſt part extracted from *animal and vegetable ſubſtances*, and have uſually the colour which they are intended to give to the cloth. Thus a blue colour is given to cloth by covering its fibres with indigo, a blue powder extracted from a ſhrub; a red colour, by the colouring matter extracted by water from an inſect called *cochineal*, or from the root of a plant called *madder*.

99 ot re- ight.

2. Mr Delaval has publiſhed a very intereſting ſet of experiments on colouring matters in the ſecond volume of the Mancheſter Memoirs. He has proved, by a very numerous ſet of experiments, that they are all tranſparent, and that they do not *reflect* any light, but only tranſmit it: For every colouring matter which he tried, even when diſſolved in a liquid, and forming a tranſparent coloured ſolution, when ſeen merely by reflected light, was black, whatever was the colour of the matter; but when ſeen by tranſmitted light, it appeared of its natural colour.* This diſcovery, which Mr Delaval has eſtabliſhed very completely, and to which, as far at leaſt as dye ſtuffs are concerned, there are but few exceptions, is of very great importance to the art of dyeing, and explains ſeveral particulars which would otherwiſe be unintelligible.

nch. ii.

Since the particles of the colouring matter with which cloth, when dyed, is covered, are tranſparent, it follows, that all the light reflected from dyed cloth muſt be reflected, not by the dye ſtuff itſelf, but by the fibres of the cloth below the dye ſtuff. The colour therefore does not depend upon the dye alone, but alſo upon the previous colour of the cloth. If the cloth be *black*, it is clear that we cannot dye it any colour whatever; becauſe as no light in that caſe is reflected, none can be tranſmitted, whatever dye ſtuff we employ. If the cloth were red, or blue, or yellow, we could not dye it any colour except black; becauſe as only red, or blue, or yellow rays were reflected, no other could be tranſmitted (x). Hence the importance of a fine white colour when cloth is to receive bright dyes: It then reflects all the rays in abundance; and therefore any colour may be given, by covering it with a dye ſtuff which tranſmits only ſome particular rays.

400 They muſt be combined with the cloth.

3. If the colouring matters were merely ſpread over the ſurface of the fibre of cloth by the dyer, the colours produced might be very bright, but they could not be permanent; becauſe the colouring matter would be very ſoon rubbed off, and would totally diſappear whenever the cloth was waſhed, or even barely expoſed to the weather. The colouring matter, then, however perfect a colour it poſſeſſes, is of no value, unleſs it alſo adheres ſo firmly to the cloth, that none of the ſubſtances uſually applied to cloth in order to clean it, &c. can diſplace it. Now this can only happen when there is a ſtrong *affinity* between the colouring matter and the cloth, and when they are actually combined together in conſequence of that affinity.

401 Can only be applied in a ſtate of ſolution.

4. Dyeing, then, is merely a chemical proceſs, and conſiſts in combining a certain colouring matter with the fibres of cloth. This proceſs can in no inſtance be performed, unleſs the dye ſtuff be firſt reduced to its integrant particles; for the attraction of aggregation between the particles of dye ſtuffs is too great to be overcome by the affinity between them and cloth, unleſs they could be brought within much ſmaller diſtances than is poſſible, while they both remain in a ſolid form. It is neceſſary, therefore, previouſly to diſſolve the colouring matter in ſome liquid or other, which has a weaker affinity for it than the cloth has. When the cloth is dipped into this ſolution, the colouring matter, reduced by this contrivance to a liquid ſtate, is brought within the attracting diſtance; the cloth therefore acts upon it, and by its ſtronger affinity takes it from the ſolvent, and fixes it upon itſelf. By this contrivance, too, the equality of the colour is in ſome meaſure ſecured, as every part of the cloth has an opportunity of attracting to itſelf the proper proportion of colouring particles.

The facility with which cloth imbibes a dye, depends upon two things, namely, the affinity between the cloth and the dye ſtuff, and the affinity between the dye ſtuff and its ſolvent. It is directly as the former, and inverſely as the latter. It is of importance to preſerve a due proportion between theſe two affinities, as upon that proportion much of the accuracy of dyeing depends. If the affinity between the colouring matter and the cloth be too great, compared with the affinity between the colouring matter and the ſolvent, the cloth will take the dye too rapidly, and it will be ſcarce poſſible to prevent its colour from being unequal. On the other hand, if the affinity between the colouring matter and the ſolvent be too great, compared with that

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(x) Theſe remarks hold only on the ſuppoſition, that the *whole* of the ſurface is of the given colour, which, in many inſtances is not the caſe.

that between the colouring matter and the cloth, the cloth will either not take the colour at all, or it will take it very ſlowly and very faintly.

Wool has the ſtrongeſt affinity for almoſt all colouring matters, ſilk the next ſtrongeſt, cotton a conſiderably weaker affinity, and linen the weakeſt affinity of all. Therefore, in order to dye cotton or linen, the dye ſtuff ſhould in many caſes be diſſolved in a ſubſtance for which it has a weaker affinity than for the ſolvent employed in the dyeing of wool or ſilk. Thus we may uſe oxyd of iron diſſolved in ſulphuric acid, in order to dye wool; but for cotton and linen, it is better to diſſolve it in acetous acid.

402 Nature of mordants.

5. Were it poſſible to procure a ſufficient number of colouring matters having a ſtrong affinity for cloth, to anſwer all the purpoſes of dyeing, that art would be exceedingly ſimple and eaſy. But this is by no means the caſe: if we except indigo, the dyer is ſcarcely poſſeſſed of a dye ſtuff which yields of itſelf a good colour ſufficiently permanent to deſerve the name of a dye.

This difficulty, which at firſt ſight appears inſurmountable, has been obviated by a very ingenious contrivance. Some ſubſtance is pitched upon which has a ſtrong affinity both for the cloth and the colouring matter. This ſubſtance is previouſly combined with the cloth, which is then dipped into the ſolution containing the dye ſtuff. The dye ſtuff combines with the intermediate ſubſtance; which, being firmly combined with the cloth, ſecures the permanence of the dye. Subſtances employed for this purpoſe are denominated *mordants* (y).

The moſt important part of dyeing is undoubtedly the proper choice and the proper application of mordants, as upon them the permanency of almoſt every dye depends. Every thing which has been ſaid reſpecting the application of colouring matters, applies equally to the application of mordants. They muſt be previouſly diſſolved in ſome liquid, which has a weaker affinity for them than the cloth has to which they are to be applied; and the cloth muſt be dipped, or even ſteeped, in this ſolution, in order to ſaturate itſelf with the mordant.

Almoſt the only ſubſtances uſed as mordants are, earths, metallic oxyds, tan, and oil.

403 Earthy mordants.

6. Of earthy mordants, by far the moſt important and moſt generally uſed is alumina. It was uſed as a mordant in very early ages, and ſeems indeed to have been the very firſt ſubſtance employed for that purpoſe. Alumina has a very ſtrong affinity for wool and for ſilk; but its affinity for cotton and linen is a good deal weaker.

It is uſed as a mordant in two ſtates; either in the ſtate of alum, in which it is combined with ſulphuric acid and a little potaſs; or in the ſtate of acetite of alumina, in which it is combined with acetous acid.

Alum was employed as a mordant very early. The ancients, indeed, do not ſeem to have been generally acquainted with pure alum; they uſed it in that ſtate of impurity in which it is found native; of courſe it was uſed in dyeing long before the nature of its ingredients was underſtood, and therefore long before the part which it acts was ſuſpected. Indeed, it is but a very ſhort time ſince the office which mordants perform was ſuſpected: the firſt perſon that hit upon it was Mr Keir; he gave an account of the real uſe of mordants in his tranſlation of Macquer's Dictionary, publiſhed in 1771.*

* Macqu p. 215.

Alum when uſed as a mordant, is diſſolved in water, and very frequently a quantity of tartar is diſſolved along with it. Into this ſolution the cloth is put and kept in it till it has abſorbed as much alumina as is neceſſary. It is then taken out, and for the moſt part waſhed and dried. It is now a good deal heavier than it was before, owing to the alumina which has combined with it. The tartar ſerves two purpoſes; the potaſs which it contains combines with the ſulphuric acid of the alum, and thus prevents that very corroſive ſubſtance from injuring the texture of the cloth, which otherwiſe might happen; the tartarous acid, on the other hand, combines with part of the alumina, and forms a tartrite of alumina, which is more eaſily decompoſed by the cloth than alum.

Acetite of alumina has been introduced into dyeing ſince the commencement of the 18th century; and, like many other very important improvements, we are indebted for it to the ignorance of the calico printers, who firſt introduced it. As they did not underſtand the nature nor uſe of the mordants which they employed, they were accuſtomed to mix with their alum an immenſe farrago of ſubſtances a great proportion of which were injurious inſtead of being of ſervice. Some one or other had mixed with alum acetite of lead: the good effects of this mixture would be ſoon perceived; the quantity of acetite was gradually increaſed, and the other ingredients omitted.* This mordant is now prepared, by pouring acetite of lead into a ſolution of alum: a double decompoſition takes place, the ſulphuric acid combines with the lead, and the compound precipitates in the form of an inſoluble powder; while the alumina combines with the acetous acid, and remains diſſolved in the liquid. This mordant is employed for cotton and linen, which have a weaker affinity than wool for alumina. It anſwers much better than alum, the cloth is more eaſily ſaturated with alumina, and takes, in conſequence, both a richer and a more permanent colour.

* Banc p. 176.

Beſides alumina, *lime* is ſometimes uſed as a mordant. Cloth has a ſtrong enough affinity for it; but in general it does not anſwer ſo well, as it does not give ſo good a colour. When uſed, it is either in the ſtate of lime-water or of ſulphat of lime diſſolved in water.

40 Metall mordan

7. Almoſt all the metallic oxyds have an affinity for cloth; but only two of them are extenſively uſed as mordants, namely, the oxyds of tin and of iron.

The oxyd of tin was firſt introduced into dyeing by Kuſter (z), a German chemiſt, who brought the ſecret to London in 1543. This period forms an era in the hiſtory of dyeing. The oxyd of tin has enabled the moderns

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(y) This term, impoſed by the French dyers before the action of mordants was underſtood, ſignifies *biters* or *corroders*. Theſe bodies were ſuppoſed to act merely by corroding the *cloth*. Mr Henry of Mancheſter has propoſed to ſubſtitute the word *baſis* for *mordant*; but that word is too general to anſwer the purpoſe well.

(z) Mr Delaval has ſuppoſed, that the Tyrians were acquainted with the uſe of tin in dyeing, and Mr Henry moderns greatly to ſurpaſs the ancients in the fineneſs of their colours: by means of it alone, *ſcarlet*, the brighteſt of all colours, is produced. The method of producing the celebrated purple dye of the ancients is underſtood at preſent, and the ſhell fiſh which yield the dye ſtuff are found abundantly on the coaſts of Britain and France; but no perſon thinks now of putting the ancient mode in practice, becauſe infinitely more beautiful colours can be produced at a ſmaller price. Much of this ſuperiority is owing to the employment of the oxyd of tin.

Tin, as Prouſt has proved, is capable of two degrees of oxydation: The firſt oxyd is compoſed of 0.70 parts of tin, and 0.30 of oxygen; the ſecond, or white oxyd, of 0.60 parts of tin, and 0.40 of oxygen.* The firſt oxyd abſorbs oxygen with very great facility even from the air, and is rapidly converted into white oxyd. This fact makes it certain, that it is the white oxyd of tin alone which is the real mordant: even if the other oxyd were applied to cloth, as it probably often is, it muſt ſoon be converted into white oxyd, by abſorbing oxygen from the atmoſphere.

Tin is uſed as a mordant in three ſtates; diſſolved in nitro-muriatic acid, in acetous acid, and in a mixture of ſulphuric and muriatic acids. Nitro-muriat of tin is the common mordant employed by dyers. They prepare it by diſſolving tin in diluted nitric acid, to which a certain proportion of muriat of ſoda, or of ammonia, is added. Part of the nitric acid decompoſes theſe ſalts, combines with their baſe, and ſets the muriatic acid at liberty. They prepared it at firſt with nitric acid alone; but that mode was very defective; becauſe the nitric acid very readily converts tin to white oxyd, and then is incapable of diſſolving it. The conſequence of which was, the precipitation of the whole of the tin. To remedy this defect, common ſalt, or ſal ammoniac, was very ſoon added; muriatic acid having the property of diſſolving white oxyd of tin very readily. A conſiderable ſaving of nitric acid might be obtained, by employing as much ſulphuric acid as is juſt ſufficient to ſaturate the baſe of the common ſalt, or ſal ammoniac, employed.

When the nitro-muriat of tin is to be uſed as a mordant, it is diſſolved in a large quantity of water, and the cloth is dipped in the ſolution, and allowed to remain till ſufficiently ſaturated. It is then taken out, and waſhed and dried. Tartar is uſually diſſolved in the water along with the nitro-muriat. The conſequence of this is a double decompoſition; the nitro-muriatic acid combines with the potaſs of the tartar, while the tartarous acid diſſolves the oxyd of tin. When tartar is uſed, therefore, in any conſiderable quantity, the mordant is not a nitro-muriat, but a tartrite of tin.

Mr Hauſſman, to whom the art of dyeing lies under numerous obligations, has propoſed to ſubſtitute acetite of tin for nitro-muriat as a mordant for cotton and linen. It may be prepared by mixing together acetite of lead and nitro-muriat of tin. This mordant is preferable for theſe ſtuffs; becauſe it is much more eaſily decompoſed than the nitro-muriat.†

Dr Bancroft has propoſed to ſubſtitute a ſolution of tin in a mixture of ſulphuric and muriatic acid inſtead of nitro-muriat of tin, as a mordant for wool. This mordant, he informs us, is much cheaper, and equally efficacious. It may be prepared by diſſolving ſomewhat leſs than one part of tin in two parts of ſulphuric and three of muriatic acid, at the degree of concentration at which they are commonly ſold in this country.‡ This mordant, like the others, muſt be diſſolved in a ſufficient quantity of water, in order to be uſed.

Iron, like tin, is capable of two degrees of oxydation; but the green oxyd abſorbs oxygen ſo readily from the atmoſphere, that it is very ſoon converted into the red oxyd. It is only this laſt oxyd which is really uſed as a mordant in dyeing. The green oxyd is indeed ſometimes applied to cloth; but it very ſoon abſorbs oxygen, and is converted into the red oxyd. This oxyd has a very ſtrong affinity for all kinds of cloth. The permanency of the iron ſpots on linen and cotton is a ſufficient proof of this. As a mordant, it is uſed in two ſtates; in that of ſulphat of iron, and acetite of iron. The firſt is commonly uſed for wool. The ſalt is diſſolved in water, and the cloth dipped in it. It may be uſed alſo for cotton; but in moſt caſes acetite of iron is preferred. It is prepared by diſſolving iron, or its oxyd, in vinegar, ſour beer, &c. and the longer it is kept, the more is it preferred. The reaſon is, that this mordant ſucceeds beſt when the iron is in the ſtate of red oxyd. It would be better then to oxydate the iron, or convert it into ruſt before uſing it; which might eaſily be done, by keeping it for ſome time in a moiſt place, and ſprinkling it occaſionally with water. Of late, pyrolignous acid has been introduced inſtead of acetous. It is obtained by diſtilling wood or tar.

405 Tan.

8. Tan, which has been already deſcribed in the firſt part of this article, has a very ſtrong affinity for cloth, and for ſeveral colouring matters. It is therefore very frequently employed as a mordant. An infuſion of *nut galls*, or of *ſumach* (A), or any other ſubſtance containing tan, is made in water, and the cloth is dipped in this infuſion, and allowed to remain till it has abſorbed a ſufficient quantity of tan. Silk is capable of abſorbing a very great proportion of tan, and by that means acquires a very great increaſe of weight. Manufacturers ſometimes employ this method of increaſing the weight of ſilk.*

Tan is often employed alſo, along with other mordants, in order to produce a compound mordant. Oil is alſo uſed for the ſame purpoſe in the dyeing of cotton and linen. The mordants, with which tan moſt frequently is combined, are alumina and oxyd of iron.

406 Other mordants.

Beſides theſe mordants, there are ſeveral other ſubſtances frequently uſed as auxiliaries, either to facilitate the combination of the mordant with the cloth, or to alter

† *Ann. de Chim.* xxx. 15.

‡ *Bancroft*, p. 290.

* *Berthollet*, ii. 10.

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ry has declared himſelf of the ſame opinion. But his reaſoning, as Dr Bancroft has ſhewn, proceeds upon a miſtake. He ſuppoſes that tin is *neceſſary* for the production of red colours.

(A) Sumach is the *rhus coriaria*; a ſhrub which is cultivated in the ſouthern parts of Europe. Its ſhoots are dried, and afterwards ground to powder: in which ſtate they are ſold to the dyer and tanner.

alter the ſhade of colour. The chief of theſe are, *tartar, acetite of lead, common ſalt, ſal ammoniac, ſulphat* or *acetite of copper*, &c.

407 Mordants affect the colour.

9. Mordants not only render the dye permanent, but have alſo conſiderable influence on the colour produced. The ſame colouring matter produces very different dyes, according as the mordant is changed. Suppoſe, for inſtance, that the colouring matter be cochineal; if we uſe the aluminous mordant, the cloth will acquire a crimſon colour; but the oxyd of iron produces with it a black. Theſe changes, indeed, might naturally have been expected: for ſince the colour of a dye ſtuff depends upon its affinity for light, every new combination into which it enters, having a tendency to alter theſe affinities, will naturally give it a new colour. Now, in all caſes, the colouring matter and mordant combine together: the colour of the cloth, then, muſt be that which the particles of the dye and of the mordant, when thus combined together, exhibit. Indeed ſome mordants may be conſidered in the light of colouring matters alſo, as they always communicate a particular colour to cloth. Thus, iron communicates a brown colour, and iron and tan together conſtitute a black dye.

In dyeing, then, it is not only neceſſary to procure a mordant, which has a ſufficiently ſtrong affinity for the colouring matter and the cloth, and a colouring matter which poſſeſſes the wiſhed for colour in perfection, we muſt procure a mordant and a colouring matter of ſuch a nature, that when *combined together* they ſhall poſſeſs the wiſhed-for colour in perfection. It is evident, too, that a great variety of colours may be produced with a ſingle dye ſtuff, provided we can change the mordant ſufficiently.

408 How applied.

10. Every thing which tends to weaken the affinity between the mordant and the cloth, or between the mordant and the colouring matter, and every thing which tends in any way to alter the nature of the mordant, muſt injure the permanency of the dye: becauſe, whenever the mordant is deſtroyed, there is no longer any thing to cauſe the dye-ſtuff to adhere; and when its nature is altered, the colour of the dye muſt alter at the ſame time. All the obſervations, then, which were made in the laſt chapter, concerning the nature of colouring matters, and the changes to which they are ſubject, apply equally to mordants. Theſe ſubſtances, indeed, are ſcarcely liable themſelves to any alteration. They are of a much more ſimple nature, in general, than dye ſtuffs; and therefore not nearly ſo liable to decompoſition. But when the colouring matter itſelf is altered it comes to the ſame thing. Its affinity for the mordant being now deſtroyed, there is nothing to retain it.

As the permanency of a dye depends upon the degree of affinity between the mordant and the colouring matter, it is clear that a dye may want permanency, even though it reſiſt the oxy muriatic acid, and all the other ſaline teſts propoſed by chemiſts. Theſe ſubſtances may happen to have very little action on the dye ſtuff, and therefore may not affect it; yet it may ſoon diſappear, in conſequence of its want of affinity for the mordant.

409 Dye-ſtu do not cover th whole ſ face of cloth.

11. The colouring matter with which cloth is dyed, does not cover every portion of its ſurface; its particles attach themſelves to the cloth at certain diſtances from each other; for cloth may be dyed different ſhades of the ſame colour, lighter or darker, merely by varying the quantity of colouring matter. With a ſmall quantity, the ſhade is light; and it becomes deeper as the quantity increaſes. Now this would be impoſſible, if the dye-ſtuff covered the whole of the cloth. Newton has demonſtrated, that colours are rendered faint when the rays of light which occaſion them are mixed with white rays. Conſequently, from cloth dyed of a light ſhade a conſiderable quantity of white rays paſſes off unchanged: but this could not be the caſe if the ſtuff were covered with coloured matter; becauſe all the white rays would be decompoſed as they paſs through the coloured matter. Therefore, in light ſhades, the colouring matter does not cover the cloth; its particles adhere to it, at a certain diſtance from each other, and from every part of the cloth which is uncovered, the white rays paſs off unchanged. Even when the ſhade of colour is as deep as poſſible, the colouring particles do not cover the whole of the cloth, but are at a certain diſtance from each other. This diſtance, undoubtedly, is diminiſhed in proportion to the deepneſs of the ſhade: for the deeper the ſhade, the ſmaller is the number of white rays which eſcape undecompoſed; the more, therefore, of the ſurface is covered, and, conſequently, the ſmaller is the diſtance at which each of them is placed. A ſhade may be even conceived ſo very deep, that not a particle of white light eſcapes the action of the colouring matter; in which caſe, the diſtance between the particles of colouring matter could not exceed double that diſtance at which a particle of matter is able to act upon light.

410 Compou colours.

That the particles of colouring matter, even when the ſhade is deep, are at ſome diſtance, is evident from this well known fact, that cloth may be dyed two colours at the ſame time. All thoſe colours, to which the dyers give the name of *compound*, are in fact two different colours applied to the cloth at once. Thus cloth gets a *green* colour, by being firſt dyed *blue* and then *yellow*. The rays of light that paſs from green cloth thus dyed are blue and yellow; by the mixture of which it is well known that green is produced. In this caſe, it is clear, that each of the colouring matters performs the very ſame office as if it were alone; and that the new colour is not produced by the combination of the two colouring matters. That part of the white light, reflected from the cloth, which paſſes through the blue colouring matter, is decompoſed, and the blue rays only tranſmitted; and that part of the white light which paſſes through the yellow colouring matter is alſo decompoſed, and only the yellow rays tranſmitted. It is clear, therefore, that both of the colouring matters equally cover the naked fibres of the cloth; conſequently the one muſt be placed in the intervals of the other: wherefore the particles of each of the colouring matters are at ſome diſtance. Now the ſame effect happens how deep ſoever the ſhade be; and it makes no difference which of the two dyes be firſt given. Nay, if one of the dyes have a ſtrong affinity for the cloth, and the other only a weak affinity, the latter will ſoon diſappear, and leave the cloth of the colour which the firſt dye gives it.

The difference, then, in the ſhade of colour, and alſo the compound colours which cloth may receive, depend entirely upon the diſtance between the particles of the colouring matters attached to the cloth, and the poſſibility

lity of partly filling up the intervals, either with the ſame colouring matter, or with a different one.

Thus we have taken a view of the theory of dyeing, as far, at leaſt, as it is at preſent underſtood. It remains for us ſtill to give an account of the particular manner by which each of the colours is imparted to cloth. This ſhall be the ſubject of the three following chapters. In the *firſt* we ſhall treat of the manner of dyeing the ſimple colours; in the *ſecond*, of dyeing the compound colours; and in the *third*, of dyeing cloth partially ſeveral different colours at the ſame time, or of that branch of the art of dyeing which is known in this country by the name of *calico printing*.

CHAP. IV. OF DYEING SIMPLE COLOURS.

THE colours denominated by dyers *ſimple*, becauſe they are the foundation of all their other proceſſes, are four; namely, 1*ſt*, blue;—2*d*, yellow;—3*d*, red;—4*th*, black. To theſe they uſually add a fifth, under the name of *root*, or brown colour. Theſe ſhall form the ſubject of the following ſections.

SECT. I. *Of Blue.*

11 dyes. THE only colouring matters employed in dyeing blue are *woad* and *indigo*: attempts, indeed, have been made to dye with pruſſiat of iron; but theſe attempts have hitherto failed.

12 d. 1. The *iſatis tinctoria*, or *woad*, is a plant commonly enough cultivated in Scotland, and even found wild in ſome parts of England. It is of a yellowiſh colour. Some perſons think that it was this plant with which the ancient Britons ſtained their bodies, to make them appear terrible to their enemies. When arrived at maturity, this plant is cut down, waſhed, dried haſtily in the ſun, ground in a mill, placed in heaps, and allowed to ferment for a fortnight; then well mixed together, formed into balls, which are piled upon each other, and expoſed to the wind and ſun. In this ſtate they gradually become hot, and exhale a putrid ammoniacal ſmell. The fermentation is promoted, if neceſſary, by ſprinkling the balls with water. When it has continued for a ſufficient time, the woad is allowed to fall to a coarſe powder. In this ſtate it is ſold to the dyers.

13 o. 2. Indigo, is a blue coloured powder extracted from the *indigofera tinctoria*, and from ſeveral other ſpecies of the ſame genus of plants, which are cultivated for that purpoſe both in the Eaſt and Weſt Indies.

14 pre- When the *indigofera* has arrived at maturity, it is cut a few inches above ground, placed in ſtrata in a large veſſel, and covered with water. The plants ſoon acquire heat, ferment, and diſcharge abundance of carbonic acid gas. When the fermentation is far enough advanced, which is judged of by the paleneſs of the leaves, the liquid, now of a green colour, is decanted into large flat veſſels, where it is conſtantly agitated till blue flocculæ begin to make their appearance. Lime water is now poured in, which cauſes the blue flocks to precipitate. The colourleſs liquid is decanted off, and the blue ſediment poured into linen bags. When the water has drained from it ſufficiently, it is formed into ſmall lumps, and dried in the ſhade. In this ſtate it is ſold to the dyer under the name of *indigo*.

Dr Roxbourgh, who firſt drew the attention of manufacturers to the *nerium tinctorium*, a tree very common in Indoſtan, from the leaves of which indigo may be extracted with much advantage, has given a much ſhorter method of obtaining that pigment. The leaves are kept in a copper full of water, ſupported at the temperature of 160°, till they aſſume a yellowiſh hue, and the liquid acquire a deep green colour. The liquid is then to be drawn off, agitated in the uſual manner, till the blue flocculæ appear; and then the indigo is to be precipitated with lime water.*

This proceſs, which ſucceeds equally well with the indigofera, ſhews us that the plants, from which indigo may be extracted, contain a peculiar green pollen, ſoluble in water. The intention, both of the fermentation of the common method, and of the ſcalding, according to Dr Roxbourgh's method, is merely to extract this pollen. Mr Hauſſman firſt ſhewed, that this green baſis of indigo has a ſtrong affinity for oxygen; and the ſubſequent experiments of Drs Roxbuurgh and Bancroft have confirmed his obſervations, and put them beyond the reach of doubt. It gradually attracts oxygen from the air; in conſequence of which, it acquires a blue colour, and becomes inſoluble in water. The agitation is intended to facilitate this abſorption, by expoſing a greater ſurface to the action of the air. The lime water, by abſorbing a quantity of carbonic acid, with which the green pollen ſeems to be combined, greatly facilitates the ſeparation of the indigo.

The method of preparing indigo, and of applying it to the purpoſes of dyeing, ſeems to have been very early known in India. But in Europe, though it had been occaſionally uſed as a paint,* its importance as a dye ſtuff was not underſtood before the middle of the 16th century. It is not even mentioned in the *Plictho*, which was publiſhed in 1548. At that period, then, the uſe of indigo muſt have been unknown to the Italian dyers. The Dutch were the people who firſt imported it from India, and made its importance known in Europe. It was afterwards cultivated in Mexico and the Weſt Indies with ſuch ſucceſs, that the indigo from theſe countries was preferred to every other. In conſequence of this preference, they ſupplied almoſt the whole of the European market. But within theſe few years, the Eaſt Indian indigo, owing entirely to the enlightened exertions of ſome men of ſcience, has recovered its character, and is now imported, in very conſiderable quantities, into Britain.

The indigo of commerce has different ſhades of colour, according to the manner in which it has been prepared, and the proportion of foreign ſubſtances with which it is mixed. The principal ſhades are copper colour, violet, and blue. That indigo, which has the ſmalleſt ſpecific gravity, is always moſt eſteemed; becauſe it is moſt free from impurities. Bergman† found the pureſt indigo of commerce which he could procure, compoſed of

47	pure indigo,
12	gum,
6	reſin,
22	earth,
13	oxyd of iron.
100 (B).	

* Bancroft, i. 423.

* Plinii, l. 35. c. 6.

† Berg. v. 36.

(B) Prouſt informs us, that he found magneſia, even abundantly, in indigo.—*Nicholſon's Jour.* III. 325.

415 Its properties.

Pure indigo is inſoluble in water, alcohol, æther, and oils: neither alkalies nor earths have any action on it; none of the acids hitherto tried have any effect on it, except the nitric and ſulphuric. Nitric acid very ſoon converts it into a dirty white colour, and at laſt decompoſes it completely.* When the acid is concentrated, it even ſets fire to the indigo (c); when it is diluted, the indigo becomes brown, cryſtals make their appearance, reſembling thoſe of oxalic and tartarous acids; and there remains behind, after the acid and the cryſtals are waſhed off, a viſcid ſubſtance, of a very bitter taſte, and poſſeſſing many of the properties of a reſin.†

Concentrated ſulphuric acid diſſolves indigo readily, and much heat is evolved. The ſaturated ſolution is opaque, and conſequently black; but it aſſumes a deep blue colour when diluted with water. This ſolution is well known in commerce under the name of *liquid blue*. Bancroft has given it the name of *ſulphat of indigo*. During the ſolution of the indigo, ſome ſulphurous acid, and ſome hydrogen gas, are evolved,‡ and the blue colour of the indigo is much heightened. Theſe facts have led Bancroft to ſuppoſe, that the indigo, during its ſolution, combines with an additional quantity of oxygen.* This *may* poſſibly be the caſe, but the phenomena are not ſufficient to eſtabliſh it: for the hydrogen gas and ſulphurous acid evolved may owe their formation, not to the action of the ſulphuric acid on indigo, but upon the impurities with which it is always mixed; and the improvement of the colour may be owing to the abſence of theſe impurities. The carbonats of fixed alkalies precipitate ſlowly from ſulphat of indigo a blue coloured powder, which poſſeſſes the properties of indigo; but it is ſoluble in moſt acids and in alkalies. Pure alkalies deſtroy the colour and properties of ſulphat of indigo: they deſtroy alſo precipitated indigo.§ Theſe facts give ſome probability to Bancroft's opinion; but they do not eſtabliſh it: becauſe the differences between common and precipitated indigo may depend merely on the ſtate of greater minuteneſs to which it is reduced, which prevents the attraction of aggregation from obſtructing the action of other bodies. Even ſilica, when newly precipitated, is ſoluble in many menſtrua.

416 Method of dyeing with ſulphat of indigo.

3. Indigo has a very ſtrong affinity for wool, ſilk, cotton and linen. Every kind of cloth, therefore, may be dyed with it, without the aſſiſtance of any mordant whatever. The colour thus induced is very permanent; becauſe the indigo is already ſaturated with oxygen, and becauſe it is not liable to be decompoſed by thoſe ſubſtances, to the action of which the cloth is expoſed. But it can only be applied to cloth in a ſtate of ſolution; and the only ſolvent known being ſulphuric acid, it would ſeem at firſt ſight that the ſulphuric acid ſolution is the only ſtate in which indigo can be employed as a dye.

The ſulphat of indigo is indeed often uſed to dye wool and ſilk blue; but it can ſcarcely be applied to cotton and linen, becauſe the affinity of theſe ſubſtances for indigo is not great enough to enable them readily to decompoſe the ſulphat. The colour given by ſulphat of indigo is exceedingly beautiful: it is known by the name of Saxon blue; becauſe the proceſs, which was diſcovered by councellor Barth in 1740, was firſt carried on at Groſſenhayn in Saxony. The method of the original inventor was very complicated, from the great number of uſeleſs ingredients which were mixed with the ſulphat. But theſe ingredients were gradually laid aſide, and the compoſition ſimplified by others, after the nature of it, which was for ſome time kept ſecret, became known to the public. The beſt proceſs is that of Mr Poerner.*

One part of indigo is to be diſſolved in four parts of concentrated ſulphuric acid; to the ſolution one part of dry carbonat of potaſs is to be added, and then it is to be diluted with eight times its weight of water. The cloth muſt be boiled for an hour in a ſolution, containing five parts of alum and three of tartar for every 32 parts of cloth. It is then to be thrown into a water bath, containing a greater or ſmaller proportion of the diluted ſulphat of indigo, according to the ſhade which the cloth is intended to receive. In this bath it muſt be boiled till it has acquired the wiſhed-for colour. The alum and tartar are not intended to act as mordants, but to facilitate the decompoſition of the ſulphat of indigo. Bergman aſcertained that alum poſſeſſes this property. The alkali added to the ſulphat anſwers the ſame purpoſe. Theſe ſubſtances, alſo, by ſaturating part of the ſulphuric acid, ſerve, in ſome meaſure, to prevent the texture of the cloth from being injured by the action of the acid, which is very apt to happen in this proceſs.

417 Method of dyeing b decompoſing indi

4. But ſulphat of indigo is by no means the only ſolution of that pigment employed in dyeing. By far the moſt common method, and indeed the only method known before 1740, is to deprive indigo of the oxygen to which it owes its blue colour, and thus to reduce it to the ſtate of green pollen; and then to diſſolve it in water by means of alkalies, or alkaline earths, which in that ſtate act upon it very readily. Indigo is preciſely in the ſtate of green pollen when it is firſt extracted from the plant in the ſcalding proceſs deſcribed by Dr Roxbourgh. If, therefore, there were any method of ſtopping ſhort here, and of ſeparating the pigment while it retains its green colour, it would be preciſely in the ſtate beſt adapted for dyeing. Nothing more would be neceſſary but to diſſolve it in water by means of an alkali, and to dip the cloth into the ſolution.†

But as indigo is not brought home to us in that ſtate, the dyer is under the neceſſity of undoing the laſt part of the indigo maker's proceſs, by ſeparating again the oxygen, and reſtoring it to its original green colour. Two different methods are employed for this purpoſe. The firſt of theſe methods is to mix with indigo a ſolution of ſome ſubſtance which has a ſtronger affinity for oxygen than the green baſis of indigo. Green oxyd of iron, for inſtance, and different metallic ſulphurets. If, therefore, indigo, lime, and green ſulphat of iron, be mixed together in water, the indigo gradually

* *Berg.* v. 3.

† *Hauſſmann.*

‡ *Id.*

* *Bancroft*, i. 130.

§ *Berg.* v. 7.

* *Inſtruct ſur l'Art la Teintu* p. 183.

† *Bancro*

(c) The combuſtion of indigo by nitric acid, of the denſity 1.52°, was firſt publiſhed by Mr Sage; but Woulfe appears to have obſerved the fact before him, and to have pointed it out to Rouelle, who ſhewed it in his lectures. *Prouſt, Nicholſon's Jour.* III. 325.

gradually loſes its blue colour, becomes green, and is diſſolved, while the green oxyd of iron is converted into the red oxyd. The manner in which theſe changes take place is obvious. Part of the lime decompoſes the ſulphat of iron; the green oxyd, the inſtant that it is ſet at liberty, attracts oxygen from the indigo, decompoſes it, and reduces it to the ſtate of green pollen. This green pollen is immediately diſſolved by the action of the reſt of the lime. In like manner, indigo is diſſolved, when mixed in water, with pure antimony and potaſs, or with ſulphuret of arſenic and potaſs. For theſe intereſting facts we are indebted to Mr Hauſſman.

The ſecond method is to mix the indigo in water with certain vegetable ſubſtances which readily undergo fermentation. During this fermentation, the indigo is deprived of its oxygen, and diſſolved by means of quicklime or alkali, which is added to the ſolution. The firſt of theſe methods is uſually followed in dyeing cotton and linen; the ſecond, in dyeing wool and ſilk.

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5. In the dyeing of wool, woad and bran are commonly employed as vegetable ferments, and lime as the ſolvent of the green baſe of the indigo. Woad contains itſelf a colouring matter preciſely ſimilar to indigo; by following the common proceſs, indigo may be extracted from it. In the uſual ſtate of woad, when purchaſed by the dyer, the indigo which it contains is probably not far from the ſtate of green pollen. Its quantity in woad is but ſmall, and it is mixed with a great proportion of other vegetable matter. Before the introduction of indigo into Europe, woad alone was employed as a blue dye; and even as late as the 17th century, the uſe of indigo was reſtricted in different countries, and dyers obliged to employ a certain quantity of woad (D). But theſe abſurd reſtrictions were at laſt removed, and woad is now ſcarcely uſed in dyeing, except as a ferment to indigo. The blue colouring matter, however, which it contains, muſt, in all caſes, contribute conſiderably to the dye.

A ſufficient quantity of woad, mixed with bran, is put into a wooden veſſel filled with warm water, whoſe temperature is kept up ſufficiently to enſure fermentation. Afterwards quicklime and indigo are added. The indigo is deprived of its oxygen, and diſſolved by the lime. When the ſolution is complete, the liquid has a green colour, except at the ſurface, where it is copper coloured, or blue, becauſe the indigo at the ſurface abſorbs oxygen from the air, and aſſumes its natural colour. The woollen cloth is dipped in, and paſſed thro' the liquid as equably as poſſible, piece after piece; thoſe pieces being firſt dyed which are to aſſume the deepeſt ſhade. No part of the cloth ſhould come in contact with the ſediment, which would ſpoil the colour. When the cloth is firſt taken out of the vat, it is of a green colour; but it ſoon becomes blue, by attracting oxygen from the air. It ought to be carefully waſhed, to carry off the uncombined particles. This ſolution of indigo is liable to two inconveniences: 1. It is apt ſometimes to run too faſt into the putrid fermentation: this may be known by the putrid vapours which it exhales, and by the diſappearing of the green colour. In this ſtate it would ſoon deſtroy the indigo altogether. The inconvenience is remedied by adding more lime, which has the property of moderating the putreſcent tendency. 2. Sometimes the fermentation goes on too languidly. This defect is remedied by adding more bran or woad, in order to diminiſh the proportion of quicklime.

419
Silk,

6. Silk is uſually dyed blue by the following proceſs: Six parts of bran, and ſix of indigo, with nearly one part of madder, are ſtirred into a ſufficient quantity of water, in which ſix parts of common potaſh of commerce is diſſolved. The liquid is kept at a temperature proper for fermentation. When the indigo, deprived of its oxygen by the fermentation, is diſſolved by the potaſs, the liquid aſſumes a green colour. The ſilk, previouſly well ſcoured, is put into the ſolution in ſmall quantities at a time; then wrung out of the dye, and hung up in the open air, till the green colour which it has at firſt is changed into blue. By this method, ſilk can only be made to receive a light blue colour. In order to give ſilk a dark blue, it muſt previouſly receive what is called a ground colour; that is, be previouſly dyed ſome other colour. A particular kind of red dye-ſtuff, called *archil* (E), is commonly employed for this purpoſe.

The madder employed in the above proceſs may, at firſt ſight, appear ſuperfluous; it ſeems, however, to contribute ſomething to the colour.

420
Cotton, and linen.

7. Cotton and linen are dyed blue by the following proceſs: One part of indigo, one part of green ſulphat of iron, and two parts of quicklime, are ſtirred into a ſufficient quantity of water. The ſolution is at firſt green, but it gradually aſſumes a yellow colour, and its ſurface is covered with a ſhining copper coloured pellicle. The cloth is to be allowed to remain in the ſolution for five or ſix minutes. When taken out, it has a yellow colour; but on expoſure to the atmoſphere, it ſoon becomes green, and then blue, in conſequence of the abſorption of oxygen. The indigo, in this proceſs, ſeems to be deprived of a greater quantity of oxygen than is neceſſary to reduce it to the ſtate of green pollen. Mr Hauſſman has obſerved, that the cloth acquires a much deeper colour, provided it be plunged, the inſtant it is taken out of the dyeing vat, into water acidulated with ſulphuric acid. It is uſual to dip the cloth into a ſucceſſion of vats, variouſly charged with colouring matter; beginning with the vat which contains leaſt colouring matter, and paſſing gradually to thoſe which contain moſt. By this contrivance the cloth is dyed more equally, than it probably would be, if it were plunged all at once into a ſaturated ſolution of colouring matter.

SECT. II. *Of YELLOW.*

421
Yellow dyes.

THE principal colouring matters employed to dye yellow are *weld*, *fuſtic*, and *quercitron bark*.

1. Reſeda luteola, known in this country by the name of

(D) The employment of indigo was ſtrictly prohibited in England in the reign of Queen Elizabeth; nor was the prohibition taken off till the reign of Charles II. It was prohibited alſo in Saxony. In the edict it is ſpoken of as a corroſive ſubſtance, and called *food for the devil.* Colbert reſtricted the French dyers to a certain quantity of it.

(E) This will be deſcribed in a ſubſequent ſection.

Yellow. 422 Weld. of *weld*, is a plant which grows wild very commonly in Scotland, and in moſt European countries. Cultivated weld has a more ſlender ſtem than the wild kind, but it is more valuable, becauſe it is much more rich in colouring matter. It is an annual plant, of a yellowiſh green colour, furniſhed with a great number of ſmall leaves. When ripe it is pulled, dried, tied up in parcels, and in that ſtate ſold to the dyer.

Weld readily yields its colouring matter to water. The ſaturated decoction of it is brown; but when ſufficiently diluted with water it becomes yellow. Acids render its colour ſomewhat paler, but alkalies give it a deeper ſhade. When alum is added to it, a yellow coloured precipitate falls down, conſiſting of alumina combined with the colouring matter of weld. The affinity therefore of this colouring matter for alumina is ſo great, that it is able to abſtract it from ſulphuric acid. Its affinity for oxyd of tin is at leaſt equally great; for muriat of tin cauſes a copious bright yellow precipitate, compoſed of the colouring matter and the oxyd combined. Moſt of the metallic ſalts occaſion ſimilar precipitates, but varying in colour according to the metal employed. With iron, for inſtance, the precipitate is dark grey, and with copper browniſh green.*

423 Fuſtic. 2. The *morus tinctoria* is a large tree which grows in the Weſt India iſlands. The wood of this tree is of a yellow colour, with orange veins. The French call it *yellow wood (bois jaune)*; but the Engliſh dyers have given it the abſurd name of *old fuſtic* (r). This wood has been introduced into dyeing ſince the diſcovery of America. The preciſe time is not known; but that it was uſed in England ſoon after the middle of the 17th century, is evident from Sir William Petty's paper on *Dyeing*, read to the Royal Society ſoon after its inſtitution. In that paper particular mention is made of *old fuſtic*.

Fuſtic gives out its colouring matter with great facility to water. The ſaturated decoction of it is of a deep reddiſh yellow colour; when ſufficiently diluted it becomes orange yellow. Acids render it turbid, give it a pale yellow colour, and occaſion a ſlight greeniſh precipitate, which alkalies rediſſolve. Alkalies give the decoction a very deep colour, inclining to red; ſome time after they have been added, a yellow matter ſeparates from the liquid, and either ſwims on the ſurface, or adheres to the ſides of the veſſel. Alum, ſulphat of iron, of copper, and of zinc, produce precipitates compoſed of the colouring matter combined reſpectively with the baſes of theſe different ſalts; and the colour varies according to the ſubſtance with which this colouring matter is combined. With alumina it is yellow; with iron, yellowiſh brown; with copper, browniſh yellow; and with zinc, greeniſh brown.†

424 Quercitron. 3. The *quercus nigra*, to which Dr Bancroft has given the name of *quercitron*, is a large tree which grows naturally in North America. Dr Bancroft diſcovered, about the year 1784, that the bark of this tree contains a great quantity of yellow colouring matter, and ſince that time it has been introduced into dyeing with much advantage. To prepare it for the dyer, the epidermis is ſhaved off, and then it is ground in a mill. It ſeparates partly into ſtringy filaments, and partly into a fine light powder. Both of theſe contain colouring matter, and therefore are to be employed; but as they contain unequal quantities, they ſhould be uſed in their natural proportions.

Quercitron bark readily gives out its colouring matter to water at the temperature of 100°. The infuſion has a yellowiſh brown colour, which is rendered lighter by acids, and darker by alkalies. Alum occaſions a ſcanty precipitate of a deep yellow colour; muriat of tin, a copious bright yellow precipitate; ſulphat of tin, a dark olive precipitate; and ſulphat of copper, a precipitate of a yellow colour inclining to olive.‡

425 Other y low dy 4. Beſides theſe dye ſtuffs there are others occaſionally uſed by dyers. The following are the moſt remarkable:

Geniſta tinctoria, or *dyers broom*. This plant yields a very inferior yellow; it is only uſed for coarſe woollen ſtuffs.

Serratula tinctoria, or *ſaw-wort*. This plant yields a yellow nearly of the ſame nature with *weld*; for which, therefore, it is a good ſubſtitute.

Juglans alba, or *American hiccory*. The bark of this tree yields a colouring matter exactly ſimilar to that of quercitron bark, but much ſmaller in quantity.

Anotta is a name given to a red paſte formed of the berries of the bixa orellana, a tree which is a native of America. This paſte yields its colouring matter to a ſolution of alkali in water. The ſolution affords an exceedingly beautiful yellow dye, but very fading, and incapable of being fixed by any known mordant.

Turmeric is the root of the *curcuma longa*, a plant which grows both in the Eaſt and Weſt Indies. It is richer in colouring matter than any other yellow dye ſtuff. It yields very beautiful yellows, but too fading to be of much uſe, and no mordant has any influence in contributing to their permanence.

42 Yellow quires mordan 5. Yellow colouring matters have too weak an affinity for cloth to produce permanent colours without the uſe of mordants. Cloth, therefore, before it be dyed yellow, is always prepared by combining ſome mordant or other with it. The mordant moſt commonly employed for this purpoſe is alumina. Oxyd of tin is ſometimes uſed when very fine yellows are wanted. Tan is often employed as a ſubſidiary to alumina, in order to fix it more copiouſly on cotton and linen. Tartar is alſo uſed as an auxiliary to brighten the colour; and muriat of ſoda, ſulphat of lime, and even ſulphat of iron, in order to render the ſhade deeper.

6. The yellow dyed by means of fuſtic is more permanent, but not ſo beautiful as that given by weld or quercitron. As it is permanent, and not much injured by acids, it is often uſed in dyeing compound colours where

* Bartholet, ii. 260.

† Id. ii. 269.

‡ Bancr i. 320.

(r) The *rhus cotinus*, or Venice ſumach, is a ſmall ſhrub, formerly employed as a yellow dye, but now almoſt out of uſe. The French call it *fuſtet*, from which word it is probable, as Dr Bancroft ſuppoſes, that our dyers formed the term *fuſtic*. When the *morus tinctoria* was introduced as a dye-ſtuff, they gave it the ſame name: but in order to diſtinguiſh the two, they called the ſumach, which was a ſmall ſhrub, *young fuſtic*; and the morus, which was a large tree, *old fuſtic*. See *Bancroft*, i. 412.

where a yellow is required. The mordant is alumina. When the mordant is oxyd of iron, ſuſtic dyes a good permanent drab colour.

Weld and quercitron bark yield nearly the ſame kind of colour; but as the bark yields colouring matter in much greater abundance, it is much more convenient, and, upon the whole, cheaper than weld. It is probable, therefore, that it will gradually ſuperſede the uſe of that plant. The method of uſing each of theſe dye ſtuffs is nearly the ſame.

7. Wool may be dyed yellow by the following proceſs: Let it be boiled for an hour, or more, with about $\frac{1}{6}$th of its weight of alum, diſſolved in a ſufficient quantity of water. It is then to be plunged, without being rinced, into a bath of warm water, containing in it as much quercitron bark as equals the weight of the alum employed as a mordant. The cloth is to be turned through the boiling liquid till it has acquired the intended colour. Then a quantity of clean powdered chalk, equal to the hundredth part of the weight of the cloth, is to be ſtirred in, and the operation of dyeing continued for eight or ten minutes longer. By this method a pretty deep and lively yellow may be given fully as permanent as weld yellow.*

For very bright *orange*, or golden *yellows*, it is neceſſary to have recourſe to the oxyd of tin as a mordant. A fine orange yellow may be given to woollen cloth, by putting, for every ten parts of cloth, one part of bark into a ſufficient quantity of hot water; after a few minutes, an equal weight of murio-ſulphat of tin is to be added, and the mixture well ſtirred. The cloth acquires the wiſhed-for colour in a few minutes when briſkly turned in this bath.†

The ſame proceſs will ſerve for producing *bright golden yellows*, only ſome alum muſt be added along with the tin. For the brighteſt golden yellow, the proportions ſufficient for dyeing 100 parts of cloth are, 10 parts of bark, 7 parts of murio-ſulphat of tin, and 5 parts of alum. All the poſſible ſhades of golden yellow may be given to cloth merely by varying the proportion of the ingredients according to the ſhade.‡

In order to give the yellow that delicate *green* ſhade ſo much admired for certain purpoſes, the ſame proceſs may be followed, only tartar muſt be added in different proportions according to the ſhade. Thus to dye 100 parts of cloth a *full bright yellow*, delicately inclining to *green*, 8 parts of bark, 6 of murio-ſulphat, 6 of alum, and 4 of tartar, are to be employed. The tartar is to be added at the ſame time with the other mordants. If the proportion of alum and tartar be increaſed, the green ſhade is more lively: to render it as lively as poſſible, all the four ingredients ought to be employed in equal proportions. As theſe fine lemon-yellows are generally required only pale, 10 parts of each of the ingredients will be ſufficient to dye about 300 parts of cloth.§

By adding a ſmall proportion of cochineal, the colour may be raiſed to a fine orange, or even an aurora‖.

8. Silk may be dyed different ſhades of yellow, either by weld or quercitron bark, but the laſt is the cheapeſt of the two. The proportion ſhould be from 1 to 2 parts of bark to 12 parts of ſilk, according to the ſhade. The bark, tied up in a bag, ſhould be put into the dyeing veſſel while the water which it contains is cold, and when it has acquired the heat of about 100°, the ſilk, previouſly alumed, ſhould be dipped in, and continued till it aſſumes the wiſhed-for colour. When the ſhade required is deep, a little chalk or pearl aſh ſhould be added towards the end of the operation. When a very lively yellow is wanted, a little murio-ſulphat of tin ſhould be added, but not too much, becauſe tin always injures the gloſſineſs of ſilk. The proportions may be 4 parts of bark, 3 of alum, and 2 of murio-ſulphat of tin.¶

Silk is dyed fine orange and aurora colours by annotta. The proceſs is merely dipping the ſilk into an alkaline ſolution of annotta. To produce the orange ſhade the alkali is ſaturated with lemon juice. The colours thus produced are exceedingly beautiful, but they want permanency.

429
Cotton, and linen.

9. The common method of dyeing cotton and linen yellow, has been deſcribed in the article DYEING in the *Encyclopædia*. The cloth is firſt ſoaked in a ſolution of alum, and then dyed in a decoction of weld. After this it is ſoaked for an hour in a ſolution of ſulphat of copper, and, laſtly, it is boiled for an hour in a ſolution of hard ſoap. This proceſs, beſides the expence of it, is defective; becauſe the yellow is neither ſo beautiful nor ſo permanent as it might be if the mordant were uſed in a different form.

The method recommended by Dr Bancroft is much more advantageous, yielding more permanent and beautiful colours at a ſmaller expence. The mordant ſhould be acetite of alumina, prepared by diſſolving 1 part of acetite of lead, and 3 parts of alum, in a ſufficient quantity of water. This ſolution ſhould be heated to the temperature of 100°, the cloth ſhould be ſoaked in it for two hours, then wrung out and dried. The ſoaking may be repeated, and the cloth again dried as before. It is then to be barely wetted with lime water, and afterwards dried. The ſoaking in the acetite of alumina may be again repeated; and if the ſhade of yellow is required to be very bright and durable, the alternate wetting with lime water, and ſoaking in the mordant, may be repeated three or four times. By this contrivance a ſufficient quantity of alumina is combined with the cloth, and the combination is rendered more permanent by the addition of ſome lime. The dyeing bath is prepared by putting 12 or 18 parts of quercitron bark (according to the depth of the ſhade required), tied up in a bag, into a ſufficient quantity of cold water. Into this bath the cloth is to be put, and turned round in it for an hour, while its temperature is gradually raiſed to about 120°. It is then to be brought to a boiling heat, and the cloth allowed to remain in it after that only a few minutes. If it be kept long at a boiling heat the yellow acquires a ſhade of brown*.

Another way of dyeing cotton and linen very permanent yellows, would be to imitate the method adopted for dyeing cotton in the Eaſt. That method is indeed exceedingly tedious, but it might be very much ſhortened by carefully attending to the uſes of the ingredients. The eſſential part of the proceſs is to cauſe the alumina to combine in ſufficient quantity with the cloth, and to adhere with ſufficient firmneſs to enſure a permanent colour. This is accompliſhed by uſing three mordants; firſt oil, then tan, and laſtly alum. The combination of theſe three ſubſtances produces a mordant which enſures a very permanent colour.

The cotton is firſt ſoaked in a bath compoſed of a ſufficient quantity of oil, and mixed with a weak ſolution

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¶ Bancroft, i. 345.

* Ibid. 351.

tion of ſoda. Animal oil ſeems to anſwer beſt for the purpoſe. Vogler found that glue anſwered extremely well. The ſoda ſhould be cauſtic: In that ſtate it combines with the oil, and enables the cloth to abſorb it equally. It is then, after being waſhed, put into an infuſion of nut galls (the whiter the better). The tan combines with the oil, while the gallic acid carries off the alkali that may remain attached to the cloth. The infuſion ought to be hot; and the cotton, after coming out of it, ſhould be dried as quickly as poſſible. Care ſhould be taken that the quantity of galls do not exceed a juſt proportion compared with the oil, otherwiſe the colour will be darkened. The cotton, thus prepared, is to be put into a ſolution of alum. There is a ſtrong affinity between tan and alumina; in conſequence of which, the alum is decompoſed, and the alumina combines with the tan in ſufficient abundance.† The cotton, thus prepared, is to be dyed, as above deſcribed, with quercitron bark.

† *Chaptal, Ann. de Chim.* xxvi. 251.

430
Chaptal's proceſs for cotton.

Mr Chaptal, whoſe ingenious labours have contributed exceedingly to elucidate the theory of dyeing, has propoſed an exceedingly ſimple and cheap method of dyeing cotton a fine permanent nankeen yellow. His proceſs is as follows (G).

Cotton has ſo ſtrong an affinity for oxyd of iron, that if put into a ſolution of that oxyd in any acid whatever, it decompoſes the ſalt, abſorbs the iron, and acquires a yellow colour. The cotton to be dyed is to be put into a cold ſolution of ſulphat of iron, of the ſp. gr. 1.020; it is then wrung out, and put directly into a ley of potaſs, of the ſp. gr. 1.010, into which a ſolution of alum has been poured till it was ſaturated with it. After the cotton has remained in this bath four or five hours, it may be taken out, waſhed, and dried. By this proceſs cotton may be dyed all the different ſhades of nankeen, by varying the proportion of the ſulphat of iron. This colour has the advantage of not being injured by waſhing, and of being exceedingly cheap.§

§ *Ibid.* 270.

SECT. III. *Of* RED.

431
Red dyes.

THE principal colouring matters employed in dyeing *red* are, *kermes*, *cochineal*, *archil*, *madder*, *carthamus*, and *Brazil wood*.

432
Kermes.

1. In different parts of Aſia and the ſouth of Europe, there grows a ſmall ſpecies of oak, to which Linnæus gives the name of *quercus coccifera*. On this oak reſides a ſmall inſect, of a reddiſh brown colour; in commerce it is known by the name of *kermes*. This inſect is a ſpecies of *coccus*: Linnæus called it *coccus ilicis*. Theſe inſects are gathered in the month of June, when the female, which alone is uſeful, is ſwelled with eggs. They are ſteeped for ten or twelve hours in vinegar to kill the young inſects contained in the eggs, and afterwards dried on a linen cloth. In this ſtate they are ſold to the dyer.

Kermes readily gives out its colouring matter to water or alcohol. It was much uſed by the ancients in dyeing; the colours which it produced were highly eſteemed, being inferior in price only to their celebrated purple. They gave it the name of *coccus*.

The colour which it communicates to cloth is exceedingly permanent, but being far inferior in beauty to thoſe which may be obtained from cochineal, it has been but little employed by dyers ſince that ſplendid pigment came into common uſe.

43
Cochin

2. Cochineal is likewiſe an inſect, a ſpecies of *coccus*. Linnæus diſtinguiſhes it by the name *coccus cacti*. It inhabits different ſpecies of cacti, but the moſt perfect variety is confined to the *cactus coccinillifer*. The cochineal inſect was firſt diſcovered in Mexico; the natives had employed it in their red dyes before the arrival of the Spaniards. It became known in Europe ſoon after the conqueſt of Mexico; and the beauty of the colour which it communicates to cloth very ſoon attracted general attention. For many years it was miſtaken for a vegetable production, as had been the caſe alſo with the kermes. Different accounts of its real nature had indeed appeared very early in the Philoſophical Tranſactions; but the opinion of Pomet, who inſiſted that it was the ſeed of a particular plant, gained ſo much credit, that it was not entirely deſtroyed till the publication of Mr Ellis's paper in the 52d volume of the Philoſophical Tranſactions, which eſtabliſhed the contrary beyond the poſſibility of doubt.

The female cochineal inſect remains like the kermes, during her whole life adhering to a particular ſpot of the tree on which it feeds. After fecundation, her body ſerves merely as a nidus for her numerous eggs, and gradually ſwells as theſe advance towards maturity. In this ſtate the inſects are gathered, put into a linen bag, which is dipt into hot water to deſtroy the life of the young animals contained in the eggs, and then dried. In this ſtate they are ſent to Europe and ſold to the dyer.

The quantity of cochineal diſpoſed of in Europe is very great. Bancroft informs us, that the Spaniards annually bring to market about 600,000 lbs. of it. Hitherto the rearing of the inſects has belonged almoſt excluſively to that nation. Other nations have indeed attempted to ſhare it with them, but without any remarkable ſucceſs; as the Spaniards uſe every precaution to confine the true cochineal, and even the ſpecies of cactus on which it feeds, to Mexico. Mr Thiery de Menonville was fortunate enough to procure ſome ſpecimens of both, and to transfer them in ſafety to St Domingo; but after his death, the inſects were allowed to periſh. The wild cochineal inſect, which differs from the cultivated kind merely in being ſmaller, and containing leſs colouring matter, was produced in St Domingo, in conſiderable quantities, before the commencement of the preſent war. Several ſpirited Britiſh gentlemen have lately contrived to procure the inſect; and vigorous efforts are making to rear it in the Eaſt Indies. We have not yet learned the ſucceſs of theſe attempts; but we have reaſon to hope every thing from the zeal and abilities of thoſe gentlemen who have taken an active part in the enterprize.

Cochineal readily gives out its colouring matter to water. The decoction is of a crimſon colour, inclining to violet: It may be kept for a long time without putrifying or loſing its tranſparency. Sulphuric acid gives

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(G) We ought to mention, that this proceſs, or at leaſt one very ſimilar, has been long well known to the calico printers of this country. Moſt of their brown yellows, or drabs, are dyed with iron.

gives it a red colour, inclining to yellow, and occaſions a ſmall fine red precipitate. Tartar gives it a yellowiſh red colour, which becomes yellow after a ſmall quantity of red powder has ſubſided. Alum brightens the colour of the decoction, and occaſions a crimſon precipitate. Muriat of tin gives a copious fine red precipitate; ſulphat of iron, a browniſh violet precipitate; ſulphat of zinc, a deep violet precipitate; acetite of lead, and ſulphat of copper, violet precipitates.†

Water is not capable of extracting the whole of the colouring matter of cochineal; but the addition of a little alkali or tartar enables the water to extract the whole of it.*

3. Archil (H) is a paſte formed of the *lichen roccella*, pounded and kept moiſt for ſome time with ſtale urine. It gives out its colouring matter to water, to alcohol (I), and to a ſolution of ammonia in water.

The lichen roccella grows abundantly in the Canary iſlands, from which it is imported and ſold to the dyers. Other lichens are likewiſe uſed to dye red, eſpecially the *parellus*, from which the pigment called *litmus*, and by chemiſts *turnſole*, is prepared; the *omphalodes* and *tartareus*, which are often employed in this country to dye coarſe cloths. To theſe many others might be added; but the reader may conſult the treatiſes of Hoffman and Weſtring on the ſubject.

4. The *rubia tinctorum* is a ſmall well known plant, cultivated in different parts of Europe for the ſake of its roots, which are known by the name of *madder*. They are about the thickneſs of a gooſe quill, ſomewhat tranſparent, of a reddiſh colour, and a ſtrong ſmell. They are dried, cleaned, ground in a mill, and in that ſtate uſed by dyers.

Madder gives out its colouring matter to water. The infuſion is of a browniſh orange colour; alum produces in it a deep browniſh red precipitate; alkaline carbonats, a blood red precipitate, which is rediſſolved on adding more alkali. The precipitate occaſioned by acetite of lead is browniſh red; by nitrat of mercury, purpliſh brown; by ſulphat of iron, a fine bright brown. After the red colouring matter has been extracted from madder by water, it is ſtill capable of yielding a brown colour.‡

5. *Carthamus tinctorius* is an annual plant, cultivated in Spain, Egypt, and the Levant, for the ſake of its flowers, which alone are uſed in dyeing. After the juice has been ſqueezed out of theſe flowers, they are waſhed repeatedly with ſalt water, preſſed between the hands, and ſpread on mats to dry. Care is taken to cover them from the ſun during the day, and to expoſe them to the evening dews, in order to prevent them from drying too faſt. Such is the method followed in Egypt.

Red.

The flowers of carthamus contain two colouring matters; a yellow, which is ſoluble in water, and a red, inſoluble in water, but ſoluble in alkaline carbonats. The method of preparing them above deſcribed, is intended to carry off the yellow colouring matter, which is of no uſe, and to leave only the red. After the flowers are thus prepared, they are of a red colour, and have loſt nearly one-half of their weight. An alkaline ley readily extracts their colouring matter, which may be precipitated by ſaturating the alkali with an acid. Lemon juice is commonly uſed for this purpoſe, becauſe it does not injure the colour of the dye. Next to citric, ſulphuric acid is to be preferred, provided too great a quantity be not uſed. The red colouring matter of carthamus, extracted by carbonat of ſoda, and precipitated by lemon juice, conſtitutes the *rouge* employed by the ladies as a paint. It is afterwards ground with a certain quantity of talc. The fineneſs of the talc, and the proportion of it mixed with the carthamus, occaſion the difference between the cheaper and dearer kinds of *rouge*.

437
Brazil wood.

6. *Brazil wood*, or *fernambouc*, as it is called by the French, is the wood of the *cæſalpinia criſta*, a tree which grows naturally in America and the Weſt Indian iſlands. It is very hard; its ſpecific gravity is greater than that of water; its taſte is ſweetiſh: its colour, when freſh cut, is pale; but after expoſure to the atmoſphere, it becomes reddiſh.

Brazil wood yields its colouring matter to alcohol, and likewiſe to boiling water. The decoction is of a fine red colour. The mineral acids make it yellow, and occaſion a reddiſh brown precipitate. Oxalic acid cauſes an orange red precipitate. Fixed alkali gives the decoction a crimſon colour, inclining to brown; ammonia, bright purple. Alum occaſions a copious crimſon precipitate, eſpecially if alkali is added at the ſame time. Sulphat of iron renders the decoction black. The precipitate produced by muriat of tin is roſe coloured; that by acetite of lead of a fine deep red.*

* *Berthollet*, ii. 240.

The decoction of Brazil wood is fitter for dyeing after it has ſtood ſome time, and undergone a kind of fermentation.

438
Red requires a mordant.

7. None of the red colouring matters has ſo ſtrong an affinity for cloth as to produce a permanent red, without the aſſiſtance of mordants. The mordants employed are alumina and oxyd of tin; oil and tan, in certain proceſſes, are alſo uſed; and tartar and muriat of ſoda are frequently called in as auxiliaries.

8. Coarſe woollen ſtuffs are dyed red with madder or

(H) If we believe Tournefort, this dye ſtuff was known to the ancients. They employed it to dye the colour known by the name of *purple* of Amorgos, one of the Cyclades iſlands. If this account be accurate, the knowledge of it had been loſt during the dark ages. It was accidentally diſcovered by a Florentine merchant about the year 1300, who obſerved, that urine gave a very fine colour to the lichen roccella. Mr Dufay diſcovered, that archil poſſeſſes the property of tinging indelibly white marble, of forming veins, and giving it the appearance of jaſper. See *Mem. Par.* 1732.

(I) The tincture of archil is uſed for making *ſpirit of wine thermometers*. It is a ſingular fact, that this tincture becomes gradually colourleſs when excluded from the contact of air, and that it again recovers its colour when expoſed to the atmoſphere. The phenomenon was firſt obſerved by the Abbé Nollet, and deſcribed by him in an eſſay, publiſhed among the memoirs of the Academy of Sciences for 1742.

Red.

or archil; but fine cloth is almoſt excluſively dyed with cochineal; though the colour which it receives from kermes is much more durable. Brazil wood is ſcarcely uſed, except as an auxiliary; becauſe the colour which it imparts to wool is not permanent.

439 Wool how dyed crimſon,

Wool is dyed *crimſon*, by firſt impregnating it with alumina by means of an alum bath, and then boiling it in a decoction of cochineal till it has acquired the wiſhed for colour. The crimſon will be finer if the tin mordant be ſubſtituted for alum: indeed it is uſual with dyers to add a little nitro-muriat of tin when they want fine crimſons. The addition of archil and potaſs to the cochineal, both renders the crimſon darker and gives it more bloom; but the bloom very ſoon vaniſhes. For paler crimſons, one-half of the cochineal is withdrawn, and madder ſubſtituted in its place.

440 And ſcarlet.

Wool may be dyed *ſcarlet*, the moſt ſplendid of all colours, by firſt boiling it in a ſolution of murio-ſulphat of tin; then dyeing it pale yellow with quercitron bark, and afterwards crimſon with cochineal: For ſcarlet is a compound colour, conſiſting of *crimſon* mixed with a little *yellow*. This method was ſuggeſted by Dr Bancroft, who firſt explained the nature of the common method. The proportions which he gives are eight parts of murio-ſulphat of tin for 100 parts of cloth. After the cloth has been boiled in this ſolution for a quarter of an hour, it is to be taken out, and about four parts of cochineal, and two and a half parts of quercitron bark, are to be thrown into the bath. After theſe are well mixed, the cloth is to be returned again to the bath, and boiled in it, till it has acquired the proper colour.*

The common proceſs for dyeing ſcarlet is as follows: Twelve parts of tartar are diſſolved in warm water; then one part of cochineal is added, and ſoon after ten parts of nitro-muriat of tin. When the bath boils, 100 parts of cloth are put in, turned briſkly through the bath, boiled in it for two hours; then taken out, aired, waſhed, and dried. Into another bath eleven parts of cochineal are put; and after its colouring matter is ſufficiently extracted, 28 parts of nitro-muriat of tin are added. In this bath the cloth is boiled for an hour, and then waſhed and dried.

Every preceding writer on dyeing took it for granted, that the yellow tinge neceſſary for ſcarlet was produced by the nitro-muriat of tin, or rather by the nitric acid of that compound, and that the tartar was only uſeful in enlivening the colour. But Dr Bancroft aſcertained, by actual experiment, that nitro-muriat of tin has no ſuch effect; that cloth, impregnated with this or any other tin mordant, and afterwards dyed with cochineal, acquires only a crimſon colour, unleſs tartar be added; that the tartar has the property of converting part of the cochineal to yellow; and therefore is the real agent in producing the ſcarlet colour. Good ſcarlet, indeed, cannot be made without tin; becauſe every other mordant ſullies the colour, and renders it dull.†

441 Red dyes employed for ſilk,

9. Silk is uſually dyed red with cochineal or carthamus, and ſometimes with Brazil wood. Kermes does not anſwer for ſilk; madder is ſcarcely ever uſed for that purpoſe, becauſe it does not yield a bright enough colour. Archil is employed to give ſilk a bloom; but it is ſcarcely uſed by itſelf, unleſs when the colour wanted is lilac.

Red.

442 In dyein crimſon,

Silk may be dyed crimſon by ſteeping it in a ſolution of alum, and then dyeing it in the uſual way in a cochineal bath. But the common proceſs is to plunge the ſilk, after it has been alumed, into a bath formed of the following ingredients: Two parts of white galls, three parts of cochineal, three-ſixteenths of tartar, and three-ſixteenths of nitro-muriat of tin, for every ſixteen parts of ſilk. The ingredients are to be put into boiling water in the order they have been enumerated; the bath is then to be filled up with cold water; the ſilk put into it, and boiled for two hours. After the bath has cooled, the ſilk is uſually allowed to remain in it for three hours longer.

443 Poppy

The colours known by the names of poppy, cherry, roſe, and fleſh colour, are given to ſilk by means of carthamus. The proceſs conſiſts merely in keeping the ſilk, as long as it extracts any colour, in an alkaline ſolution of carthamus, into which as much lemon juice as gives it a fine cherry colour has been poured. To produce a deep poppy red, the ſilk muſt be put ſucceſſively into a number of ſimilar baths, and allowed to drain them. When the ſilk is dyed, the colour is brightened by plunging it into hot water acidulated with lemon juice. The ſilk ought to be previouſly dyed yellow with anotta.

444 Cherry

Cherry red is produced the ſame way, only the anotta ground is omitted, and leſs colouring matter is neceſſary. When a fleſh colour is required, a little ſoap ſhould be put into the bath, which ſoftens the colour, and prevents it from taking too quickly.

445 Fleſh re

To leſſen the expenſe, ſome archil is often mixed with carthamus for dark ſhades.

The ſame ſhades may be dyed by means of brazil wood, but they do not ſtand.

446 Scarlet

Silk cannot be dyed a full ſcarlet; but a colour approaching to ſcarlet may be given it, by firſt impregnating the ſtuff with murio-ſulphat of tin, and afterwards dyeing it in a bath compoſed of four parts of cochineal and four parts of quercitron bark. To give the colour more body, both the mordant and the dye may be repeated.* A colour approaching ſcarlet may be alſo given to ſilk, by firſt dyeing it crimſon, then dyeing it with *carthamus*, and laſtly yellow without heat.†

447 How tc dye cotton and linen re

10. Cotton and linen are dyed red with madder. The proceſs was borrowed from the Eaſt; hence the colour is often called *Adrianople* or *Turkey red*. The cloth is firſt impregnated with oil, then with galls, and laſtly with alum, in the manner deſcribed in the laſt ſection. It is then boiled for an hour in a decoction of madder, which is commonly mixed with a quantity of blood. After the cloth is dyed, it is plunged into a ſoda ley, in order to brighten the colour. The red given by this proceſs is very permanent, and when properly conducted it is exceedingly beautiful. The whole difficulty conſiſts in the application of the mordant, which is by far the moſt complicated employed in the whole art of dyeing.

Cotton may be dyed ſcarlet by means of murio-ſulphat of tin, cochineal, and quercitron bark, uſed as for ſilk; but the colour is too fading to be of any value.*

SECT. IV. *Of BLACK.*

448 Black d

1. THE ſubſtances employed to give a black colour to cloth are red oxyd of iron and tan. Theſe two ſubſtances

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* *Bancroft*, i. 291.

† *Ibid.* 288.

* *Bancr* i. 312.

† *Bertho* ii. 203.

* *Bancr* i. 316.

lack- ſtances have a ſtrong affinity for each other; and when combined, aſſume a deep black colour, not liable to be deſtroyed by the action of air and light. The affinity which each of them has for the different kinds of cloth has been already mentioned.

2. Logwood is uſually employed as an auxiliary, becauſe it communicates luſtre, and adds conſiderably to the fullneſs of the black. It is the wood of the tree called by Linnæus *hæmatoxylum campechianum*, which is a native of ſeveral of the Weſt India iſlands, and of that part of Mexico which ſurrounds the Bay of Honduras. It yields its colouring matter to water. The decoction is at firſt a fine red bordering on violet, but if left to itſelf it gradually aſſumes a black colour. Acids give it a deep red colour; alkalies a deep violet, inclining to brown. Sulphat of iron renders it as black as ink, and occaſions a precipitate of the ſame colour. The precipitate produced by alum is dark red; the ſupernatent liquid becomes yellowiſh red.* rtbollet,

55. 3. Cloth, before it receives a black colour, is uſually dyed blue. This renders the colour much fuller and finer than it otherwiſe would be. If the cloth be coarſe, the blue dye may be too expenſive; in that caſe a brown colour is given by means of walnut peels.

149 r to in- a : on 4. Wool is dyed black by the following proceſs. It is boiled for two hours in a decoction of nut galls, and afterwards kept for two hours more in a bath compoſed of logwood and ſulphat of iron, kept during the whole time at a ſcalding heat, but not boiled. During the operation it muſt be frequently expoſed to the air; becauſe the green oxyd of iron, of which the ſulphat is compoſed muſt be converted into red oxyd by abſorbing oxygen, before the cloth can acquire a proper colour. The common proportions are five parts of galls, five of ſulphat of iron, and 30 of logwood for every 100 of cloth. A little acetite of copper is commonly added to the ſulphat of iron, becauſe it is thought to improve the colour.

5● ilk, 5. Silk is dyed nearly in the ſame manner. It is capable of combining with a very great deal of tan; the quantity given is varied at the pleaſure of the artiſt, by allowing the ſilk to remain a longer or ſhorter time in the decoction. After the galling, the ſilk is put into a ſolution of ſulphat of iron which is uſually mixed with a certain quantity of iron filings and of gum. It is occaſionally wrung out of the bath, expoſed for ſome time to the air, and again immerſed. When it has acquired a ſufficiently full colour, it is waſhed in cold water, and afterwards ſteeped in a decoction of ſoap to take off the harſhneſs, which ſilk always has after being dyed black.

51 n, and on. 6. It is by no means ſo eaſy to give a full black to linen and cotton. The cloth, previouſly dyed blue, is ſteeped for 24 hours in a decoction of nut galls. A bath is prepared, containing acetite of iron, formed by ſaturating acetous acid with brown oxyd of iron. Into this bath the cloth is put in ſmall quantities at a time, wrought with the hand for a quarter of an hour, then wrung out and aired, again wrought in a freſh quantity of the bath, and afterwards aired. Theſe alternate proceſſes are repeated till the colour wanted is given. A decoction of alder bark is uſually mixed with the liquor containing the nut galls.

It would probably contribute to the goodneſs and permanence of the colour, if the cloth, before being galled, were impregnated with oil, by being ſteeped in a mixture of alkaline ley and oil combined as is practiſed for dyeing cotton red.

Brown.

SECT. V. *Of BROWN.*

THAT particular *brown* colour, with a caſt of *yellow*, which the French call *fauve*, and to which the Engliſh writers on *dyeing* have appropriated the word *fawn*, though in fact a compound, is commonly ranked among ſimple colours; becauſe it is applied to cloth by a ſingle proceſs. The ſubſtances employed to produce this colour are numerous; but we ſhall ſatisfy ourſelves with enumerating the following:

452 Brown dyes. Walnut-peels are the green covering of the walnut. When firſt ſeparated, they are white internally; but ſoon aſſume a brown, or even a black colour, on expoſure to the air. They readily yield their colouring matter to water. They are uſually kept in large caſks, covered with water, for above a year, before they are uſed. To dye wool brown with them, nothing more is neceſſary than to ſteep the cloth in a decoction of them till it has acquired the wiſhed-for colour. The depth of the ſhade is proportional to the ſtrength of the decoction. The root, as well as the peel of the walnut tree, contains the ſame colouring matter, but in ſmaller quantity. The bark of the birch, alſo, and many other trees, may be uſed for the ſame purpoſe.

It is very probable, that the brown colouring matter is in theſe vegetable ſubſtances combined with tan. This is certainly the caſe in ſumach, which is often employed to produce a brown. This combination explains the reaſon why no mordant is neceſſary; the tan has a ſtrong affinity for the cloth, and the colouring matter for the tan. The dye ſtuff and the mordant are already in fact combined together.

CHAP. V. OF COMPOUND COLOURS.

COMPOUND colours are produced by mixing together two ſimple ones; or, which is the ſame thing, by dyeing cloth firſt one ſimple colour, and then another. The reſult is a compound colour, varying in ſhade according to the proportions of each of the ſimple colours employed.

453 Diviſion of compound colours. Compound colours are exceedingly numerous, varying almoſt to infinity, according to the proportions of the ingredients employed. They may be all arranged under the following claſſes:

Mixtures of 1. blue and yellow,
2. blue and red,
3. yellow and red,
4. black and other colours.

To deſcribe all the different ſhades which belong to each of theſe claſſes, would be impoſſible; and even if it were poſſible, it would be unneceſſary; becauſe all the proceſſes depend upon the principles laid down in the preceding chapters, and may eaſily be conceived and varied by thoſe who underſtand theſe principles. In the following ſections, therefore, it will be ſufficient to mention the principal compound colours produced by the mixture of ſimple colours, and to exhibit a ſpecimen or two of the mode of producing them.

SECT. I. *Of Mixtures of BLUE and YELLOW.*

THE colour produced by mixtures of blue and yellow

Mixtures of Blue and Yellow.

is *green*; which is diſtinguiſhed by dyers by a great variety of names, according to the depth of the ſhade, or the prevalence of either of the component parts. Thus we have *ſea green*, *meadow* or *graſs green*, *pea green* &c. &c.

454 How to induce green

455 On wool,

Wool is uſually dyed green by giving it firſt a blue colour, and afterwards dyeing it yellow; becauſe, when the yellow is firſt given, ſeveral inconveniences follow; the yellow partly ſeparates again in the blue vat, and communicates a green colour to it; and thus renders it uſeleſs for every other purpoſe, except dyeing green. Any of the proceſſes for dyeing blue, deſcribed in the laſt chapter may be followed; care being taken always to proportion the depth of the blue to the ſhade of the green which is required. The cloth thus dyed blue may receive a yellow colour, by following the proceſſes deſcribed in the laſt chapter for that purpoſe. When the ſulphat of indigo is employed, it is uſual to mix all the ingredients together, and to dye the cloth at once; the colour produced is known by the name of *Saxon*, or *Engliſh green*. One of the moſt convenient methods of conducting this proceſs is the following.

Six or eight parts of quercitron bark, tied up in a bag, are to be put into the dyeing veſſel, which ſhould contain only a ſmall quantity of warm water. When the water boils, ſix parts of murio-ſulphat of tin, and four parts of alum, are to be added. In a few minutes the dyeing veſſel ſhould be filled up with cold water, till the temperature is reduced to about 130°. After this as much ſulphat of indigo is to be poured in as is ſufficient to produce the intended ſhade of green. When the whole has been ſufficiently ſtirred, a hundred parts of cloth are to be put in, and turned briſkly for about fifteen minutes, till it has acquired the wiſhed-for ſhade.* By this method, a much more beautiful colour is obtained than is given by the uſual proceſs, in which fuſtic is employed to give the yellow ſhade.

456 Silk,

Silk, intended to receive a green colour, is uſually dyed yellow firſt by means of weld, according to the proceſs deſcribed in the laſt chapter; afterwards, it is dipped into the blue vat, and dyed in the uſual manner. To deepen the ſhade, or to vary the tint, decoctions of logwood, anotta, fuſtic, &c. are added to the yellow bath. Or ſilk may be dyed at once green, by adding ſuitable proportions of ſulphat of indigo to the common quercitron bark bath, compoſed of four parts of bark, three parts of alum and two parts of murio-ſulphat of tin.†

457 Cotton, and linen.

Cotton and linen muſt be firſt dyed blue, and then yellow according to the methods deſcribed in the laſt chapter. It is needleſs to add, that the depth of each of theſe colours muſt be proportioned to the ſhade of green colour which it is the intention of the dyer to give.

SECT. II. *Of Mixtures of Blue and Red.*

458 Violet, purple, lilac.

The mixture of blue and red produces *violet*, *purple*, and *lilac*, of various ſhades, and known by various names, according to the proportion of the ingredients employed. When the colour is deep, and inclines moſt to blue, it is called *violet*; but when the red is prevalent, it gets the name of *purple*. When the ſhade is light, the colour is uſually called *lilac*. For violet, therefore, the cloth muſt receive a deeper blue; for purple, a deeper red? and for lilac, both of theſe colours muſt be light.

Mixture of Blue a Red.

459 How in duced o wool,

Wool is uſually dyed firſt *blue*; the ſhade, even for violet, ought not to be deeper than that called *ſky blue*; afterwards it is dyed ſcarlet, in the uſual manner. The violets and purples are dyed firſt; and when the vat is ſomewhat exhauſted, the cloth is dipped in which is to receive the lilac, and the other lighter ſhades. By means of ſulphat of indigo, the whole proceſs may be performed at once. The cloth is firſt alumed, and then dyed in a veſſel, containing cochineal, tartar, and ſulphat of indigo, in proportions ſuited to the depth of the colour required.* A violet colour may alſo be given to wool, by impregnating it with a mordant compoſed of tin diſſolved in a mixture of ſulphuric and muriatic acids, formed by diſſolving muriat of ſoda in ſulphuric acid: to which ſolution a quantity of tartar and ſulphat of copper is added. The wool is then boiled in a decoction of logwood till it has acquired the wiſhed-for colour.†

460 Silk

Silk is firſt dyed crimſon, by means of cochineal, in the uſual way, excepting only that no tartar, nor ſolution of tin is employed; It is then dipped into the indigo vat till it has acquired the wiſhed-for ſhade. The cloth is often afterwards paſſed through an archil bath which greatly improves the beauty of the colour. Archil is often employed as a ſubſtitute for cochineal: The ſilk firſt receives a red colour, in the uſual way, by being dyed in an archil bath; afterwards it receives the proper ſhade of blue. The violet, or purple, given by this proceſs is very beautiful, but not very laſting.‡

Silk may be dyed violet or purple at once, by firſt treating it with a mordant, compoſed of equal parts of nitro-muriat of tin and alum, and then dipping it into a cochineal bath into which a proper quantity of ſulphat of indigo has been poured. But this dye is fading; the blue colour ſoon decays, and the ſilk becomes red.*

461 Cotton, and lin

Cotton and linen are firſt dyed blue, then galled, then ſoaked in a decoction of logwood; ſome alum and acetite of copper are added to the decoction, and the cloth is ſoaked again. This proceſs is repeated till the proper colour is obtained.† The colour produced by this method is not nearly equal in permanency to that deſcribed in this *Supplement* under the word IRON; to which we beg leave to refer the reader. The proceſs there deſcribed has been long known; but Mr Chaptal has ſimplified it ſomewhat.

SECT. III. *Of Mixtures of Yellow and Red.*

462 Orange and oliv

THE colour produced by the mixture of *red* and *yellow* is *orange*; but almoſt an infinity of ſhades reſults from the different proportions of the ingredients, and from the peculiar nature of the yellow employed. Sometimes *blue* is combined with red and yellow on cloth; the reſulting colour is called *olive*.

463 How in duced o wool,

Wool may be dyed orange by preciſely the ſame proceſs which is uſed for ſcarlet, only the proportion of red muſt be diminiſhed, and that of yellow increaſed. When wool is firſt dyed red with madder, and then yellow with weld, the reſulting colour is called *cinnamon colour*. The mordant, in this caſe, is a mixture of alum and tartar. The ſhade may be varied exceedingly, by uſing other yellow dye ſtuffs inſtead of weld, and by varying the proportions, according to circumſtances. Thus a reddiſh yellow may be given to cloth, by firſt dyeing it yellow, and then paſſing it through a madder bath.

464 Silk

Silk is dyed orange by means of carthamus: the method

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* *Bancroft*, i. 336.

† *Ibid.* 346.

* *Poern*

† *Decro zille*, *Be thollet*, 331.

‡ *Berth* ii. 327.

* *Gubli Bertholl* ii. 329

† *Berth* ii. 337

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Black
other
lours.

method has been deſcribed in the laſt chapter. Cinnamon colour is given to it by dyeing it, previouſly alumed, in a bath compoſed of the decoctions of logwood, Brazil wood, and fuſtic mixed together.

65
on,
linen.

Cotton and linen receive a cinnamon colour by means of weld and madder. The proceſs is complicated. The cloth is firſt dyed with weld and acetite of copper, then dipped in a ſolution of ſulphat of iron, then galled, then alumed, and then dyed in the uſual way with madder.*

rtbollet,
44.

For *olive*, the cloth is firſt dyed blue, then yellow, and laſtly paſſed through a madder bath. The ſhade depends upon the proportion of each of theſe colours. For very deep ſhades the cloth is alſo dipped into a ſolution of ſulphat of iron. Cotton and linen may be dyed *olive* by dipping them into a bath, compoſed of the decoction of four parts of weld and one of potaſs, mixed with the decoction of Brazil wood and a little acetite of copper.†

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SECT. IV. *Of Mixtures of BLACK with other Colours.*

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STRICTLY ſpeaking, the mixtures belonging to this ſection are not mixtures of *black colours* with other colours, but combinations of the *black dye* with other colours; the ingredients of which, galls and brown oxyd of iron, being both mordants, variouſly modify other colouring matters by combining with them. Thus if cloth be previouſly combined with brown oxyd of iron, and afterwards dyed yellow with quercitron bark, the reſult will be a *drab* of different ſhades, according to the proportion of mordant employed. When the proportion is ſmall, the colour inclines to olive or yellow; on the contrary, the drab may be deepened or ſaddened, as the dyers ſpeak, by mixing a little ſumach with the bark.* The precautions formerly mentioned in applying the oxyd muſt be obſerved.

ncroft,
3.

It is very common to dip cloth already dyed ſome particular colour into a ſolution of ſulphat of iron, and galls or ſome other ſubſtance containing tan, called the *black bath*, in order to alter the ſhade, and to give the colour greater permanency. We ſhall give a few inſtances: greater minuteneſs would be inconſiſtent with the nature of this article

Cloth dyed blue, by being dipped into the *black* bath, becomes *bluiſh grey*. Cloth dyed *yellow*, by the ſame proceſs, becoms *blackiſh grey*, *drab*, or *yellowiſh brown*. Cloth previouſly alumed, and dyed in a decoction of cochineal and acetite of iron, acquires a permanent *violet colour* inclining to *brown*, or a *lilac*, if the dyeing veſſel be ſomewhat exhauſted.* Cloth ſteeped in a mordant, compoſed of alum and acetite of iron diſſolved in water, and afterwards dyed in a bath compoſed of the decoction of galls and madder mixed together, acquires a fine deep *brown*. The method of varying the ſhades of linen and cotton will be readily conceived, after we have given an account of calico printing, which forms the ſubject of the next chapter.

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bollet,
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CHAP. VI. OF CALICO PRINTING.

CALICO printing is the art of communicating different colours to particular ſpots or figures on the ſurface of cotton or linen cloth, while the reſt of the ſtuff retains its original whiteneſs.

Calico
Printing.

467
Origin of
calico
printing.

This ingenious art ſeems to have originated in India, where we know it has been practiſed for more than 2000 years. Pliny indeed informs us, that the Egyptians were acquainted with calico printing; but a variety of circumſtances combine to render it more than probable that they borrowed it from India. The art has but lately been cultivated in Europe; but the enlightened induſtry of our manufacturers has already improved prodigiouſly upon the tedious proceſſes of their Indian maſters. No art has riſen to perfection with greater celerity: a hundred years ago it was ſcarcely known in Europe; at preſent, the elegance of the patterns, the beauty and permanency of the colours, and the expedition with which the different operations are carried on, are really admirable.

A minute detail of the proceſſes of calico printing would not only be foreign to the plan of this article, but of very little utility. To the artiſt the proceſſes are already known; an account of them therefore could give him no new information; while it would fatigue and diſappoint thoſe readers who wiſh to underſtand the principles of the art. We ſhall content ourſelves, therefore, with a ſhort view of theſe principles.

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tially to
cotton.

Calico printing conſiſts in impregnating thoſe parts of the cloth which are to receive a colour with a mordant, and then dyeing it as uſual with ſome dye ſtuff or other. The dye ſtuff attaches itſelf firmly only to that part of the cloth which has received the mordant. The whole ſurface of the cotton is indeed more or leſs tinged; but by waſhing it, and bleaching it for ſome days on the graſs with the wrong ſide uppermoſt, all the unmordanted parts reſume their original colour, while thoſe which have received the mordant retain it. Let us ſuppoſe, that a piece of white cotton cloth is to receive red ſtripes; all the parts where the ſtripes are to appear are pencled over with a ſolution of acetite of alumina. After this, the cloth is dyed in the uſual manner with madder When taken out of the dyeing veſſel, it is all of a red colour; but by waſhing and bleaching, the madder leaves every part of the cloth white except the ſtripes impregnated with the acetite of alumina, which remain red. In the ſame manner, may yellow ſtripes, or any other wiſhed-for figure, be given to cloth, by ſubſtituting quercitron bark, weld, &c. for madder.

469
Which is
afterwards
dyed and
bleached.

When different colours are to be given to different parts of the cloth at the ſame time, it is done by impregnating it with various mordants. Thus if ſtripes be drawn upon a cotton cloth with acetite of alumina, and other ſtripes with acetite of iron, and the cloth be afterwards dyed in the uſual way with madder and then waſhed and bleached, it will be ſtriped *red* and *brown*. The ſame mordants with quercitron bark give *yellow*, and *olive* or *drab*.

470
Mordants
employed.

The mordants employed in calico printing are acetite of alumina and acetite of iron, prepared in the manner deſcribed in the third chapter of this part. Theſe mordants are applied to the cloth, either with a pencil or by means of blocks, on which the pattern, according to which the cotton is to be printed, is cut. As they are applied only to particular parts of the cloth, care muſt be taken that none of them ſpread to the part of the cloth which is to be left white, and that they do not interfere with one another when more than one are applied.

applied. If theſe precautions be not attended to, all the elegance and beauty of the print muſt be deſtroyed. It is neceſſary, therefore, that the mordants ſhould be of ſuch a degree of conſiſtence that they will not ſpread beyond thoſe parts of the cloth on which they are applied. This is done by thickening them with flour or ſtarch when they are to be applied by the block, and with gum arabic when they are to be put on with a pencil. The thickening ſhould never be greater than is ſufficient to prevent the ſpreading of the mordants; when carried too far, the cotton is apt not to be ſufficiently ſaturated with the mordant; of courſe the dye takes but imperfectly.

471 How applied.

In order that the parts of the cloth impregnated with mordants may be diſtinguiſhed by their colour, it is uſual to tinge the mordants with ſome colouring matter or other. The printers commonly uſe the decoction of Brazil wood for this purpoſe; but Bancroft has objected to this method, becauſe he thinks that the Brazil wood colouring matter impedes the ſubſequent proceſs of dyeing. It is certain, that the colouring matter of the Brazil wood is diſplaced during that operation by the ſuperior affinity of the dye ſtuff for the mordant. Were it not for this ſuperior affinity, the colour would not take at all. Dr Bancroft* adviſes to colour the mordant with ſome of the dye ſtuff afterwards to be applied; and he cautions the uſing of more for that purpoſe than is ſufficient to make the mordant diſtinguiſhable when applied to the cloth. The reaſon of this precaution is obvious. If too much dye be mixed with the mordant, a great proportion of the mordant will be combined with colouring matter; which muſt weaken its affinity for the cloth, and of courſe prevent it from combining with it in ſufficient quantity to enſure a permanent dye.

Sometimes theſe two mordants are mixed together in different proportions; and ſometimes one or both is mixed with an infuſion of ſumach or of nut galls. By theſe contrivances, a great variety of colours are produced by the ſame dye ſtuff.

472 Subſequent treatment of the cloth.

After the mordants have been applied, the cloth muſt be completely dried. It is proper for this purpoſe to employ artificial heat; which will contribute ſomething towards the ſeparation of the acetous acid from its baſe, and towards its evaporation; by which the mordant will combine in a greater proportion, and more intimately with the cloth.

When the cloth is ſufficiently dried, it is to be waſhed with warm water and cow dung, till all the flour or gum employed to thicken the mordants, and all thoſe parts of the mordants which are uncombined with the cloth, are removed. The cow dung ſerves to entangle theſe looſe particles of mordants, and to prevent them from combining with thoſe parts of the cloth which are to remain white. After this the cloth is thoroughly rinſed in clean water.

47 Dye ſt uſed.

Almoſt the only dye ſtuffs employed by calico printers are, indigo, madder, and quercitron bark or weld. This laſt ſubſtance, however, is now but little uſed by the printers of this country, except for delicate greeniſh yellows. The quercitron bark has almoſt ſuperſeded it; becauſe it gives colours equally good, and is much cheaper, and more convenient, not requiring ſo great a heat to fix it. Indigo, not requiring any mordant, is commonly applied at once either with the block or a pencil. It is prepared by boiling together indigo, potaſs made cauſtic by quicklime, and orpiment: the ſolution is afterwards thickened with gum (K). It muſt be carefully ſecluded from the air, otherwiſe the indigo would ſoon be regenerated, which would render the ſolution uſeleſs. Dr Bancroft has propoſed to ſubſtitute coarſe brown ſugar for orpiment. It is equally efficacious in decompoſing the indigo and rendering it ſoluble; while it likewiſe ſerves all the purpoſes of gum.*

When the cloth, after being impregnated with the mordant, is ſufficiently cleanſed, it is dyed in the uſual manner. The whole of it is more or leſs tinged with the dye ſtuff. It is well waſhed, and then ſpread out for ſome days on the graſs, and bleached with the wrong ſide uppermoſt. This carries the colour off completely from all the parts of the cotton which have not imbibed the mordant, and leaves them of their original whiteneſs, while the mordanted ſpots retain the dye as ſtrongly as ever.

Let us now give an example or two of the manner in which the printers give particular colours to calicoes. Some calicoes are only printed of one colour, others have two, others three, or more, even to the number of eight, ten, or twelve. The ſmaller the number of colours, the fewer in general are the proceſſes.

47 Meth printi drabs,

1. One of the moſt common colours on cotton prints is a kind of nankeen yellow, of various ſhades, down to a deep yellowiſh brown or drab. It is uſually in ſtripes or ſpots. To produce it, the printers beſmear a block, cut out into the figure of the print, with acetite of iron thickened with gum or flour; apply it to the cotton; which, after being dried and cleaned in the uſual manner, is

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* *Bancroft*, i. 373.

* *Banc* i. 120

(K) Different proportions are uſed by different perſons. Mr Hauſſman mixes 25 gallons of water with 16 pounds of indigo well ground (or a greater or ſmaller quantity, according to the quality of the indigo and the depth of colour wanted); to which he adds 30 pounds of good carbonat of potaſs, placing the whole over a fire; and as ſoon as the mixture begins to boil, he adds, by a little at a time, 12 pounds of quick lime, to render the alkali cauſtic, by abſorbing its carbonic acid. This being done, 12 pounds of red orpiment are alſo added to the mixture; which is then ſtirred, and left to boil for ſome little time, that the indigo may be perfectly diſſolved; which may be known by its giving a yellow colour immediately upon being applied to a piece of white tranſparent glaſs. M. Oberkampf, proprietor of the celebrated manufactory at Jouy near Verſailles, uſes a third more of indigo; and others uſe different proportions, not only of indigo, but of lime, potaſs, and orpiment; which all ſeem to anſwer with nearly equal ſucceſs: but with the beſt copper-coloured Guatamala indigo, it is certain that a good blue may be obtained from only half the quantity preſcribed by Mr Hauſſman, by uſing as much ſtone, or oyſter ſhell lime, as of indigo, nearly twice as much potaſs, and a fourth part leſs of orpiment than of indigo. See *Bancroft*, I. 113.

lico ting. is plunged into a potaſs ley. The quantity of acetite of iron is always proportioned to the depth of the intended ſhade.

75 ow, 2. For yellow, the block is beſmeared with acetite of alumina. The cloth, after receiving this mordant, is dyed with quercitron bark, and then bleached.

76 d, 3. Red is communicated by the ſame proceſs, only madder is ſubſtituted for the bark.

77 ue; 4. The fine light blues, which appear ſo often on printed cottons, are produced, by applying to the cloth a block beſmeared with a compoſition, conſiſting partly of wax, which covers all thoſe parts of the cloth which are to remain white. The cloth is then dyed in a cold indigo vat; and after it is dry, the wax compoſition is removed by means of hot water.

8 5. Lilac, flea brown, and blackiſh brown, are given by means of acetite of iron; the quantity of which is always proportioned to the depth of the ſhade. For very deep colours, a little ſumach is added. The cotton is afterwards dyed in the uſual manner with madder, and then bleached.

9 love. 6. Dove colour and drab, by acetite of iron and quercitron bark.

o ca- f dif- co- o the cloth. When different colours are to appear in the ſame print, a greater number of operations are neceſſary. Two or more blocks are employed, upon each of which that part of the print only is cut which is to be of ſome particular colour. Theſe are beſmeared with different mordants, and applied to the cloth, which is afterwards dyed as uſual. Let us ſuppoſe, for inſtance, that three blocks are applied to cotton; one with acetite of alumina, another with acetite of iron, a third with a mixture of theſe two mordants, and that the cotton is then dyed with quercitron bark, and bleached. The parts impregnated with the mordants would have the following colours.

Acetite of alumina,	- -	Yellow,
iron,	- - -	Olive, drab, dove (L),
The mixture,	- - - -	Olive green, olive.

If part of the yellow be covered over with the indigo liquor, applied with a pencil, it will be converted into *green*: By the ſame liquid, blue may be given to ſuch parts of the print as require it.

If the cotton be dyed with madder inſtead of quercitron bark, the print will exhibit the following colours:

Acetite of alumina,	- - -	Red,
iron,	- - - -	Brown, black,
The mixture,	- - - - -	Purple.

When a greater number of colours are to appear; for inſtance, when thoſe communicated by bark and thoſe by madder are wanted at the ſame time, mordants for part of the pattern are to be applied; the cotton is then to be dyed in the madder bath and bleached; then the reſt of the mordants, to fill up the pattern, are added, and the cloth is again dyed with quercitron bark and bleached. This ſecond dyeing does not much affect the madder colours; becauſe the mordants, which render them permanent, are already ſaturated. The yellow tinge is eaſily removed by the ſubſequent bleaching. Calico Printing. Sometimes a new mordant is alſo applied to ſome of the madder colours; in conſequence of which they receive a new permanent colour from the bark. After the laſt bleaching, new colours may be added by means of the indigo liquor. The following table will give an idea of the colours which may be given to cotton by theſe complicated proceſſes.

I. *Madder dye.*		*Colours.*
Acetite of alumina,	- - -	Red,
iron,	- - - -	Brown, black,
Ditto diluted,	- - - - -	Lilac,
Both mixed,	- - - - -	Purple.
II. *Bark dye.*		
Acetite of alumina,	- - -	Yellow,
iron,	- - - -	Dove, drab,
Lilac and acetite of alumina,		Olive,
Red and acetite of alumina,		Orange.
III. *Indigo dye.*		
Indigo,	- - - - - - - -	Blue,
Indigo and yellow	- - -	Green.

Thus no leſs than 12 colours may be made to appear together in the ſame print by theſe different proceſſes.

Theſe inſtances will ſerve to give the reader an idea of the nature of calico printing, and at the ſame time afford an excellent illuſtration of the importance of mordants in dyeing.

481 Colours for pencilling. If it were poſſible to procure colours ſufficiently permanent, by applying them at once to the cloth by the block or the pencil, as is the caſe with the mordants, the art of calico printing would be brought to the greateſt poſſible ſimplicity: but at preſent this can only be done in one caſe, that of indigo; every other colour requires dyeing. Compoſitions indeed may be made by previouſly combining the dye ſtuff and the mordants. Thus *yellow* may be applied at once by employing a mixture of the infuſion of quercitron bark and acetite of alumina; *red*, by mixing the ſame mordant with the decoction of alumina, and ſo on. Unfortunately the colours applied in this way are far inferior in permanency to thoſe produced when the mordant is previouſly combined with the cloth, and the dye ſtuff afterwards applied ſeparately. In this way are applied almoſt all the fugitive colours of calicoes which waſhing or even expoſure to the air deſtroys.

As the application of colours in this way cannot always be avoided by calico printers, every method of rendering them more permanent is an object of importance. We ſhall therefore conclude this chapter with a deſcription of ſeveral colours of this kind propoſed by Dr Bancroft, which have a conſiderable degree of permanence.

A *yellow* printing colour may be formed by the following method: Let three pounds of alum, and three ounces of clean chalk, be firſt diſſolved in a gallon of hot water, and then add two pounds of ſugar of lead; ſtir this mixture occaſionally during the ſpace of 24 or 36 hours, then let it remain 12 hours at reſt, and afterwards decant and preſerve the clear liquor; this being

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(L) According to the proportion of acetite of iron employed.

Calico Printing.

ing done, pour ſo much more warm water upon the remaining ſediment, as after ſtirring and leaving the mixture to ſettle will afford clear liquor enough to make, when mixed with the former, three quarts of this aluminous mordant or acetite of alumine. Then take not leſs than ſix, nor more than eight, pounds of quercitron bark properly ground; put this into a tinned copper veſſel, with four or five gallons of clean ſoft water, and make it boil for the ſpace of one hour at leaſt, adding a little more water, if at any time the quantity of liquor ſhould not be ſufficient to cover the ſurface of the bark: the liquor having boiled ſufficiently, ſhould be taken from the fire, and left undiſturbed for half an hour, and then the clear decoction ſhould be poured off through a fine ſieve or canvas ſtrainer. This being done, let ſix quarts more of clear water be poured upon the ſame bark, and made to boil ten or fifteen minutes, both having been firſt well ſtirred; and being afterwards left a ſufficient time to ſettle, the clean decoction may then be ſtrained off, and put with the former into a ſhallow wide veſſel to be evaporated by boiling, until what remains, being joined to the three quarts of aluminous mordant before mentioned, and to a ſufficient quantity of gum or paſte for thickening, will barely ſuffice to make three gallons of liquor in the whole. It will be proper, however, not to add the aluminous mordant, until the decoction is ſo far cooled as to be but little more than blood warm; and theſe being thoroughly mixed by ſtirring, may afterwards be thickened by the gum of Senegal or by gum arabic, if the mixture is intended for penciling; or by a paſte made with ſtarch or flour, if it be intended for printing.

Calic Printin

By ſubſtituting a pound of murio-ſulphat of tin for the aluminous mordant in the above compoſition, a mixture may be formed which affords a very bright and full yellow, of conſiderable durability.

Sulphat of tin, mixed with a decoction of quercitron bark, communicates to cotton a *cinnamon* colour, which is ſufficiently permanent.*

When the decoctions of quercitron bark and logwood are boiled together, and ſuitable proportions of ſulphat of copper and of verdigris are added to them, with a little carbonat of potaſs, a compound is formed, which gives a *green* colour to cotton. Bancroft has made trial of this; and though it has not fully anſwered his expectation, his attempts were attended with ſufficient ſucceſs to determine him to perſevere in his experiments.†

If acetite of iron be mixed with a decoction of quercitron bark, and the mixture be properly thickened, the compound will communicate to cotton a *drab* colour of ſome durability. This compound, mixed with the olive colouring liquor above deſcribed, will produce an olive. If a ſolution of iron, by a diluted muriatic acid, or by a diluted nitric acid, be employed for this purpoſe inſtead of iron liquor, it will produce colours a little more laſting; but theſe ſolutions ſhould be employed ſparingly, that they may not hurt the texture of the linen or cotton to which they are intended to be applied.

* *Bancr.* i. 400.

† *Ibid.* 4

Subtriple || Sudbury.

SUBTRIPLE, is when one quantity is the 3d part of another; as 2 is ſubtriple of 6. And *Subtriple Ratio* is the ratio of 1 to 3.

SUBTRIPLICATE RATIO, is the ratio of the cube roots. So the ſubtriplicate ratio of *a* to *b*, is the ratio of $^3\sqrt{a}$ to $^3\sqrt{b}$, or of $a^{\frac{1}{3}}$ to $b^{\frac{1}{3}}$.

SUCCESS, a bay, alſo called *Good Succeſs*, on Terra del Fuego, or the weſtern ſhore of Strait le Maire. S. lat. 54 50, W. long. 65 25. Cape Succeſs, on the point of this bay, lies in lat. 55 1 S. and long. 65 27 W.—*Morse.*

SUCCESS, a townſhip of New-Hampſhire, in Grafton county, N. E. of the White Mountains on the eaſt line of the State, incorporated in 1773.—*ib.*

SUCCESSION OF SIGNS, in aſtronomy, is the order in which they are reckoned, or follow one another, and according to which the ſun enters them; called alſo *conſequentia*. As Aries, Taurus, Gemini, Cancer, &c.

SUCK *Creek* empties into Tenneſſee river from the ſouth-ſouth-eaſt, at the *Suck* or *Whirl*, where the river is contracted to the breadth of 70 yards. It is a few miles north from the Georgia north line.—*Morse.*

SUCKLING *Cape*, on the N. W. part of N. America; off which, and to the N. E. end of Kaye's Iſland, is a muddy bottom with from 43 to 27 fathoms water. The ſouth-weſt point of Kaye's Iſland is in lat. 59 49 N. and long. 143 2 W.—*ib.*

SUDBURY, a county of New-Brunſwick, on the W. ſide of St John's river, towards its mouth.—*ib.*

Sudbu || Suffiel

SUDBURY, a townſhip of Vermont, in Rutland county, having Orwell on the weſt. It contains 258 inhabitants.—*ib.*

SUDBURY, *Eaſt*, a townſhip of Maſſachuſetts, Middleſex county, on the poſt-road 19 miles weſt of Boſton. It was incorporated in 1780, and contains 801 inhabitants.—*ib.*

SUDBURY, *Weſt*, or *Sudbury*, a townſhip weſt of Eaſt-Sudbury, and 25 miles weſt of Boſton. It was incorporated in 1639, and contains 1,290 inhabitants.—*ib.*

SUDBURY *Canada*, in York county, Diſtrict of Maine, is ſituated on the ſouth ſide of Androſcoggin river, and ſouthward of Andover. In 1796, it was erected into a townſhip called Bethel, and has two pariſhes.—*ib.*

SUE, *La*, a powerful nation of Indians inhabiting weſtward of Lake Superior, and the Miſſiſſippi. Warriors 10,000.—*ib.*

SUER, *Fort le*, in Louiſiana, is on the weſtern bank of the Miſſiſſippi, and eaſterly of Fort L'Huillier, on St Peter's river.—*ib.*

SUFFIELD, a pleaſant poſt-town of Connecticut, Hartford county, having a handſome church and ſome reſpectable dwelling houſes. It is on the weſt bank of Connecticut river on the great poſt-road from Boſton to New-York, 10 miles ſouth of Springfield, 17 N. of Hartford, and 232 N. E. of Philadelphia. This townſhip was purchaſed of two Indian ſachems for £30, and in 1670, was granted to Major John Pyncheon, by the aſſembly of Maſſachuſetts.—*ib.*

SUFFOLK,

SUFFOLK, a county of Maſſachuſetts, ſo named from that in England, in which governor Winthrop lived, before he emigrated to America. It contained in 1790, 23 townſhips, 6,335 houſes, 13,038 families, 44,875 inhabitants. In 1793, the county was divided; and now the new county, Norfolk, comprehends all the towns except Boſton, Chelſea, Hull, and Hingham. Suffolk was conſtituted a county, May 10, 1643.—*ib.*

Suffolk, a county of New-York, L. Iſland, is about 100 miles long, and 10 broad, and comprehends all that part of the State bounded eaſterly and ſoutherly by the Atlantic Ocean, northerly by the Sound, and weſterly by Lloyd's Neck, or Queen's Village, Cold Spring harbour, and the eaſt bounds of the townſhip of Oyſter Bay; the line continued ſouth to the Atlantic Ocean, including the Iſle of Wight, now called Gardner's Iſland, Shelter Iſland, Plumb Iſlands, Robin's Iſland, and the Gull Iſlands. Fiſher's Iſland alſo belongs to it. It contains 16,440 inhabitants, of whom 1,098 are ſlaves. There are 9 townſhips, and 2,609 of the inhabitants are electors. Suffolk county court-houſe, is 15 miles from Southampton, 27 from Sagg Harbour, and 80 from New-York city.—*ib.*

Suffolk, a poſt-town of Virginia, in Nanſemond county, on the eaſt ſide of the river Nanſemond. It contains a court-houſe, gaol, and about 40 houſes. The river is thus far navigable for veſſels of 250 tons. It is 28 miles weſt by ſouth of Portſmouth, 83 E. S. E. of Peterſburg, 110 ſouth-eaſt of Richmond, and 386 from Philadelphia.—*ib.*

SUFFRAGE, a townſhip of New-York, ſituated in Otſego county, on the north ſide of Suſquehannah river; taken from Unadilla, and incorporated in 1796. —*ib.*

SUGAR *Creek*, or *Cæſar's Creek*, a conſiderable branch of Little Miami river.—*ib.*

Sugar *Hill*, a ragged eminence the top of which overlooks and commands the whole works of Ticonderoga, where the waters of Lake George empty into Lake Champlain, and oppoſite to Fort Independence, in the State of Vermont. Gen. Burgoyne made a lodgement on this hill, which the Americans eſteemed inacceſſible; and thus forced Gen. St Clair to abandon the fort in June, 1777.—*ib.*

Sugar *River*, in Cheſhire county, New-Hampſhire, riſes in Sunapee lake, and, after a ſhort courſe weſterly, empties into Connecticut river, at Clermont, and oppoſite to Aſhcutney mountain in Vermont. There is a ſtrong expectation of uniting this river, by a ſhort canal, with Contocook, which falls into Merrimack river at Boſcawen.—*ib.*

Sugar-Loaf *Bay*, on the north-eaſt ſide of Juan Fernandes Iſland; 100 leagues to the weſt of the coaſt of Chili.—*ib.*

Sugar, a river of Veragua, which empties into the Bay of Honduras.—*ib.*

SULLIVAN, a townſhip of Cheſhire county, New-Hampſhire, containing 220 inhabitants.—*ib.*

Sullivan, a poſt-town of the Diſtrict of Maine, Hancock county, and on Frenchman's Bay, 12 miles north-weſt of Goldſborough, 38 W. S. W. of Penobſcot, 310 north-eaſt of Boſton, and 645 north-eaſt of Philadelphia. The townſhip contains 504 inhabitants. —*ib.*

Sullivan, a county of Tenneſſee, in Waſhington diſtrict. In 1795, it contained according to the State cenſus, 8,457 inhabitants, of whom 777 were ſlaves. —*ib.*

Sullivan's *Iſland*, one of the three iſlands which form the north part of Charleſton harbour, in S. Carolina. It is about 7 miles ſouth-eaſt of Charleſton.—*ib.*

SULPHUR *Creek*, *Little*, one of the ſouthern upper branches of Green river in Kentucky; and lies ſouth-weſt of another branch called Bryant's Lick creek. Near this is a ſulphur ſpring.—*ib.*

Sulphur *Mountain*, a noted mountain in the iſland of Guadaloupe, famous for exhalations of ſulphur, and eruptions of aſhes. On the E. ſide are two mouths of an enormous ſulphur pit; one of theſe mouths is 100 feet in diameter; the depth is unknown.—*ib.*

SULPHURET of lime having lately been recommended by an eminent chemiſt* as a ſubſtitute for *potaſh* in the new method of bleaching, which, if it anſwer, may certainly be afforded at leſs expenſe, we ſhall here give the method of preparing the ſulphuret.

Take of ſulphur, or brimſtone in fine powder, four pounds; lime, well ſlaked and ſifted, twenty pounds; water, ſixteen gallons:—theſe are all to be well mixed and boiled for about half an hour in an iron veſſel, ſtirring them briſkly from time to time. Soon after the agitation of boiling is over, the ſolution of the ſulphuret of lime clears, and may be drawn off free from the inſoluble matter, which is conſiderable, and which reſts upon the bottom of the boiler (a). The liquor in this ſtate is pretty nearly of the colour of ſmall beer, but not quite ſo tranſparent.

Sixteen gallons of freſh water are afterwards to be poured upon the inſoluble dregs in the boiler, in order to ſeparate the whole of the ſulphuret from them. When this clears (being previouſly well agitated), it is alſo to be drawn off and mixed with the firſt liquor; to theſe again thirty-three gallons more of water may be added, which will reduce the liquor to a proper ſtandard for ſteeping the cloth.

Here we have (an allowance being made for evaporation, and for the quantity retained in the dregs) ſixty gallons of liquor from four pounds of brimſtone.

Although ſulphur by itſelf is not in any ſenſible degree ſoluble in water, and lime but very ſparingly ſo, water diſſolving but about one ſeven-hundredth part of its weight of lime; yet the ſulphuret of lime is highly ſoluble.

When the above proportion of lime and ſulphur is boiled with only twelve gallons of water, the ſulphuret partly cryſtallizes upon cooling; and when once cryſtallized it is not eaſy of ſolution.

SUMANYSTOWN, a village of Pennſylvania, in Montgomery county, ſituated on the E. ſide of Great Swamp creek, which empties into the Schuylkill above Norriton. It is 33 miles N. W. by N. of Philadelphia.—*Morſe.*

* *W. Higgins, M. R. I. A.*

(a) Although lime is one of the conſtituent principles of the ſulphuret, yet being ſo intimately united to the ſulphur, it has no longer the property of lime; upon the ſame principle that ſulphuric acid in ſulphat of potaſh has not the property of that acid.

SUMNER, a county of Tenneſſee, in Mero diſtrict. According to the State cenſus of 1795, it contained 6,370 inhabitants, of whom 1,076 were ſlaves.—*ib.*

SUN (See ASTRONOMY-*Index*, Encycl.) is certainly that celeſtial body which, of all others, ſhould moſt attract our attention. It has accordingly employed much of the time and meditation, not only of the aſtronomer, but alſo of the ſpeculative philoſopher, in all ages of the world; and many hypotheſes have been formed, and ſome diſcoveries made, reſpecting the nature and the uſes of this vaſt luminary.

Sir Iſaac Newton has ſhewn, that the ſun, by its attractive power, retains the planets of our ſyſtem in their orbits; he has alſo pointed out the method whereby the quantity of matter which it contains may be accurately determined. Dr Bradly has aſſigned the velocity of the ſolar light with a degree of preciſion exceeding our utmoſt expectation. Gallileo, Scheiner, Hevelius, Caſſini, and others, have aſcertained the rotation of the ſun upon its axis, and determined the poſition of its equator. By means of the tranſit of Venus over the diſk of the ſun, our mathematicians have calculated its diſtance from the earth, its real diameter and magnitude, the denſity of the matter of which it is compoſed, and the fall of heavy bodies on its ſurface. We have therefore a very clear notion of the vaſt importance and powerful influence of the ſun on its planetary ſyſtem; but with regard to its internal conſtruction, we are yet extremely ignorant. Many ingenious conjectures have indeed been formed on the ſubject; a few of which we ſhall mention as an introduction to Dr Herſchel's, of which, as it is the lateſt, and perhaps the moſt plauſible, we ſhall give a pretty full account nearly in his own words.

The dark ſpots in the ſun, for inſtance, have been ſuppoſed to be ſolid bodies revolving very near its ſurface. They have been conjectured to be the ſmoke of volcanoes, or the ſcum floating upon an ocean of fluid matter. They have alſo been taken for clouds. They were explained to be opaque maſſes ſwimming on the fluid matter of the ſun, dipping down occaſionally. It has been ſuppoſed that a fiery liquid ſurrounded the ſun, and that by its ebbing and flowing the higheſt parts of it were occaſionally uncovered, and appeared under the ſhape of dark ſpots; and that by the return of the fiery liquid, they were again covered, and in that manner ſucceſſively aſſumed different phaſes. The ſun itſelf has been called a globe of fire, though perhaps metaphorically. The waſte it would undergo by a gradual conſumption, on the ſuppoſition of its being ignited, has been ingeniouſly calculated; and in the ſame point of view its immenſe power of heating the bodies of ſuch comets as draw very near to it has been aſſigned.

In the year 1779 there was a ſpot on the ſun which was large enough to be ſeen with the naked eye. By a view of it with a ſeven feet reflector, charged with a very high power, it appeared to be divided into two parts. The largeſt of the two on the 19th of April, meaſured 1′ 8″.06 in diameter, which is equal in length to more than 31,000 miles. Both together muſt certainly have extended above 50,000. The idea of its being occaſioned by a volcanic exploſion violently driving away a fiery fluid, ought to be rejected (ſays Dr Herſchel) on many accounts. "To mention only one, the great extent of the ſpot is very unfavourable to ſuch a ſuppoſition. Indeed a much leſs violent and leſs pernicious cauſe may account for all the appearances of the ſpot. When we ſee a dark belt near the equator of the planet Jupiter, we do not recur to earthquakes and volcanoes for its origin. An atmoſphere, with its natural changes, will explain ſuch belts. Our ſpot on the ſun may be accounted for on the ſame principles. The earth is ſurrounded by an atmoſphere compoſed of various elaſtic fluids. The ſun alſo has its atmoſphere; and if ſome of the fluids which enter into its compoſition ſhould be of a ſhining brilliancy, in the manner that will be explained hereafter, while others are merely tranſparent, any temporary cauſe which may remove the lucid fluid will permit us to ſee the body of the ſun through the tranſparent ones. If an obſerver were placed on the moon, he would ſee the ſolid body of the earth only in thoſe places where the tranſparent fluids of our atmoſphere would permit him. In others, the opaque vapours would reflect the light of the ſun without permitting his view to penetrate to the ſurface of our globe. He would probably alſo find, that our planet had occaſionally ſome ſhining fluids in its atmoſphere; as, not unlikely, ſome of our northern lights might not eſcape his notice, if they happened in the unenlightened part of the earth, and were ſeen by him in his long dark night. Nay, we have pretty good reaſon to believe, that probably all the planets emit light in ſome degree; for the illumination which remains on the moon in a total eclipſe cannot be entirely aſcribed to the light which may reach it by the refraction of the earth's atmoſphere. For inſtance, in the eclipſe of the moon October 22. 1790, the rays of the ſun refracted by the atmoſphere of the earth towards the moon, admitting the mean horizontal refraction to be 30′ 50″.8, would meet in a focus 189,000 miles beyond the moon; ſo that conſequently there could be no illumination from rays refracted by our atmoſphere. It is, however, not improbable, that about the polar regions of the earth there may be refraction enough to bring ſome of the ſolar rays to a ſhorter focus. The diſtance of the moon at the time of the eclipſe would require a refraction of 54′ 6″, equal to its horizontal parallax at that time, to bring them to a focus ſo as to throw light on the moon.

The unenlightened part of the planet Venus has alſo been ſeen by different perſons; and not having a ſatellite, thoſe regions that are turned from the ſun cannot poſſibly ſhine by a borrowed light; ſo that this faint illumination muſt denote ſome phoſphoric quality of the atmoſphere of Venus.

In the inſtance of the large ſpot on the ſun already mentioned, Dr Herſchel concludes, from appearances, that he viewed the real body of the ſun itſelf, of which we rarely ſee more than its ſhining atmoſphere. In the year 1783 he obſerved a fine large ſpot, and followed it up to the edge of the ſun's limb. Here he took notice that the ſpot was plainly depreſſed below the ſurface of the ſun, and that it had very broad ſhelving ſides. He alſo ſuſpected ſome part, at leaſt, of the ſhelving ſides to be elevated above the ſurface of the ſun; and obſerved that, contrary to what uſually happens, the margin of that ſide of the ſpot which was fartheſt from the limb was the broadeſt.

The luminous ſhelving ſide of a ſpot may be explained ed by a gentle and gradual removal of the ſhining fluid, which permits us to ſee the globe of the ſun. As to the uncommon appearance of the broadeſt margin being on that ſide of the ſpot which was fartheſt from the limb when the ſpot came near the edge of it, we may ſurmiſe that the ſun has inequalities on its ſurface, which may poſſibly be the cauſe of it. For when mountainous countries are expoſed, if it ſhould chance that the higheſt parts of the landſcape are ſituated ſo as to be near that ſide of the margin or penumbra of the ſpot which is towards the limb, they may partly intercept our view of it when the ſpot is ſeen very obliquely. This would require elevations at leaſt five or ſix hundred miles high; but conſidering the great attraction exerted by the ſun upon bodies at its ſurface, and the ſlow revolution it has upon its axis, we may readily admit inequalities to that amount. From the centrifugal force at the ſun's equator, and the weight of bodies at its ſurface, he computes, that the power of throwing down a mountain by the exertion of the former, balanced by the ſuperior force of keeping it in its place of the latter, is near 6½ times leſs on the ſun than on our equatorial regions; and as an elevation ſimilar to one of three miles on the earth would not be leſs than 334 miles on the ſun, there can be no doubt but that a mountain much higher would ſtand very firmly. The little denſity of the ſolar body ſeems alſo to be in favour of the height of its mountains; for, *cæteris paribus*, denſe bodies will ſooner come to their level than rare ones. The difference in the vaniſhing of the ſhelving ſide, inſtead of explaining it by mountains, may alſo, and perhaps more ſatisfactorily be accounted for from the real difference of the extent, the arrangement, the height, and the intenſity of the ſhining fluid, added to the occaſional changes that may happen in theſe particulars during the time in which the ſpot approaches to the edge of the diſk. However, by admitting large mountains on the face of the ſun, we ſhall account for the different opinions of two eminent aſtronomers; one of whom believed the ſpots depreſſed below the ſurface of the ſun, while the other believed them elevated above it. For it is not impoſſible that ſome of the ſolar mountains may be high enough occaſionally to project above the ſhining elaſtic fluid, when, by ſome agitation or other cauſe, it is not of the uſual height; and this opinion is much ſtrengthened by the return of ſome remarkable ſpots which ſerved Caſſini to aſcertain the period of the ſun's rotation. A very high country, or chain of mountains, may oftener become viſible, by the removal of the obſtructing fluid, than the lower regions, on account of its not being ſo deeply covered with it.

In 1791 the Doctor examined a large ſpot on the ſun, and found it evidently depreſſed below the level of the ſurface. In 1792 he examined the ſun with ſeveral powers from 90 to 500, when it appeared evidently, that the black ſpots are the opaque ground, or body of the ſun; and that the luminous part is an atmoſphere, which, being interrupted or broken, gives us a tranſient glimpſe of the ſun itſelf. He perceived likewiſe, that the ſhining ſurface of the ſun is unequal, many parts of it being elevated and others depreſſed; and that the elevations, to which Hevelius gave the name of *faculæ*, ſo far from reſembling torches, were rather like the ſhrivelled elevations upon a dried apple, extended in length, and moſt of them joined together, making waves or waving lines. The faculæ being elevations, very ſatisfactorily explains the reaſon why they diſappear towards the middle of the ſun, and reappear on the other margin; for about the place where we loſe them, they begin to be edgewiſe to our view; and if between the faculæ ſhould lie dark ſpots, they will moſt frequently break out in the middle of the ſun, becauſe they are no longer covered by the ſide-views of theſe faculæ.

The Doctor gives a very particular account of all his obſervations, which ſeem to have been accurately made, and we need not ſcarcely add with excellent teleſcopes. For that account, however, we muſt refer to the memoir itſelf, and haſten to lay before our readers the reſult of his obſervations. "That the ſun (ſays he) has a very extenſive atmoſphere, cannot be doubted; and that this atmoſphere, conſiſts of various elaſtic fluids, that are more or leſs lucid and tranſparent, and of which the lucid one is that which furniſhes us with light, ſeems alſo to be fully eſtabliſhed by all the phenomena of its ſpots, of the faculæ, and of the lucid ſurface itſelf. There is no kind of variety in theſe appearances but what may be accounted for with the greateſt facility, from the continual agitation which, we may eaſily conceive, muſt take place in the regions of ſuch extenſive elaſtic fluids.

"It will be neceſſary, however, to be a little more particular as to the manner in which I ſuppoſe the lucid fluid of the ſun to be generated in its atmoſphere. An analogy that may be drawn from the generation of clouds in our own atmoſphere, ſeems to be a very proper one, and full of inſtruction. Our clouds are probably decompoſitions of ſome of the elaſtic fluids of the atmoſphere itſelf, when ſuch natural cauſes, as in this grand chemical laboratory are generally at work, act upon them; we may therefore admit, that in the very extenſive atmoſphere of the ſun, from cauſes of the ſame nature, ſimilar phenomena will take place; but with this difference, that the continual and very extenſive decompoſitions of the elaſtic fluids of the ſun are of a phoſphoric nature, and attended with lucid appearances, by giving out light.

"If it ſhould be objected, that ſuch violent and unremitting decompoſitions would exhauſt the ſun, we may recur again to our analogy, which will furniſh us with the following reflections. The extent of our own atmoſphere, we ſee, is ſtill preſerved, notwithſtanding the copious decompoſitions of its fluids in clouds and falling rain; in flaſhes of lightning, in meteors, and other luminous phenomena; becauſe there are freſh ſupplies of elaſtic vapours continually aſcending to make good the waſte occaſioned by thoſe decompoſitions. But it may be urged, that the caſe with the decompoſition of the elaſtic fluids in the ſolar atmoſphere would be very different, ſince light is emitted, and does not return to the ſun, as clouds do to the earth when they deſcend in ſhowers of rain. To which I anſwer, that, in the decompoſition of phoſphoric fluids, every other ingredient but light may alſo return to the body of the ſun. And that the emiſſion of light muſt waſte the ſun, is not a difficulty that can be oppoſed to our hypotheſis: for as it is an evident fact that the ſun does emit light, the ſame objection, if it could be one, would equally militate againſt every other aſſignable way to account for the phenomenon.

"There are, moreover, conſiderations that may leſſen the

the preſſure of this alleged difficulty. We know the exceeding ſubtilty of light to be ſuch, that in ages of time its emanation from the ſun cannot very ſenſibly leſſen the ſize of this great body. To this may be added, that very poſſibly there may always be ways of reſtoration to compenſate for what is loſt by the emiſſion of light, though the manner in which this can be brought about ſhould not appear to us. Many of the operations of Nature are carried on in her great laboratory which we cannot comprehend, but now and then we ſee ſome of the tools with which ſhe is at work. We need not wonder that their conſtruction ſhould be ſo ſingular as to induce us to confeſs our ignorance of the method of employing them; but we may reſt aſſured that they are not a mere *luſus naturæ*." Here he alludes to the great number of ſmall teleſcopic comets; which he ſuppoſes, as others had done before him, may be employed to reſtore to the ſun what had been loſt by the emiſſion of light. "My hypotheſis, however, (continues he) does not lay me under any obligation to explain how the ſun can ſuſtain the waſte of light, nor to ſhew that it will ſuſtain it for ever; and I ſhould alſo remark that, as in the analogy of generating clouds, I merely allude to their production as owing to a decompoſition of ſome of the elaſtic fluids of our atmoſphere, that analogy, which firmly reſts upon the fact, will not be leſs to my purpoſe, to whatever cauſe theſe clouds may owe their origin. It is the ſame with the lucid clouds, if I may ſo call them, of the ſun. They plainly exiſt, becauſe we ſee them; the manner of their being generated may remain an hypotheſis—and mine, till a better can be propoſed, may ſtand good; but whether it does or not, the conſequences I am going to draw from what has been ſaid will not be affected by it."

Before he proceeds to draw theſe conſequences, he informs us that, according to the above theory, a dark ſpot in the ſun is a place in its atmoſphere, which happens to be free from luminous decompoſitions; that faculæ are, on the contrary, more copious mixtures of ſuch fluids as decompoſe each other; and that the regions, in which the luminous ſolar clouds are formed, adding thereto the elevation of the faculæ, cannot be leſs than 1843, nor much more than 2765 miles in depth. It is true, continues he, that in our atmoſphere the extent of the clouds is limited to a very narrow compaſs; but we ought rather to compare the ſolar ones to the luminous decompoſitions which take place in our *aurora borealis*, or luminous arches, which extend much farther than the cloudy regions. The denſity of the luminous ſolar clouds though very great, may not be exceedingly more ſo than that of our *aurora borealis*. For if we conſider what would be the brilliancy of a ſpace two or three thouſand miles deep, filled with ſuch corruſcations as we ſee now and then in our atmoſphere, their apparent intenſity, when viewed at the diſtance of the ſun, might not be much inferior to that of the lucid ſolar fluid.

From the luminous atmoſphere of the ſun, he proceeds to its opaque body; which, by calculation from the power it exerts upon the planets, we know to be of great ſolidity; and from the phenomena of the dark ſpots, many of which, probably on account of their high ſituations, have been repeatedly ſeen, and otherwiſe denote inequalities in their level, we ſurmiſe that its ſurface is diverſified with mountains and valleys.

What has been ſaid, enables us to come to ſome very important concluſions, by remarking, that this way of conſidering the ſun and its atmoſphere removes the great diſſimilarity we have hitherto been uſed to find between its condition and that of the reſt of the great bodies of the ſolar ſyſtem.

The ſun, viewed in this light, appears to be nothing elſe than a very eminent, large, and lucid planet, evidently the firſt, or, in ſtrictneſs of ſpeaking, the only primary one of our ſyſtem, all others being truly ſecondary to it. Its ſimilarity to the other globes of the ſolar ſyſtem with regard to its ſolidity, its atmoſphere, and its diverſified ſurface, the rotation upon its axis, and the fall of heavy bodies, leads us on to ſuppoſe that it is moſt probably alſo inhabited, like the reſt of the planets, by beings whoſe organs are adapted to the peculiar circumſtances of that vaſt globe.

It may, however, not be amiſs to remove a certain difficulty, which ariſes from the effect of the ſun's rays upon our globe. The heat which is here, at the diſtance of 95 millions of miles, produced by theſe rays, is ſo conſiderable, that it may be objected, that the ſurface of the globe of the ſun itſelf muſt be ſcorched up beyond all conception.

This may be very ſubſtantially anſwered by many proofs drawn from natural philoſophy, which ſhew that heat is produced by the ſun's rays only when they act upon a calorific medium; they are the cauſe of the production of heat, by uniting with the matter of fire which is contained in the ſubſtances that are heated; as the colliſion of flint and ſteel will inflame a magazine of gunpowder, by putting all the latent fire it contains into action. But an inſtance or two of the manner in which the ſolar rays produce their effect, will bring this home to our moſt common experience.

On the tops of mountains of a ſufficient height, at an altitude where clouds can very ſeldom reach to ſhelter them from the direct rays of the ſun, we always find regions of ice and ſnow. Now if the ſolar rays themſelves conveyed all the heat we find on this globe, it ought to be hotteſt where their courſe is leaſt interrupted. Again, our aëronauts all confirm the coldneſs of the upper regions of the atmoſphere; and ſince, therefore, even on our earth, the heat of any ſituation depends upon the aptneſs of the medium to yield to the impreſſion of the ſolar rays, we have only to admit, that on the ſun itſelf, the elaſtic fluids compoſing its atmoſphere, and the matter on its ſurface, are of ſuch a nature as not to be capable of any exceſſive affection from its own rays: and indeed this ſeems to be proved by the copious emiſſion of them; for if the elaſtic fluids of the atmoſphere, or the matter contained on the ſurface of the ſun, were of ſuch a nature as to admit of an eaſy chemical combination with its rays, their emiſſion would be much impeded.

Our author then proceeds to ſupport his theory by analogical reaſoning; but as theſe will occur to ſuch of our readers as are converſant with the ſpeculations of aſtronomers, we paſs on to his reflections upon the conſequences of this theory. "That the ſtars are ſuns can hardly admit of a doubt. Their immenſe diſtance would perfectly exclude them from our view, if the light they ſend us were not of the ſolar kind. Beſides, the analogy may be traced much farther. The ſun turns on its axis; ſo does the ſtar Algol; ſo do the ſtars called β Lyræ, δ Cephei, η Antinoi, ο Ceti, and many more; moſt probably all. From what other cauſe can we ſo probably account for their periodical changes? Again, our ſun has ſpots on its ſurface; ſo has the ſtar Algol, and ſo have the ſtars already named, and probably every ſtar in the heavens. On our ſun theſe ſpots are changeable; ſo they are on the ſtar ο Ceti, as evidently appears from the irregularity of its changeable luſtre, which is often broken in upon by accidental changes while the general period continues unaltered. The ſame little deviations have been obſerved in other periodical ſtars, and ought to be aſcribed to the ſame cauſe. But if ſtars are ſuns, and ſuns are inhabitable, we ſee at once what an extenſive field for animation opens itſelf to our view.

"It is true, that analogy may induce us to conclude, that ſince ſtars appear to be ſuns, and ſuns, according to the common opinion, are bodies that ſerve to enlighten, warm, and ſuſtain a ſyſtem of planets, we may have an idea of numberleſs globes that ſerve for the habitation of living creatures. But if theſe ſuns themſelves are primary planets, we may ſee ſome thouſands of them with our own eyes, and millions by the help of teleſcopes, when at the ſame time the ſame analogical reaſoning ſtill remains in full force with regard to the planets which theſe ſuns may ſupport."

The Doctor then obſerves, that from other conſiderations, the idea of ſuns or ſtars being *merely* the ſupporters of ſyſtems of planets, is not abſolutely to be admitted as a general one. "Among the great number of very compreſſed cluſters of ſtars I have given (ſays he) in my catalogues, there are ſome which open a different view of the heavens to us. The ſtars in them are ſo very cloſe together, that, notwithſtanding the great diſtance at which we may ſuppoſe the cluſter itſelf to be, it will hardly be poſſible to aſſign any ſufficient mutual diſtance to the ſtars compoſing the cluſter, to leave room for crowding in thoſe planets, for whoſe ſupport theſe ſtars have been, or might be, ſuppoſed to exiſt. It ſhould ſeem, therefore, highly probable, that they exiſt for themſelves; and are, in fact, only very capital, *lucid*, primary planets, connected together in one great ſyſtem of mutual ſupport.

"The ſame remark may be made with regard to the number of very cloſe double ſtars, whoſe apparent diameters being alike, and not very ſmall, do not indicate any very great mutual diſtance: from which, however, muſt be deducted all thoſe where the different diſtances may be compenſated by the real difference in their reſpective magnitudes.

"To what has been ſaid may be added, that, in ſome parts of the milky way, where yet the ſtars are not very ſmall, they are ſo crowded, that in the year 1792, Aug. 22. I found by the gauges that, in 41 minutes of time, no leſs than 258,000 of them had paſſed through the field of view of my teleſcope.

"It ſeems, therefore, upon the whole, not improbable, that in many caſes ſtars are united in ſuch cloſe ſyſtems as not to leave much room for the orbits of planets or comets; and that conſequently, upon this account alſo, many ſtars, unleſs we would make them mere uſeleſs brilliant points, may themſelves be lucid planets, perhaps unattended by ſatellites."

What a magnificent idea does this theory give of the univerſe, and of the goodneſs, as well as power, of its Author? And how cold muſt be that heart, and clouded that underſtanding, who, after the contemplation of it, can for one moment liſten to the atheiſtical doctrines of thoſe men who preſume to account for all the phenomena of nature by chemical affinities and mechanical attraction? The man who, even in his heart, can ſay, that ſuch an immenſe ſyſtem, differing ſo widely in the ſtructure of the different parts of it, but everywhere crowded with life, is the effect of unintelligent agency, is indeed, to uſe the emphatic language of an ancient aſtronomer—*a fool*.

SUNAPEE, a lake and mountain in Cheſhire county, New-Hampſhire. The lake is about 8 or 9 miles long, and 3 broad, and ſends its waters through Sugar river weſt, 14 miles to Connecticut river. The mountain ſtands at the ſouth end of the lake.—*Morſe*.

SUNBURY, a county of the Britiſh province of New-Brunſwick. It is ſituated on the river St John, at the head of the Bay of Fundy; and contains 8 townſhips, viz. Conway, Gage-Town, Burton, Sunbury, St Annes, Wilmot, Newton, and Maugerville. The three laſt of theſe were ſettled from Maſſachuſetts, Connecticut, &c. The lands are generally pretty level, and tolerably fertile, abounding with variety of timber.—*ib.*

Sunbury, the chief town of Northumberland county, Pennſylvania; ſituated near where Fort Auguſta was erected, on the E. ſide of Suſquehannah river, juſt below the junction of the E. and W. branches of that river, in lat. about 40 52 N. It is regularly laid out, and contains a court-houſe, brick gaol, a Preſbyterian and German Lutheran church, and about 100 dwelling-houſes. Here the river is about half a mile broad, and at the ferry oppoſite Northumberland, about a mile higher, is ⅘ths of a mile. It is about 76 miles above Reading, and 120 N. W. of Philadelphia.—*ib.*

Sunbury, a port of entry and poſt-town of Georgia, beautifully ſituated in Liberty county, at the head of St Catherine's Sound, on the main, between Medway and Newport rivers, about 15 miles S. of Great Ogeeche river. The town and harbour are defended from the fury of the ſea by the N. and S. points of St Helena and St Catherine's Iſlands; between is the bar and entrance into the ſound: the harbour is capacious and ſafe, and has water enough for ſhips of great burden. It is a very pleaſant healthy town, and is the reſort of the planters from the adjacent country, during the ſickly months. It was burnt during the late war, but has ſince been rebuilt. An academy was eſtabliſhed here in 1788, which has been under an able inſtructor, and proved a very uſeful inſtitution. It is 40 miles S. of Savannah, and 974 from Philadelphia. —*ib.*

SUNCOOK, a ſmall plantation in York county, Diſtrict of Maine, which with Bromfield contains 250 inhabitants.—*ib.*

SUNDA, Straits of, are formed by the approach of the ſouth-eaſt extremity of the iſland of Sumatra to the north-weſt extremity of the iſland of Java (See theſe iſlands, *Encycl.*). The ſtraits are interſperſed with a number of ſmall iſles; the whole diſplaying a ſcenery ſcarcely to be exceeded in the ſoftneſs, richneſs, and gaiety of its appearance. The two great iſlands, which are low, and in ſome places marſhy near the ſhore, riſe afterwards, in a gradual ſlope, towards the interior of the country, admitting in their aſcent every variety of ſituation, and all the different tints of verdure. Of the ſmaller iſlands, a few have ſteep and naked ſides, ſuch as one in the middle of the ſtrait, which the Engliſh navigators have diſtinguiſhed, on that account, by the name of Thwart-the way, and two very ſmall round ones, called, from their figures, the Cap and Button (ſee theſe iſlands, *Suppl.*) ; but moſt of the others are entirely level, founded upon beds of coral, and covered with trees. Some of theſe iſlands are ſurrounded with a white ſandy beach, viſited frequently by turtle; but moſt of them are adorned with thick ſhrubbery to the water's edge, the roots being waſhed by the ſea, or the branches dipping into it; and on the outſide are ſhoals, in which a multitude of little aquatic animals are buſied in framing calcarious habitations for their reſidence and protection. Thoſe fabrics gradually emerge above the ſurface of the water, and at length, by the adventitious adheſion of vegetable matter, giving birth to plants and trees, become new iſlands, or add to the ſize of thoſe already produced by the ſame means. It is impoſſible not to be ſtruck with the diverſified operations of Nature for obtaining the ſame end, whether employed in originally fixing the granite foundation of the Brazils, or in throwing up, by ſome ſudden and ſubſequent convulſion, the iſland of Amſterdam, or in continuing to this hour, through the means of animated beings, the formation of new lands in the Straits of Sunda.—*Sir George Staunton's Account of the Britiſh Embaſſy to China.*

SUNDERLAND, a townſhip of Vermont, Bennington county, 16 miles N. E. of Bennington, and contains 414 inhabitants. A lead mine has been lately diſcovered in this townſhip.—*Morſe.*

SUNDERLAND, a townſhip of Maſſachuſetts, ſituated in Hampſhire county, on the E. ſide of Connecticut river, about 10 miles N. of Hadley and 100 W. of Boſton. There is here a handſome Congregational church, and 73 houſes, lying chiefly on one ſtreet. It was incorporated in 1718, and contains 462 inhabitants.—*ib.*

SUNNUD, a grant, patent, or charter, in Bengal.

SUPAY URCO, or *Devil's Hill*, a remarkable eminence in the province of Quito, in Peru, between the vallies of Chugui-pata, and thoſe of Paute. It has its name from a fabulous ſtory of enchantment, propagated by a ſuperſtitious Spaniard. It is thought to contain rich mines.—*Morſe.*

SUPERIOR, *Lake*, formerly termed the Upper Lake, from its northern ſituation. It may juſtly be termed the Caſpian Sea of America, and is ſuppoſed to be the largeſt body of freſh water on the globe. According to the French charts it is 1,500 miles in circumference. A great part of the coaſt is bounded by rocks and uneven ground. It is ſituated between 46 and 50 N. lat. and between 84 30 and 92 W. long. The water is very clear, and tranſparent. If the ſun ſhines bright, it is impoſſible through this medium to look at the rocks at the bottom, above a minute or two. Although the water, at the ſurface, is much warmed by the heat of the ſun, yet, when drawn up at about a fathom depth, it is very cold. Storms are more dreadful here than on the ocean. There are many iſlands in this lake; two of them have each land enough, if proper for cultivation, to form a conſiderable province; eſpecially Iſle Royal, which is not leſs than 100 miles long, and in many places 40 broad. The natives ſuppoſe theſe iſlands to be the reſidence of the Great Spirit. Many rivers empty their waters into this mighty reſervoir; of theſe, one is called *Nipegon*, another *Michipicooton*. This lake diſcharges its waters from the S. E. corner through the Straits of St Marie, which are about 40 miles long, into Lake Huron. Lake Superior, although about 40 rivers empty into it, many of which are large, yet it does not appear that one-tenth part of the waters which it receives, is diſcharged by the above mentioned ſtrait: great part of the waters evaporate; and Providence doubtleſs makes uſe of this inland ſea to furniſh the interior parts of the country with that ſupply of vapours, without which, like the interior parts of Africa, they muſt have been a mere deſert. A number of tribes live around Lake Superior, but little is known reſpecting them. The following extract from the journal of a late traveller will be acceptable to the curious.

"Mr M—— about the year 1790, departed from Montreal with a company of about 100 men, under his direction, for the purpoſe of making a tour through the Indian country, to collect furs, and to make ſuch remarks on its ſoil, waters, lakes, mountains, manners and cuſtoms of its inhabitants as might come within his knowledge and obſervation. He purſued his route from Montreal, entered the Indian country, and coaſted about 300 leagues along the banks of Lake Superior, from thence to the *Lake of the Woods*, of which he took an actual ſurvey, and found it to be 36 leagues in length; from thence to the lake *Ounipique*, of which he has alſo a deſcription. The tribes of the Indians which he paſſed through, were called the *Maſkego* tribe, *Shepeweyan*, *Cithiniſtinee*, *Great Belly Indians*, *Beaver Indians*, *Blood Indians*, the *Black-feet Tribe*, the *Snake Indians*, *Oſſnobians*, *Shiveytoon Tribe*, *Mandon Tribe*, *Paunees*, and ſeveral others, who in general were very pacific and friendly towards him, and are great admirers of the beſt hunting horſes, in which the country abounds. The horſes prepared by them for hunters, have large holes cut above their natural noſtrils, for which they give as a reaſon, that thoſe prepared in this manner will keep their breath longer than the others, which are not thus prepared: From experience, knowledge is gained, and the long practice of this cuſtom, conſequently on theſe trials, muſt have convinced them of the truth and utility of the experiment; otherwiſe we can hardly ſuppoſe they would torture their beſt horſes in this manner, if ſome advantage was not derived from the meaſure. In purſuing his route, he found no difficulty in obtaining a guide to accompany him from one nation to the other, until he came to the *Shining Mountains* or *Mountains of Bright Stones*, where, in attempting to paſs, he was fruſtrated by the hoſtile appearance of the Indians who inhabit that part of the country. The conſequence of which was, he was diſappointed in his intention and obliged to turn his back upon them. Having collected a number of Indians he he went forward again, with an intention to force his way over thoſe mountains, if neceſſary and practicable, and to make his way to Cook's river, on the N. W. coaſt of America, ſuppoſed by him to be about 300 leagues from the mountains; but the inhabitants of the mountains again met him with their bows and arrows, and ſo ſuperior were they in numbers to his little force, that he was obliged to flee before them. Finding himſelf thus totally diſappointed in the information he was in hopes to obtain, he was obliged to turn his back upon that part of the country for which his thirſting heart had long panted. Cold weather coming on, he built huts for himſelf and party in the *Oſſnobian* country, and near the ſource of a large river, called the *Oſſnobian river*, where they tarried during the continuance of the cold ſeaſon, and until ſome time in the warmer months. Previous to his departure from Montreal, he had ſupplied himſelf with ſeveral kinds of ſeeds, and before his huts he laid out a ſmall garden, which the natives obſerving, called them ſlaves, for digging up the ground, nothing of that kind being done by them, they living wholly on animal food; bread is unknown to them; to ſome he gave ſome remnants of hard bread, which they chewed and ſpit out again, calling it rotten wood. When his onions, &c. were ſomewhat advanced in their growth, he was often ſurprized to find them pulled up; determining therefore to know from what cauſe it proceeded, he directed his men to keep watch, who found that the Indian children, induced by motives of curioſity, came with ſticks, thruſt them through the poles of his fence, to aſcertain and ſatisfy themſelves, what the things of the white men were, and in what manner they grew, &c. The natives of this country have no fixed or permanent place of abode, but live wholly in tents made of buffaloe and other hides, and with which they travel from one place to another like the Arabs; and ſo ſoon as the feed for their horſes is expended, they remove their tents to another fertile ſpot, and ſo on continually, ſcarcely ever returning to the ſame ſpots again."—*ib.*

SUPERPARTICULAR PROPORTION, or RATIO, is that in which the greater term exceeds the leſs by unit or 1. As the ratio of 1 to 2, or 2 to 3, or 3 to 4, &c.

SUPERPARTIENT PROPORTION, or RATIO, is when the greater term contains the leſs term once, and leaves ſome number greater than 1 remaining. As the ratio

of 3 to 5, which is equal to that of 1 to $1\frac{2}{3}$;
of 7 to 10, which is equal to that of 1 to $1\frac{3}{7}$; &c.

SUPPLEMENT, OF AN ARCH OR ANGLE, in geometry or trigonometry, is what it wants of a ſemicircle, or of 180°; as the *compliment* is what it wants of a quadrant, or of 90°. So, the ſupplement of 50° is 130°; as the compliment of it is 40°.

SURINAM, a province or diſtrict in South-America, belonging to the Dutch.—*Morse.*

SURINAM, a beautiful river of South-America, and in Dutch Guiana; three-quarters of a mile wide at its mouth; navigable for the largeſt veſſels 12 miles, and for ſmaller veſſels 60 or 70 miles further. Its banks, quite to the water's edge, are covered with evergreen mangrove trees, which render the proſpect very delightful. The entrance is guarded by a fort and two redoubts, but not of any great ſtrength. At 6 miles up, the Commanwine falls into it, and on the point of land between the two rivers are the forts. The town of Surinam is in lat. 6 10 N. and long. 55 22 W. The beſt anchorage is under Zelandia Fort.—*ib.*

Surry.

SURRY, a county of N. Carolina, in Saliſbury diſtrict; bounded eaſt by Stokes, and weſt by Wilkes. It contains 7,191 inhabitants, including 698 ſlaves. The Moravian ſettlements of Wachovia are in this county. Near the river Yadkin is a forge, which manufactures bar-iron. The Ararat or Pilot Mountain, about 16 miles north-weſt of Salem, draws the attention of every curious traveller in this part of the State. It is diſcernible at the diſtance of 60 or 70 miles, overlooking the country below. It was anciently called the Pilot, by the Indians, as it ſerved them for a beacon, to conduct their routes in the northern and ſouthern wars. On approaching it, a grand diſplay of nature's workmanſhip in rude dreſs, is exhibited. From its broad baſe, the mountain riſes in eaſy aſcent, like a pyramid, near a mile high, to where it is not more than the area of an acre broad; when, on a ſudden, a vaſt ſtupendous rock, having the appearance of a large caſtle, with its battlements, erects its perpendicular height to upwards of 300 feet, and terminates in a flat, which is generally as level as a floor. To aſcend this precipice, there is only one way, which, through cavities and fiſſures of the rock, is with ſome difficulty and danger effected. When on the ſummit, the eye is entertained with a vaſt, delightful proſpect of the Apalachian mountains, on the north, and a wide, extended level country below, on the ſouth; while the ſtreams of the Yadkin and Dan, on the right and left hand, are diſcovered at ſeveral diſtant places, winding their way, through the fertile low grounds, towards the ocean.—*ib.*

SURRY, a county of Virginia, bounded north by James river which ſeparates it from Charles City county, eaſt by Iſle of Wight, and weſt by Prince George's county. It contains 6,227 inhabitants, of whom 3,097 are ſlaves.—*ib.*

SURRY, a townſhip of New-Hampſhire, in Cheſhire county, containing 448 inhabitants. It lies eaſt of Walpole, adjoining, and was incorporated in 1769.—*ib.*

Suſquehannah.

SUSQUEHANNAH *River*, riſes in Lake Ultayantho, in the State of New-York, and runs in ſuch a ſerpentine courſe that it croſſes the boundary line between the States of Pennſylvania and New-York, three times. It receives the Tyoga river in N. lat. 41 57. Afterwards it proceeds ſouth-eaſt to Wyoming, without any obſtruction by falls, and then ſouth-weſt over Wyoming falls, till, at Sunbury, in lat. 41 it meets the weſt branch of Suſquehannah, which is navigable 90 miles from its mouth. From Sunbury the river is paſſable with boats to Harriſburg and Middleton on the Swatara. About 15 miles above Harriſburg, it receives the Juniatta, from the north-weſt, proceeding from the Alleghany mountains and flowing through a broken country. Hence it takes its courſe about ſouth-eaſt, until it falls into the head of Cheſapeak Bay, juſt below Havre de Grace. It is about a mile wide at its mouth, and navigable only 20 miles, the navigation being obſtructed beyond that by the Rapids. The inland navigation between Schuylkill and Suſquehannah, will bring by water to Philadelphia, the trade of a moſt fertile country of about 1000 miles ſquare, or 6,000,000 acres of land. If this can be accompliſhed, an inland navigation may be eaſily made to the Ohio and to Lake Erie, which would at once open a communication with above 2,000 miles extent of weſtern country, viz. with all the great lakes, together with the countries which lie on the waters of Miſſiſippi, Miſſouri, and all their branches. The water communication between Schuylkill and Suſquehannah, which is the ſoul of all this, will be about 60 miles, as the navigation muſt go, although the diſtance on a line is only 40 miles. This tract is cut by two creeks, the Quitapahilla and the Tulpehoken. Theſe two creeks lead within 4 miles of each other; the level of their head waters is nearly the ſame, and the ſpace between them makes the height of land, or, as it is commonly called, the *crown land* between the two rivers which is nearly on a plain, and the bottom of the canal, through which the navigation muſt paſs, will no where riſe more than 30 feet above the level of the head waters of the two creeks above-mentioned, nor ſo much as 200 feet above the level of the waters of Suſquehannah or Schuylkill. The Company, inſtituted the 29th of Sept. 1791, has a capital of 1000 ſhares at 400 dollars each, payable at ſuch time as the Company ſhall direct. The work is already commenced. Coal of an excellent quality is found on ſeveral parts of this river, particularly at Wyoming.—*ib.*

SUSSEX, the north-weſternmoſt county of New-Jerſey. It is mountainous and healthy, and has ſeveral iron mines; and works have been erected for the manufacture of bar and pig iron. It produces excellent crops of wheat; and in no part of the State are greater herds of cattle. The produce is floated down the Delaware in boats and rafts. Here are 5 Preſbyterian churches, 2 for Anabaptiſts, 1 for German Lutherans, and 1 for Quakers. It contains 12 townſhips; the chief of which are Newton, Greenwich, Hardyſton, Knowltown, and Oxford. The population is 19,500 including 439 ſlaves. It is bounded N. E. by the State of New-York, N. W. by Delaware river, which ſeparates it from Northampton county, in Pennſylvania, and ſouth-eaſt and ſouth by Morris and Hunterdon counties. Paulin's Kill is here navigable for ſmall craft 15 miles. The Muſconetcony, which divides the county from Hunterdon, is capable of beneficial improvements, as is the Pequeſt or Pequaſet, between the above-mentioned rivers. The court-houſe in this county is 13 miles ſouth-weſt of Hamburg; 38 N. E. of Eaſton, in Pennſylvania; 41 ſouth-weſt of Goſhen, in New-York; and 108 N. by E. of Philadelphia. The village at this place is called Newton.—*ib.*

Sussex, a county of Virginia; bounded N. E. by Surry, and ſouth-weſt by Dinwiddie. It contains 10,554 inhabitants, including 5,387 ſlaves.—*ib.*

Sussex, a maritime county of Delaware State, bounded weſt and ſouth by the State of Maryland, north-eaſt by Delaware Bay, eaſt by the Atlantic Ocean, and north by Kent county. It contains 20,488 inhabitants, including 4,025 ſlaves. Cape Henlopen is in the north eaſtern part of the county. Chief town, Georgetown.—*ib.*

SUTTON (Thomas Eſq;), founder of the charter-houſe, was born at Knaith in Lincolnſhire in 1532, of an ancient and genteel family. He was educated at Eton-ſchool, and probably at Cambridge, and ſtudied the law in Lincoln's Inn; but this profeſſion not ſuiting his diſpoſition, he travelled into foreign countries, and made ſo long a ſtay in Holland, France, Spain, and Italy, as to acquire the languages of thoſe various nations. During his abſence, his father died, and left him a conſiderable fortune. On his return home, being a very accompliſhed gentleman, he became ſecretary to the earl of Warwick and his brother the earl of Leiceſter. By the former of theſe noblemen, in 1569, he was appointed maſter of the ordnance at Berwick; and diſtinguiſhing himſelf greatly in that ſituation, on the rebellion which at that time broke out in the north, he obtained a patent for the office of maſter-general of the ordnance for that diſtrict for life. He is named as one of the chiefs of thoſe 1500 men who marched into Scotland, by the order of Queen Elizabeth, to the aſſiſtance of the regent, the earl of Morton, in 1573; and he commanded one of the five batteries which obliged the ſtrong caſtle of Edinburg to ſurrender to the Engliſh. He purchaſed of the biſhop of Durham the manors of Gateſhead and Wickham; which, producing coal mines, became to him a ſource of extraordinary wealth. In 1580, he was reputed to be worth L. 50,000.

Soon after this, he married a rich widow, who brought him a conſiderable eſtate; and taking up the buſineſs of a merchant, riches flowed in to him with every tide. He is ſaid to have had no leſs than thirty agents abroad. He was likewiſe one of the chief victuallers of the navy; and ſeems to have been maſter of the barque called Sutton, in the liſt of volunteers attending the Engliſh fleet againſt the Spaniſh armada. It is probable, alſo, that he was a principal inſtrument in the defeat of it, by draining the bank of Genoa of that money with which Philip intended to equip his fleet, and thereby hindering the invaſion for a whole year. He is likewiſe ſaid to have been a commiſſioner for prizes under Lord Charles Howard, High Admiral of England; and going to ſea with letters of marque, he took a Spaniſh ſhip worth L. 20,000. His whole fortune, at his death, appears to have been in land L. 5,000 *per annum*; in money, upwards of L. 60,000; the greateſt eſtate in the poſſeſſion of any private gentleman till much later times. He lived with great munificence and hoſpitality; but loſing his lady in 1602, he retired from the world, leſſened his family, and lived in a private frugal manner; and, having no iſſue, reſolved to diſtinguiſh his name by ſome important charity. Accordingly, he purchaſed of the Earl of Suffolk, Howard-Houſe, or the late diſſolved charter-houſe, near Smithfield, for the ſum of L. 13,000, where he founded the preſent hoſpital, in 1611, for the relief of poor men and children. Before he had fixed upon this deſign, the court endeavoured to divert him from his purpoſe, and to engage him to make Charles I. then Duke of York, his heir, by conferring on him a peerage; but being free from ambition, and now near his grave, the luſtre of the coronet could not tempt him to change his plan. He died the 11th of December, 1611, at Hackney, aged 79. His body was conveyed, with the moſt ſolemn proceſſion, to Chriſt-church in London, and there depoſited, till 1614, when it was removed to the charter-houſe, and interred in a vault on the north ſide of the chapel, under a magnificent tomb.

Sutton, a townſhip of New-Hampſhire, Hillſborough

rough county, containing 520 inhabitants. It was firſt called Perryſtown, and was incorporated in 1784. —*Morſe.*

Sutton, a townſhip in Worceſter county, Maſſachuſetts, 46 miles W. S. W. of Boſton, and 10 miles S. by E. of Worceſter. It was incorporated in 1718, and contains 2,642 inhabitants. Here are 10 griſt-mills, 6 ſaw-mills, 3 fulling-mills, a paper mill, an oil-mill, and 7 trip-hammers. There are 5 ſcythe and ax-makers, one hoe-maker, ſeveral who work at nail-making, and 6 works for making pot-aſh. Here are found ginſeng and the cohuſh-root. The cavern, commonly called *Purgatory*, in the ſouth-eaſtern part of the town, is a natural curioſity. Bodies of ice are found here in June, although the deſcent is to the ſouth.—*ib.*

SUWOROW (a) Rimnikski (Count Alexander), was a man ſo eminent in his profeſſion, that, if war be an art founded on ſcience, it would be improper not to give ſome account of his life in a Work of this nature. Various accounts of him, indeed, are already in the hands of the public; but they differ ſo much from one another in the pictures which they preſent of the *man*, that it is not eaſy, if it be always poſſible, to diſtinguiſh truth from falſehood. With reſpect to the talents of the *General*, there is not room for the ſame difference of repreſentation; becauſe a train of military ſucceſſes, almoſt unrivalled, has rendered theſe conſpicuous to all Europe. In the ſhort detail that our limits permit us to give of the life of this ſingular man, we ſhall avail ourſelves of all the information, public and private, which we have been able to obtain, and believe to be authentic; and we hope to make our readers acquainted with ſome particulars reſpecting his perſon and domeſtic habits which are not yet generally known.

The family of Suworow is ſaid to have been from Sweden, and of a noble deſcent. The firſt of this name ſettled in Ruſſia about the latter end of the laſt century; and having engaged in the wars againſt the Tartars and the Poles, were rewarded by the Czars of that period with lands and peaſants. Baſil, the father of our hero, is ſaid to have been the godſon of Peter the Great; to have been held in high eſtimation for his political knowledge and extenſive erudition; and to have enjoyed, at his death, the two-fold rank of General and Senator*.

As this account is given by a man who profeſſes to have formed an intimate acquaintance with Suworow himſelf, it ought to be correct; and yet we cannot help entertaining ſome doubts of its truth, or at leaſt of its accuracy. It is well known that extenſive erudition was in no eſteem in Ruſſia at the period when Baſil Suworow is here ſaid to have been ſo learned; and it is likewiſe known, that if, by erudition, be meant a knowledge of ancient literature, it was even deſpiſed, at a much later period, by all who were at once noble, and poſſeſſed of lands and peaſants (See Russia, *Encycl.*) The truth is, as we have learned from unqueſtionable authority, that the family of Suworow was ancient and reſpectable; but being far from affluent, and their little property lying at the very extremity of the empire, we have reaſon to believe, that the ſubject of this memoir was the firſt of the family that ever was at court. Baſil, however, if his anceſtors were from Sweden, may have been free from the Ruſſian prejudices againſt Greek and Latin; and this is the more probable, that he certainly gave a learned education to his ſon.

Suworow.

That ſon, Alexander Baſilowitch Suworow, was, according to the author already quoted, born in the year 1730; we have ſome reaſon to believe, that he was not born before 1732. His father had deſtined him, we are told, for the robe; but his early inclinations impelled him to the profeſſion of a ſoldier; and in 1742 he was enrolled as a fuſilier in the guards of Seimonow. He was afterwards a corporal, then a ſerjeant, and, in 1754, he quitted the guards with the brevet of Lieutenant in the army. He made his firſt campaign in the ſeven years war againſt the Pruſſians, in the year 1759, entering upon actual ſervice under Prince Wolgonſki. As ſenior officer on duty, he attended on the commander in chief Count Fermor, who, admiring the conſummate reſolution which he appeared to poſſeſs, favoured him with his particular confidence. In 1761, he was ordered on ſervice in the light troops under General Berg; and with the rank of a field officer (we think that of Lieutenant-colonel) he performed prodigies of valour, and exhibited much of that character which was afterwards ſo fully developed and diſplayed. Even then he ſeems to have formed the reſolution of dying on the field of battle rather than ſuffer himſelf to be taken priſoner; for when, with a handful of troops, he was once ſurrounded by a large detachment of Pruſſians, he determined to cut his way through them, or periſh in the attempt. In this daring enterpriſe he was not only ſucceſsful, but contrived to carry off with him twenty priſoners, though he was obliged to abandon two field-pieces, which he had a little before taken from a ſmaller detachment.

At the peace of 1762, he received from the Empreſs a colonel's commiſſion, written with her own hand; and being advanced, in 1768, to the rank of brigadier, he was, in the month of November, ordered to repair, with all poſſible ſpeed, to the frontiers of Poland. At that unfavourable ſeaſon, he croſſed rivers and moraſſes, whoſe paſſage was rendered more difficult by ſlight froſts: and, in the courſe of a month, traverſed 500 Engliſh miles, with the loſs of only a few men in the environs of Smolenſko.

The object of the Empreſs, at this time, was to ſubdue the Poliſh confederates, and to poſſeſs herſelf of certain provinces of that ill-fated kingdom. How completely ſhe and her two allies, the Emperor of Germany and the King of Pruſſia, ſucceeded in their enterpriſe, has been related elſewhere (ſee Poland, *Encycl.*). It is ſufficient, in this memoir, to obſerve, that the ſucceſſes of the Ruſſians were chiefly owing to the military ſkill and intrepidity of Suworow, who was their only active General, and was indeed, for four years, almoſt conſtantly employed in offenſive operations

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(a) This name is ſpelled ſometimes as we have ſpelled it, ſometimes Suwarrow, and ſometimes Suvoroff. This laſt is according to the pronunciation; but we have adopted the orthography of the General himſelf, in his letter to Charette, the hero of Vendee.

againſt the confederates. Not to mention the numerous actions and ſkirmiſhes of an inferior kind, in which his conduct and courage were always diſplayed, the victory at Stalowiz, over a ſuperior force, ably commanded, and the capture of Cracow, were alone ſufficient to intitle him to the character which he ever afterwards ſo well ſupported. The former of theſe drew the higheſt encomiums from the great Frederick of Pruſſia; and the latter decided the fate of Poland. It is proper to add, that Suworow, on theſe occaſions, did not tarniſh his laurels by unneceſſary cruelty. When a French officer, who ſurrendered at Cracow, offered him his ſword, according to the cuſtom of war, he refuſed it, ſaying, that he would not take the ſword of a brave man, whoſe maſter was not at war with his ſovereign; and, even to the leaders of the confederates, he granted better terms of capitulation than they had the preſumption to aſk.

In the year 1770, he had been promoted to the rank of Major general; and for his exploits in the Poliſh war, the Empreſs conferred upon him at different times, the orders of St Ann, St George, and Alexander Newſky.

After performing ſome important ſervices on the frontiers of Sweden, Suworow received orders in the beginning of 1773, to join the army in Moldavia, under the command of Field-marſhal Romanzow; and there he began that glorious career, which ſoon made his name a terror to the Turks. His firſt exploit was the taking of Turtukey; of which he wrote the following laconic account to the commander in chief:

“ Honour and glory to God! Glory to you, Romanzow! We are in poſſeſſion of Turtukey, and I am in it! “ SUWOROW.”

During the remainder of the war, which was of ſhort continuance, Suworow was conſtantly engaged, and conſtantly ſucceſsful. In the beginning of the year 1774, he was promoted to the rank of Lieutenant-general; and on the 11th of June of the ſame year, he defeated the Turks in a great battle, in which they loſt 3000 men killed, ſome hundreds of priſoners, 40 pieces of artillery, and 80 ſtandards, with their ſuperb camp. Soon after this victory, peace was concluded between the two courts; and Lieutenant-general Suworow was ordered to proceed with all poſſible haſte to Moſcow, to aſſiſt in appeaſing the interior troubles of that part of the empire.

Theſe troubles were occaſioned by a Coſſac rebel, of the name of *Pugatchew*, or *Pugatcheff*, who, at the head of a party of his diſcontented countrymen, had long eluded the vigilance of Count Panin, the commander in chief in Muſcovy, and frequently cut off detachments of the army which were ſent out in queſt of him. The chace of Pugatcheff, for ſuch it may be called, was now wholly entruſted to the well-known activity of Suworow; and that General, after purſuing the rebel with inconceivable rapidity, through woods and deſerts, came up with him at a place called Urlaſk, and carried him priſoner to Count Panin, who ſent him to Moſcow, where he ſuffered the puniſhment due to his crimes. This inſurgent, it is ſaid, had at one time collected ſuch a force, and was followed with ſuch enthuſiaſm, that, if his underſtanding had been equal to his courage, and his moderation had kept pace with his power, he might have poſſeſſed himſelf of Moſcow, and made the Imperial Catharine tremble on her throne.

For ſeveral years after the taking of Pugatcheff, Suworow was employed in the Crimea, on the Cuban, and againſt the Nogay Tartars, in a kind of ſervice which, though it was of the utmoſt importance to the Empreſs, and required all the addreſs of the Lieutenant-general, furniſhed no opportunities for that wonderful diſplay of promptitude and reſource which had characteriſed his more active campaigns. One incident, however, muſt be mentioned, even in this ſhort memoir, becauſe it ſhews the natural diſpoſition of the man. During the winter that Suworow paſſed among the Tartars, he was frequently viſited by the chiefs of that nation; and at one of theſe viſits, Mechmed Bey, the chief of the Gediſſens, often joked with Muſſa Bey, another chief, on his inclination to marry. Muſſa Bey was ſo extremely old, that Suworow thought the converſation ridiculous; and one day aſked him, What ground Mechmed could have for ſuch idle talk? Muſſa replied, that Mechmed Bey was right; that he wiſhed to marry; and that he hoped the General would make him a preſent of a beautiful Tartar girl of ſixteen! Suworow immediately bought a young Tartar ſlave of a Coſſac for 100 rubles, and ſent her to Muſſa Bey; who married her, lived with her a very few years, and died at the age of one hundred and eight! regretted, we are told, by the Lieutenant-general, who regarded him with great eſteem and attachment.

In the end of the year 1786, Suworow was promoted to the rank of General in Chief; and, at the breaking out of the war with the Turks in 1787, he ſhewed how well he was intitled to that rank, by his maſterly defence of Kinburn; a place of no ſtrength, but of great importance, as it is ſituated at the mouth of the Dneiper, oppoſite to Oczakow. For the zeal and abilities which he diſplayed on this occaſion, the Empreſs decorated him with the order of St Andrew; gave him ſix croſſes of the order of St George, to be diſtributed, according to his judgment, among ſuch of his officers as had moſt diſtinguiſhed themſelves; and, in a very flattering letter, regretted the wounds which he had received in defending the place.

At the ſiege of Oczakow, Suworow, who commanded the left wing of the army under Prince Potemkin, received a dangerous wound in the nape of the neck, which was followed by ſo ſmart a fever, that, for ſome time, his life was deſpaired of; but he perſevered in his long accuſtomed practice of preferring regimen to medicine, and his health was gradually re-eſtabliſhed. In the year 1789, he was appointed to the command of the army which was to co-operate with the Prince of Saxe Cobourg in Walachia; and, by marches of inconceivable rapidity, he twice, in the ſpace of two months, preſerved the army of that Prince from inevitable deſtruction. Putting himſelf at the head of 8000 Ruſſians, and literally running to the aid of his ally, he came up with the Turks in time to change the fate of the day at the battle of Forhani, which was fought on the 21ſt of July; and again at Rymnik, which, with 7000 men, he had reached with equal celerity, he gained, on the 22d of September, in conjunction with the Prince, one of the greateſt victories that have ever been atchieved. According to the leaſt exaggerated account,

count, the Turkiſh army, commanded by the Grand Viſier in perſon, amounted to 90,000 or 100,000 men; of which 70,000 were choſen troops: whilſt the army of the allies exceeded not 25,000. At the commencement of the attack, Suworow, who had reconnoitred the country, and formed the plan of the battle, called out to his Ruſſians, "My friends, look not at the eyes of your enemies, but at their breaſts; it is there that you muſt thruſt your bayonets." No quarter was given to the Turks; and on this account the Ruſſian General has been charged with ſavage ferocity: but the charge, if not groundleſs, muſt be ſhared equally between him and the Prince of Cobourg. The commanders of the allied army, aware of the immenſe ſuperiority of their enemies, had reſolved, before the engagement, not to encumber themſelves with priſoners, whom they could not ſecure without more than hazarding the fate of the day: And where is the man, who admits the lawfulneſs of war, that will condemn ſuch conduct in ſuch critical circumſtances?

The taking of Bender and Belgrade were the immediate conſequences of the victory of Rymnik; and ſo ſenſible was the Emperor Joſeph how much the rapid movements and military ſkill of Suworow had contributed to that victory, that he immediately created him a Count of the Roman empire, and accompanied the diploma with a very flattering letter. Similar honours were conferred upon him by his own ſovereign, who ſent him the diploma of Count of the empire of Ruſſia, with the title of Rymnikſki, and the order of St Andrew of the firſt claſs.

In the autumn of 1790, Prince Potemkin wrote to Count Suworow, requeſting a particular conference. The General, who conjectured the object of it, ſent him the following anſwer: "The flotilla of row-boats will get poſſeſſion of the mouths of the Danube; Tulcia and Iſaccia will fall into our power; our troops, ſupported by the veſſels, will take Iſmailow and Brahilow, and make Tchiſtow tremble." He was perfectly right in his conjecture: it was to concert with him meaſures for the taking of Iſmailow that the Prince had requeſted the conference. He did not, however, receive orders to undertake that deſperate enterpriſe till the beginning of November, when he rapidly approached towards that fortreſs. His army, by ſea and land, conſiſted of 23,000 men; of whom one-half were Coſſacs, and of theſe many were ſick. The troops of the garriſon, which were under the orders of ſeven Sultans, amounted to 43,000 men, of whom nearly one half were Janiſſaries; the fortreſs was by much the ſtrongeſt of any on the Turkiſh frontier: it was under the command of an old warrior, who had twice refuſed the dignity of Grand Viſier, and had diſplayed againſt the Auſtrians conſiderable abilities, as well as the moſt intrepid courage; and the Grand Seignior had publiſhed a firman, forbidding the garriſon, on pain of death without trial, to ſurrender on any terms whatever.

Potemkin, knowing that Suworow had with him no battering cannon, and dreading the conſequences of a repulſe, wrote to the General, that if he was not certain of ſucceſs, he would do well not to riſk an aſſault. The laconic reply was; "My plan is fixed. The Ruſſian army has already been twice at the gates of Iſmailow; and it would be ſhameful to retreat from them the third time without entering the place." To ſpare the effuſion of blood, however, if poſſible, he ſent a note to the Seraſkier who commanded in Iſmailow, to aſſure him, upon Count Suworow's word of honour, that if he did not hang out a white flag that very day, the place would be taken by aſſault, and all the garriſon put to the ſword. The Seraſkier returned no anſwer to the note; but another commander was pleaſed to ſay, that "The Danube would ceaſe to flow, or the heavens bow down to the earth, before Iſmailow would ſurrender to the Ruſſians!"

Having concerted with the Admiral proper meaſures for the aſſault, Suworow paſſed the night, with ſome officers of his ſuite, in impatient vigilance for the appointed hour when the ſignals were to be given. Theſe were the firing of a muſket at three, four, and five in the morning, when the army ruſhed upon the place; and notwithſtanding the deſperate oppoſition of the Turks, the depth of the moat, and the height of the ramparts, they were completely maſters of Iſmailow by four o'clock P. M. In this one dreadful day the Ottomans loſt 33,000 men killed or dangerouſly wounded; 10,000 who were taken priſoners; beſides 6000 women and children, and 2000 Chriſtians of Moldavia, who fell in the general maſſacre. The place was given up to plunder for three days, according to agreement with the army before the aſſault; but we have authority to ſay, that no perſon was murdered in cold blood, who did not prefer his property to his life.

The Ruſſians found in Iſmailow 232 pieces of cannon, many large and ſmall magazines of gunpowder, an immenſe quantity of bombs and balls, 345 ſtandards almoſt all ſtained with blood, proviſions for the Turkiſh army for ſix months, and about 10,000 horſes, of which many were extremely beautiful. Suworow, who was inacceſſible to any views of private intereſt, did not appropriate to himſelf a ſingle article, not ſo much as a horſe; but having, according to his cuſtom, rendered ſolemn thanks to God for his victory, wrote to Prince Potemkin the following Spartan letter: "The Ruſſian colours wave on the ramparts of Iſmailow."

Peace being concluded with the Turks in December 1791, no political events occurred from that period to call forth the military talents of Suworow till 1794. In the beginning of that year mutinies having broken out among the Poliſh troops in the ſervice of Ruſſia, and the Empreſs, with her two potent allies, having digeſted the plan for the partition of Poland, Count Suworow received orders, in the month of May, to proceed, by forced marches, into Red Ruſſia, with a corps of 15,000 men, and to diſarm all the Poliſh troops in that province. This ſervice he performed without the effuſion of blood, diſarming in leſs than a fortnight 8000 men, diſperſed over a country of 150 miles in circuit. Soon afterwards he was ordered to march into the interior of Poland; the King of Pruſſia having been obliged to raiſe the ſiege of Warſaw, and the Empreſs perceiving that more vigorous meaſures than had hitherto been purſued, were neceſſary to accompliſh her deſigns.

To give a detailed account of his route to Warſaw, would be to write the hiſtory of the Poliſh war, and not the memoirs of Count Suworow. It has been raſhly ſuppoſed, that he had to contend only with raw troops, commanded by inexperienced leaders, who were not cordially united among themſelves; but the fact is otherwiſe, and Suworow never diſplayed greater reſource in the day of danger, than in the numerous battles and ſkirmiſhes in which he was engaged on his march to the capital of Poland. At laſt, after ſurmounting every obſtacle, he ſat down, on the 22d of October, before Praga, a ſtrongly fortified ſuburb of Warſaw, defended by a formidable artillery, and a garriſon of 30,000 men, rendered deſperate by their ſituation. The Ruſſian army exceeded not 22,000; and with that comparatively ſmall force he reſolved to ſtorm Praga, as he had ſtormed Iſmail. Having erected ſome batteries to deceive the garriſon into a belief that they were to be regularly beſieged, he concerted with the other Generals the mode of aſſault; and when every thing was ready, he gave his orders in theſe words: "Storm, and take the batteries, and cut down all who reſiſt; but ſpare the inhabitants, unarmed perſons, and all who ſhall aſk for quarter."

There are but few examples of a military operation ſo boldly conceived, ſo ſkilfully performed, or ſo important in its conſequences, as the taking of Praga. The aſſault was made at once in ſeven different places at five in the morning; and at nine the Ruſſians were maſters of the place, having penetrated by pure force a triple entrenchment. Of the Poles 13,000 lay dead on the field of battle, one-third of whom were the flower of the youth of Warſaw; above 2000 were drowned in the Viſtula; and 14,680 were taken priſoners, of whom 8000 were diſarmed and immediately ſet at liberty, and the remainder the next day. We mention theſe circumſtances, becauſe they completely refute the tales of thoſe Jacobin ſcribblers, who have ſo ſtrenuouſly endeavoured to tarniſh the laurels of the Ruſſian hero, by repreſenting him as having ordered a general maſſacre of men, women, and children. The artillery taken from the enemy conſiſted of 104 pieces of cannon and mortars, chiefly of large calibre. The Ruſſians had 580 men killed, of whom eight were ſuperior and ſtaff-officers, and 900 wounded, of whom 23 were officers.

Soon after the ſtorming of Praga, Warſaw capitulated, and Suworow was received into the city by the magiſtrates in a body, and in their ceremonial habits. When the preſident preſented to him the keys of the city, he preſſed them to his lips, and then, holding them up towards heaven, he ſaid, "Almighty God, I render thee thanks, that I have not been compelled to purchaſe the keys of this place as dear as ....." Turning his face towards Praga, his voice failed him, and his cheeks were inſtantly bathed with tears. As he rode through the ſtreets, the windows were filled with ſpectators, who were delighted with the return of order, and the aſſurance of peace; and the air reſounded with the exulting exclamations of "Long live Catharine! Long live Suworow!"

Thus did Count Suworow, in the courſe of a very few months, overturn the kingdom and republic of Poland. It is not our buſineſs, in this article, to decide on the juſtice of the cauſe in which he was embarked. Of the Poliſh revolution, which gave riſe to the war that ſubverted the republic, and ſwept it from the number of ſovereign ſtates, the reader will find ſome account under the title Poland in the *Encyclopædia;* but it is here proper to acknowledge, that we do not now think ſo favourably, as when we wrote that article, of the views and principles of thoſe who framed the conſtitution, which brought upon them the Ruſſian and Pruſſian arms. Subſequent events ſeem to have proved completely, that if Poland had not been conquered by the allied powers, it would ſoon have been involved, under Koſkiuſko and his Jacobinical adherents, in all the horrors of revolutionary France; and the unhappy king, inſtead of being carried captive into Ruſſia, would probably have finiſhed his courſe on a ſcaffold. Suworow, who never concerned himſelf with the intrigues of courts, and expreſſed on all occaſions the moſt ſovereign contempt of thoſe Generals who affected to poſſeſs the ſecrets of ſtateſmen, probably never enquired into the final object of the war, but thought it his duty to execute, in his own ſphere, the orders of his Imperial miſtreſs. So ſenſible was Catharine of the propriety of this conduct, and of the zeal and abilities which he had diſplayed in the Poliſh campaign, that immediately on receiving accounts of the ſtorming of Praga and the ſubmiſſion of Warſaw, ſhe announced to him, in a letter written with her own hand, his well-earned advancement to the rank of Field-marſhal General. Nor did her munificence ſtop there: She loaded him with jewels, and preſented him with an eſtate of 7000 peaſants, in the diſtrict of Kubin, which had been the ſcene of his firſt battle in the courſe of the campaign.

From the ſubjugation of Poland we hear little more of Field-marſhal Suworow till he entered upon his glorious career in Italy. He is ſaid, indeed, to have given offence to the Emperor Paul ſoon after his acceſſion to the throne, by affording protection to ſome meritorious officers, whom his Majeſty had in an arbitrary manner diſmiſſed from the ſervice; but that offence was overlooked, and Suworow called again into action, when Paul joined the coalition againſt France.

Of the exploits of the Field-marſhal in Italy, where, to uſe his own words, he deſtroyed armies and overturned ſtates, we have given a full account under the title Revolution in this *Supplement*. In his former campaigns, the wiſdom of his meaſures, the diſtribution of his forces, the undaunted character of his operations, and the progreſſive continuance of his ſucceſſes, furniſh proofs of the ſuperiority of his talents hardly to be paralleled in the annals of modern war; but, animated by the nobleneſs of his cauſe, and confiding, as he ſaid, in the God of battles, he ſeems in his laſt campaign to have ſurpaſſed himſelf (B). It would appear, however, that

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(B) Were any other proof than a ſimple narrative of his ſucceſs neceſſary to evince the abilities diſplayed by Marſhal Suworow in the laſt campaign, that proof might be found in the ſad reverſes of the preſent. At the opening of the campaign of 1800, the allies poſſeſſed infinitely greater advantages over the enemy than at the beginning of the campaign of 1799; and we ventured to ſay, towards the end of the article Revolution, in this *Supplement*, that the affairs of the French ſeemed in Italy to be deſperate. But how egregiouſly have we been miſtaken? By the moſt unaccountable infatuation, the Auſtrian commander in Italy would not *believe* that the French army of reſerve, which was advancing upon him with the uſual celerity of the that his own Sovereign thought otherwiſe; and if he did, he was certainly as ſingular in that opinion as he is ſaid to be in many others. Conſidering the Field-marſhal as the conqueror of Italy, he had indeed created him a Prince by the ſtyle and title of Prince Suworow-*Italiſki*; but how did he receive him, when he returned into the Ruſſian dominions at the head of his veteran and victorious bands?

Though the old warrior thought himſelf almoſt betrayed at the end of the campaign by the crooked policy of the court of Vienna, he doubtleſs hoped to be received at the court of St Peterſburg, if not with triumphal arches, at leaſt with the moſt public teſtimonies of his Sovereign's approbation. It is ſaid, that he expected to be ſent back at the head of a large army, with full powers to act as he ſhould judge proper for bringing the war to a happy termination, and reſtoring peace and order to Europe; and he certainly expreſſed, in letters to different correſpondents, his earneſt wiſh to conclude his military career with contributing to the accompliſhment of ſo deſirable an object. What then muſt have been his diſappointment, when the Ruſſian Emperor would not ſee him, and poſitively forbad his appearance at court? To the meſſenger who brought the order, the Field-marſhal gave a purſe of money, turned his carriage another way, and drove to a wooden houſe, at a diſtance from the court, and from his former friends, "where burſt his mighty heart;" and the conqueror of the Turks, the Poles, and the French republicans, died, almoſt unattended, on the 18th of May 1800. The ſovereign, who thus diſgraced him at the end of his life, gave him a magnificent funeral!

In his perſon Suworow was tall, conſiderably exceeding ſix feet, and full cheſted. His countenance was ſtern; but among his friends his manners were pleaſant, and his diſpoſitions were kind. His temper was naturally violent; but that violence he conſtantly laboured to moderate, though he was never able completely to extinguiſh it. According to M. Anthing, an efferveſcent ſpirit of impatience predominated in his character; and it perhaps never happened (ſays that author) that the execution of his orders equalled the rapidity of his wiſhes. Though he diſliked all public entertainments, yet when circumſtances led him to any of them, he appeared to partake, and endeavoured to promote, the general pleaſure. Sometimes he condeſcended even to dance and play at cards, though very rarely, and merely that he might not interrupt the etiquette of public manners, to which, when not in the field, he was very attentive. In the field he may be ſaid to have ſpent the whole of his life from the period at which he firſt joined the army in the ſeven years war; for during the time that he was not engaged in actual warfare, and that time, taken altogether, did not exceed twelve years, he was always placed at the head of armies ſtationed on the frontier of ſome enemy's country. He was therefore a mere warrior, and as ſuch had no fixed habitation. With reſpect to his table and lodging, he contented

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Firſt Conſul's movements, conſiſted of more than *ſix thouſand men!* Inſtead therefore of marching rapidly to meet them before they could be wholly diſentangled from the paſſes over the Alps, he waited patiently for them in the plains of Marengo. If we may judge of the future by the paſt, we may ſurely ſay that ſuch would not have been the conduct of Suworow. Even after the two hoſtile armies met, and fought, on the 10th of July, one of the bloodieſt battles of the preſent war, the ſucceſs of the French was not ſuch as to intitle them to the acquiſitions which were the conſequence of their dear-bought victory. The fate of the day was long doubtful; and it was at laſt decided, not by any extraordinary exertions of the Conſul, but partly by the provident conduct of General Deſſaix, who, with the aid of freſh troops, erected a new battery at a critical point, and at a critical period; and ſtill more by the ſituation of General Melas, whoſe faculties, though frequently ſupported by wine and ſpirits, are ſaid to have wholly forſaken him in the latter part of the day. When he was in this ſtate, one falſe movement, which weakened his centre, afforded an opportunity to Deſſaix to make a vigorous and ſucceſsful charge with a body of cavalry that had not yet been engaged.

But even after this defeat, what was the ſtate of the two armies? The Auſtrians had loſt 9000 men, and the French from 12,000 to 14,000: the former, enraged at having had the victory ſo wreſted out of their hands, were eager to renew the conteſt on the following day; and the latter had obtained only the barren advantage of keeping poſſeſſion of the field of battle. In ſuch a ſituation, Suworow would certainly have encouraged the ardour of his men; but the Auſtrian commander, who complained laſt year of the Field-marſhal for being too little ſparing of blood, inſtead of following the example which he had ſet him at the battle of Trebia, concluded a capitulation unparalleled, we believe, in the annals of war; a capitulation by which he voluntarily ſurrendered into the hands of the enemy nearly all the fruits of one of the moſt glorious campaigns recorded in hiſtory. We wiſh not to throw any undue aſperſion upon the character of General Melas: We believe him to be a brave man, and ſuch he has been repreſented to us in various accounts which we have had directly from Germany; but all theſe accounts agree in repreſenting him likewiſe as fit, not to have the ſupreme command of a great army, but only to execute the orders of a ſuperior mind.

In Germany, the gallant Kray has been obliged to retreat before the equally gallant Moreau; but he has wiſely not hazarded the conſequences of a general action. We ſay *wiſely*; becauſe we have learned from authority which we cannot queſtion, that his army is in a ſtate little better than that of mutiny. To his officers he is in a great meaſure a ſtranger; and therefore theſe gentlemen think themſelves at liberty to diſobey his orders! What the conſequence of all this will be, it becomes not us to conjecture. An armiſtice has in the mean time* taken place both in Italy and in Germany; and it is not impoſſible that the Aulic Council, aided by the mob of Vienna, may induce the Emperor to make a ſeparate peace.—Since this note was written the changes which have taken place are well known—and the peace which has at laſt been definitively concluded at Amiens, will at leaſt give a reſpite to almoſt exhauſted Europe.

* September the 4th 1800.

contented himſelf with whatever he found, requiring nothing but what abſolute neceſſity demands, and what might be tranſported with eaſe from one place to another. His couch conſiſted of a heap of freſh hay ſufficiently elevated, and ſcattered into conſiderable breadth, with a white ſheet ſpread over it, with a cuſhion for his pillow, and with a cloak for his coverlid. He has been repreſented as dirty (c); but the repreſentation is falſe. M. Anthing aſſures, that he was clean in his perſon, and that, when not on actual ſervice, he waſhed himſelf frequently during the courſe of the day. It is among the ſingular, though unimportant circumſtances of his life (ſays the ſame author), that, for the laſt twenty years, he had not made uſe of a looking-glaſs, or incumbered his perſon with either watch or money.

He was ſincerely religious; took every opportunity of attending the offices of public devotion; and has been known, on Sundays and feſtivals, to deliver lectures on piety to thoſe whom duty called to attend on him. We are told by an anonymous writer, in a miſcellany not very forward to praiſe ſuch men as Suworow, or indeed to praiſe piety in men of any deſcription, that chancing one evening to overhear a captain abridge the prayer which his duty required him to repeat at the guard, the Field-marſhal called out to him, "Thou unconſcionable, abominable, impious man, thou wouldſt cheat Heaven! Thou wouldſt, no doubt, cheat likewiſe the Empreſs and me! I ſhall diſmiſs thee." His regard for ſacred things is indeed very apparent in the elegant letter which, on the 1ſt of October 1795, he wrote to Charette, the hero of Vendee, whom he congratulates upon taking up arms to reſtore the temples of the God of his fathers. Alluding to this trait of his character, and to his deteſtation of Jacobiniſm under every form, a late writer in a moſt reſpectable miſcellany has well characterized him as the

"Foe to religion's foe; of Ruſſia's throne
The prop, th' avenger, and the pride in one;
Whoſe conquering arms, in bold defiance hurl'd,
Cruſhed the rude monſter of the weſtern world."

We have already, when we thought not that we ſhould ſo ſoon be called upon to write his life, obſerved, that he was a ſcholar, a man of ſcience, and a poet. M. Anthing aſſures us, that from his earlieſt years he was enamoured of the ſciences, and improved himſelf in them; but that as the military ſcience was the ſole object of his regard, thoſe authors of every nation who inveſtigate, illuſtrate, or improve it, engroſſed his literary leiſure. Hence Cornelius Nepos was with him a favourite claſſic; and he read, with great avidity and attention, the hiſtories of Montecuculi and Turenne. Cæſar, however, and Charles XII. (ſays the ſame author) were the heroes whom he moſt admired, and whoſe activity and courage became the favourite objects of his imitation.

With reſpect to his moral character, we have every reaſon to believe that he was a man of the moſt incorruptible probity, immoveable in his purpoſes, and inviolable in his promiſes; that the cruelties of which he has been accuſed were the cruelties of Potemkin, and that by thoſe who knew him he was conſidered as a man of unqueſtionable humanity. The love of his country, and the ambition to contend in arms for its glory, were the predominant paſſions of his active life; and to them, like the ancient Romans, he ſacrificed every inferior ſentiment, and conſecrated, without reſerve, all the powers of his body and mind. His military career was one long and uniform courſe of ſucceſs and triumph, produced by his enterpriſing courage and extraordinary preſence of mind; by his perſonal intrepidity and promptitude of execution; by the rapid and unparalleled movements of his armies; and by their perfect aſſurance of victory when fighting under his banners. Such was Alexander Baſilowitch Count Suworow. In the year 1774 he married a daughter of the General Prince Iwan Proſorowſki, by whom he had two children, now living: Natalia, married to General Count Nicolai Zubow; and Arcadius Count Suworow, a youth of great promiſe, who accompanied his father in his unparalleled march from Italy to Switzerland.

SWALLOW *Iſland*, in the Pacific Ocean, S. lat. 10, E. long. from Paris, 162 30; diſcovered by Roggewins, 1722.—*Morſe.*

SWALLOW's-TAIL, in fortification, is a ſingle tenaille, which is narrower towards the place than towards the country.

SWAMSCOT, or *Great River*, to diſtinguiſh it from another much leſs, alſo called *Exeter River*, riſes in Cheſter, in New-Hampſhire, and after running through Sandown, Poplin, Brentwood, and a conſiderable part of Exeter, affording many excellent mill-ſeats, tumbles over a fall 20 or 30 rods in length, and meets the tide from Piſcataqua harbour, in the centre of the townſhip of Exeter. The ſmaller river riſes in Brentwood and joins Great river about a third of a mile above Exeter. Here are caught plenty of alewives and ſome oyſters. Swamſcot is the Indian name of Exeter.—*Morſe.*

SWAN (See ANAS, *Encycl.*). It is now aſcertained, beyond the poſſibility of doubt, that there are *black* ſwans, of equal ſize, and the ſame habitudes, with the common white ſwan of Britain. Theſe fowls have been ſeen chiefly in New Holland; and Captain Vancouver, when there, ſaw ſeveral of them in very ſtately attitudes, ſwimming on the water; and, when flying, diſcovering the under part of their wings and breaſts to be white. Black ſwans were likewiſe ſeen in New Holland by Governor Philips, Captain White, and by a Dutch navigator, ſo long ago as in 1697. Governor Philips deſcribes the black ſwan as a very noble bird, larger than the common ſwan, and equally beautiful in form. Mr White indeed ſays, that its ſize is not quite equal to that of the European ſwan; but both theſe authors agree with Captain Vancouver in mentioning ſome white feathers in its wings.

SWAN *Iſland*, in the Diſtrict of Maine, divides the waters of Kennebeck river, three miles from the Chops of Merry-Meeting Bay. It is 7 miles long, and has a navigable channel on both ſides, but that to the eaſt is moſtly uſed. It was the ſeat of the ſachem *Kenebis*. The river itſelf probably took its name from the race of Sagamores of the name of Kenebis.—*Morſe.*

(c) By the anonymous author of the life of Catharine II.

SWANNANO, the eaſt head water of French Broad river, in Tenneſſee. Alſo the name of a ſettlement within about 60 miles of the Cherokee nation.—*ib.*

SWANNSBOROUGH, the chief town of Onſlow county, Wilmington diſtrict, N. Carolina.—*ib.*

SWANSEY, a townſhip in Cheſhire county, New-Hampſhire, adjoining Cheſterfield on the E. 97 miles weſterly of Portſmouth. It was incorporated in 1753, and contains 1157 inhabitants.—*ib.*

Swansey, a townſhip in Briſtol county, Maſſachuſetts, containing 1784 inhabitants. It was incorporated in 1667, and lies 51 miles ſoutherly of Boſton.—*ib.*

SWANTON, a townſhip of Vermont, Franklin county, on the E. bank of Lake Champlain, on the ſouth ſide of Mitchiſcoui river. This townſhip has a cedar ſwamp in the N. W. part of it, towards Hog Iſland. The Miſchiſcoui is navigable for the largeſt boats 7 miles, to the falls in this town.—*ib.*

SWANTOWN, in Kent county, Maryland, is about 3 miles S. eaſterly of Georgetown.—*ib.*

SWEDESBOROUGH, a ſmall poſt-town of New-Jerſey, Glouceſter county, on Racoon Creek, 3 miles from its mouth, in Delaware river, 11 S. by W. of Woodbury, 17 N. by E. of Salem, and 20 ſoutherly of Philadelphia.—*ib.*

SWEET SPRINGS, in Virginia, 30 miles E. by N. of Greenbriar, 93 weſt of Staunton, and 380 S. W. of Philadelphia. In the ſettlement around theſe ſprings, a poſt-office is kept.—*ib.*

SWETARA, or *Swatara*, a river of Pennſylvania, which falls into the Suſquehannah from the N. E. about 7 miles S. E. of Harriſburg.—*ib.*

SWINTON (John), a very celebrated Engliſh antiquary, was a native of the county of Cheſter, the ſon of John Swinton of Bexton in that county, gent. He was born in 1703. The circumſtances of his parents were probably not affluent, as he was entered at Oxford in the rank of a ſervitor at Wadham college. This was in October 1719. It may be preſumed, that he recommended himſelf in that ſociety by his talents and behaviour, as on June 30. 1723, he was elected a ſcholar on a Cheſhire foundation in the college. In the December following, he took his firſt degree in arts. Before he became maſter of arts (which was on December 1. 1726), he had choſen the church for his profeſſion, and was ordained deacon by the biſhop of Oxford, May 30. 1725; and was afterwards admitted to prieſt's orders on May 28. 1727. He was not long without ſome preferment, being admitted to the rectory of St Peter le Bailey in Oxford (a living in the gift of the crown), under a ſequeſtration, and inſtituted to it in February 1728. In June, the ſame year, he was elected a fellow of his college; but, deſirous probably to take a wider view of the world, he accepted, not long after, the appointment of chaplain to the Engliſh factory at Leghorn, to which he had been choſen. In this ſituation he did not long enjoy his health; and leaving it on that account, he was at Florence in April 1733, where he attended Mr Coleman, the Engliſh envoy, in his laſt moments. Mr Swinton returned thro' Venice and Vienna; and, in company with ſome Engliſh gentlemen of fortune, viſited Preſburgh in Hungary, and was preſent at one of their aſſemblies.

It is poſſible that he had not quitted England in the ſummer of 1730, for he was elected a Fellow of the Royal Society in June that year, and admitted about three months later. It was probably while he was abroad that he was admitted into ſome foreign ſocieties; namely, the academy *degli Apatiſti* at Florence, and the *Etruſcan Academy* of Cortona. On his return, he ſeems to have taken up his abode at Oxford, where he reſided all the latter part of his life, and was for many years chaplain to the gaol in that city. It may be preſumed that he married in 1743; it was then, at leaſt, that he gave up his fellowſhip. In 1759 he became bachelor of divinity: in 1767, he was elected *Cuſtos Archivorum*, or keeper of the univerſity records: and, on April 4. 1777, he died; leaving no children. His wife ſurvived till 1784, and both were buried, with a very ſhort and plain inſcription, in the chapel of Wadham college.

It remains to take notice of the moſt important monuments of a literary man's life, his publications. Theſe were numerous and learned, but not of great magnitude. He publiſhed, 1. "De Linguæ Etruriæ Regalis vernacula Diſſertatio," 4to, 19 pages, Oxon. 1738. 2. "A critical eſſay concerning the words Δαιμων and Δαιμονιον, occaſioned by two late inquiries into the meaning of the demoniacs in the New Teſtament," 8vo, London, 1739. 3. "De priſcis Romanorum literis diſſertatio," 4to, 20 pages; Oxon. 1746. 4. "De Primogenio Etruſcorum Alphabeto, diſſertatio," Oxon. 1746. 5. "Inſcriptiones Citieæ: ſive in binas Inſcriptiones Phœnicias, inter rudera Citii nuper repertas, conjecturæ. Accedit de nummis quibuſdam Samaritanis et Phœniciis, vel inſolitam præ ſe literaturam ferentibus, vel in lucem hactenus non editis, diſſertatio," 4to, 87 pages, Oxon. 1750. 6. "Inſcriptiones Citieæ: ſive in binas alias Inſcriptiones Phœnicias, inter rudera Citii nuper repertas, conjecturæ," 4to, 19 pages. 7. "De nummis quibuſdam Samaritanis et Phœniciis, vel inſolitam præ ſe literaturam ferentibus, vel in lucem hactenus non editis, diſſertatio ſecunda," 4to, 36 pages. 8. "Metilia: ſive de quinario Gentis Metiliæ, è nummis vetuſtis cæteroquin minimum notæ, diſſertatio," 4to, 22 pages, Oxon. 1750. 9. Several diſſertations publiſhed in the Philoſophical Tranſactions of the Royal Society. As, "A diſſertation upon a Parthian Coin; with characters on the reverſe reſembling thoſe of the Palmyrenes," vol. xlix. p. 593. "Some remarks on a Parthian Coin, with a Greek and Parthian legend, never before publiſhed," vol. l. p. 16. "A diſſertation upon the Phœnician numeral characters anciently uſed at Sidon," vol. l. p. 791. "In nummum Parthicum hactenus ineditum conjecturæ," vol. li. p. 683. "A diſſertation upon a Samnite Denarius, never before publiſhed," vol. lii. p. 28. "An account of a ſubærated Denarius of the Plætorian family, adorned with an Etruſcan inſcription on the reverſe, never before publiſhed or explained," vol. lxii. p. 60. "Obſervations upon five ancient Perſian Coins, ſtruck in Paleſtine or Phœnicia before the diſſolution of the Perſian empire," vol. lxii. p. 345. Other papers by him may be found in the general-index to the Philoſophical Tranſactions. 10. A part of the Ancient Univerſal Hiſtory, contained in the ſixth and ſeventh volumes of that great work. The particulars of this piece of literary hiſtory were communicated by Dr Johnſon to Mr Nichols, in a paper printed in the Gentleman's Magazine for December 1784, p. 892. The original of that paper, which affords a ſtrong proof of the

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the ſteady attachment of Johnſon to the intereſts of literature, has been, according to his deſire, depoſited in the Britiſh Muſeum. The letter is as follows:

"To Mr Nichols.

"The late learned Mr Swinton of Oxford having one day remarked, that one man, meaning, I ſuppoſe, no man but himſelf, could aſſign all the parts of the Univerſal Hiſtory to their proper authors, at the requeſt of Sir Robert Chambers, or of myſelf, gave the account which I now tranſmit to you in his own hand, being willing, that of ſo great a work the hiſtory ſhould be known, and that each writer ſhould receive his due proportion of praiſe from poſterity. I recommend to you to preſerve this ſcrap of literary intelligence, in Mr Swinton's own hand, or to depoſite it in the Muſeum, that the veracity of the account may never be doubted.—I am, Sir, your moſt humble ſervant,

Dec. 6, 1784. SAM. JOHNSON."

The paper alluded to, beſides ſpecifying ſome parts written by other perſons, aſſigns the following diviſions of the hiſtory to Mr Swinton himſelf. "The hiſtory of the Carthaginians, Numidians, Mauritanians, Gætulians, Garamantes, Melano-Gætulians, Nigritæ, Cyrenaica, Marmarica, the Regio Syrtica, Turks, Tartars, and Moguls, Indians, and Chineſe, a diſſertation on the peopling of America, and one on the independency of the Arabs.

In the year 1740, Mr Swinton was involved in a law-ſuit, in conſequence of a letter he had publiſhed. It appears from a paper of the time,* that a letter from the Rev. Mr Swinton, highly reflecting on Mr George Baker, having fallen into the hands of the latter, the court of King's Bench made the rule abſolute for an information againſt Mr Swinton. Theſe two gentlemen were alſo engaged for ſome time in a controverſy at Oxford; which took its riſe from a matter relative to Dr Thiſtlethwaite, ſome time warden of Wadham, which then attracted much attention. Mr Swinton had the manners, and ſome of the peculiarities, often ſeen in very recluſe ſcholars, which gave riſe to many whimſical ſtories. Among the reſt, there is one mentioned by Mr Boſwell, in the Life of Johnſon, as having happened in the year 1754. Johnſon was then on a viſit in the univerſity of Oxford. "About this time (he ſays) there had been an execution of two or three criminals at Oxford, on a Monday. Soon afterwards, one day at dinner, I was ſaying that Mr Swinton, the chaplain of the gaol, and alſo a frequent preacher before the univerſity, a learned man, but often thoughtleſs and abſent, preached the condemnation ſermon on repentance, before the convicts, on the preceding day, Sunday; and that, in the cloſe, he told his audience, that he ſhould give them the remainder of what he had to ſay on the ſubject the next Lord's day. Upon which, one of our company, a doctor of divinity, and a plain matter-of-fact man, by way of offering an apology for Mr Swinton, gravely remarked, that he had probably preached the ſame ſermon before the univerſity. Yes, Sir (ſays Johnſon); but the univerſity were not to be hanged the next morning!"

SYDNEY, in Lincoln county, Diſtrict of Maine, is 37 miles from Pownalborough, 98 from Hallowell, and 203 from Boſton.—*Morſe.*

SYPOMBA, an iſland on the coaſt of Brazil, in S. America, about 7 leagues N. E. of St John's Iſland, and N. W. from a range of iſlands which form the great Bay of Para.—*ib.*

* *The Champions, or Evening Advertiſer,* June 17th 1740.

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TAAWIRRY, one of the two ſmall iſlands within the reef of the iſland of Otaheite, in the South Pacific Ocean. Theſe iſlands have anchorage within the reef that ſurrounds them.—*Morſe.*

TABAGO, an iſland in the bay of Panama, about 4 miles long, and 3 broad. It is mountainous, and abounds with fruit trees. N. lat. 7 50, W. long. 60 16.—*ib.*

TABASCO, an iſland in the S. W. part of the Gulf of Mexico, and at the bottom of the Gulf of Campeachy, is about 36 miles long, and about 7 broad; and on it is built the town of Tabaſco, in lat. 17 40 N. and long. 93 39 W. It is the capital of a rich province of its name, and is ſituated at the mouth of the river Grijalva, 90 miles E. of Eſpirito Santo, and 160 S. E. of Mexico. It is not large, but is well built, and is conſiderably enriched by a conſtant reſort of merchants and tradeſmen at Chriſtmas. The river Grijalva divides itſelf near the ſea into two branches, of which the weſtern falls into the river Tabaſco, which riſes in the mountains of Chiapa, and the other continues its courſe till within 4 leagues of the ſea, where it ſubdivides, and ſeparates the iſland from the continent. Near it are plains which abound with cattle and other animals, particularly the mountain cow, ſo called from its reſembling that creature, and feeding on a ſort of moſs found on the trees near great rivers.—*ib.*

TABOGUILLA, or *Little Tabago,* in the bay of Panama, a ſmaller iſland than Tabago, and near it. The channel between them is narrow but good, through which ſhips paſs to Point Chama or Nata.—*ib.*

TABOOYAMANOO, a ſmall iſland in the South Pacific Ocean, ſubject to Huaheine, one of the Society Iſlands.—*ib.*

TACAMES, a bay on the coaſt of Peru, in lat. about 1 6 N. and 3 leagues to the N. E. of Point Galera.—*ib.*

TACHIFI *Point,* on the coaſt of New Mexico, is 18 miles from the town of Pomaro.—*ib.*

TACQUET (Andrew), a Jeſuit of Antwerp, who died in 1660. He was a moſt laborious and voluminous writer in mathematics. His works were collected, and printed at Antwerp, in one large volume in folio, 1669.

TADOUSAC,

TADOUSAC, a ſmall place in Lower Canada, at the mouth of the river Saguenay, or Sagaenai, on the north ſhore of the river St Lawrence. Here a conſiderable trade has been carried on with the Indians, they bringing their furs and exchanging them for European cloths, utenſils and trinkets. It is 98 miles below Quebec. N. lat. 48, W. long. 67 35.—*Morse.*

TAENSA, a ſettlement in Weſt-Florida, on the eaſtern channel of the great Mobile river, on a high bluff, and on the ſcite of an ancient Indian town, which is apparent from many artificial mounds of earth and other ruins. It is about 30 miles above Fort Conde, or city of Mobile, at the head of the bay. Here is a delightful and extenſive proſpect of ſome flouriſhing plantations. The inhabitants are moſtly of French extraction, and are chiefly tenants. The *myrica inodora*, or wax-tree, grows here to the height of 9 or 10 feet, and produces excellent wax for candles.—*ib.*

TAGAPIPE, a caſtle erected on a point of land in the Bay of All Saints, in Brazil. It is pretty conſiderable, and adds greatly to the ſtrength of St Salvadore.—*ib.*

TAGO, *Sant*, or *Tiego Point*, on the weſt coaſt of New-Mexico, is between Salagua and the White Rock.—*ib.*

TAHOORA, or *Tahoorowa*, one of the ſmalleſt of the Sandwich Iſlands, 3 leagues from the ſouth-weſt part of Mowee. N. lat. 20 38, W. long. 156 33.—*ib.*

TALAHASOCHTE, a conſiderable town of the Seminole Indians, ſituated on the elevated eaſt banks of the Little river St John, near the bay of Apalache, in the Gulf of Mexico, about 75 miles from the Alachua ſavanna. Here are near 30 habitations conſtructed of frame work, and covered with the bark of the cypreſs tree, after the mode of Cuſcowilla, and a ſpacious and neat council-houſe. Theſe Indians have large handſome canoes, which they form out of the trunks of cypreſs trees, ſome capacious enough to hold 20 or 30 warriors. In theſe they deſcend the river on trading and hunting expeditions on the ſea-coaſt, iſlands, and keys, quite to the Point of Florida; and ſometimes croſs the Gulf and go to the Bahama Iſlands, and even to Cuba, and bring returns of ſpirituous liquors, coffee, ſugar, and tobacco.—*ib.*

TALAPOOSEE, or *Tallapooſe*, the great north-eaſt branch of the Alabama or Mobile river, in Florida. It riſes in the high lands near the Cherokees, and runs through the high country of the Oakſuſkee tribes in a weſtwardly direction, and is full of rocks, falls, and ſhoals, until it reaches the Tuckabatches, where it becomes deep and quiet; from thence the courſe is weſt about 30 miles to Little Tallaſie, where it unites with the Cooſa, or Cooſa Hatcha. At Coolſome, near Otaſſe, a Muſcogulge town, this river is 300 yards broad, and about 15 or 20 feet deep. The water is clear and ſalubrious. In moſt maps the lower part of this river is called *Oakfuſkie.*—*ib.*

TALASSEE, or *Tallaſſee*, a county conſiſting of a tract of land bounded by Eaſt-Florida on the ſouth, from which the head water of St Mary's river partly ſeparates it; north by Alatamaha river, eaſt by Glynn and Camden counties, and weſterly by a line which extends from the weſtern part of Ekanſanoka Swamp, in a N. E. direction till it ſtrikes the Alatamaha river, at the mouth of the Oakmulgee. It is ſaid that the State of Georgia had extinguiſhed the Indian claim to this tract of land, but it has been given up to the Indians as the price of peace; for which that State makes a claim for 50,000l. with intereſt, ſince the treaty, upon the United States.—*ib.*

Talaſſee, a town of the Upper Creeks, in the Georgia weſtern territory, on the ſouth ſide of Talapooſe river, diſtant about 3 days journey from Apalachicola on Chata Uche river. It is alſo called Big Talaſſee.—*ib.*

TALBERT's *Iſland*, on the coaſt of Georgia, the north point of which is in lat. about 30 44 N. where St Mary's river empties into the ocean between this iſland and Amelia Iſland on the N.—*ib.*

TALBOT, an iſland on the coaſt of Eaſt-Florida. The ſands at the entrance of Naſſau lie three miles off the ſouth-eaſt point of Amelia Iſland, and from the N. E. point of Talbot Iſland.—*ib.*

Talbot, a county of Maryland, on the eaſtern ſhore of Cheſapeak Bay, bounded E. by Choptank river, which divides it from Caroline county, and ſouth by the ſame river, which ſeparates it from Dorceſter. It contains 13,084 inhabitants, of whom 4,777 are ſlaves. The ſoil is rich and fertile.—*ib.*

TALCAGUAMA, a cape on the coaſt of Chili, 11 leagues N. E. of the iſland of St Mary, and 2 northward of Port St Vincent.—*ib.*

Talcaguama *Port*, is 6 miles within the above point of its name, and is one of two good roads in the bay of Conception.—*ib.*

TALLOW *Point*, a mark for anchoring in the harbour of Port Royal, on the ſouth coaſt of the iſland of Jamaica.—*ib.*

Tallow-Tree. See Croton (*Encycl.*), where, however, we have fallen into a miſtake, which it is here our duty to correct. We learn from Sir George Staunton, that the candles made of the vegetable tallow are firmer than thoſe made of animal tallow, and free from all offenſive ſmell, contrary to what was raſhly ſaid in the article referred to. They are not, however, equal to thoſe of wax or ſpermaceti; but the latter of theſe ſubſtances is not within the reach of the Chineſe, and the art of blanching the former is little known to them. The tallow tree is ſaid to have been tranſplanted to Carolina, and to flouriſh there as well as in China.

TALOO *Harbour*, on the N. ſide of the iſland of Eimeo, in the South Pacific Ocean. S. lat. 17 30, W. long. 150.—*Morse.*

TALOOK, an Arabic word, which ſignifies literally attachment, connection, dependence. In Bengal, however, where it occurs perpetually in the enumeration of the diſtricts and ſubdiviſions of that province contained in the inſtitutes of Akber, it ſignifies a tenure of land. Hence the *talook* of Caſhinat, the *talook* of Meheys the headman, the *talook* of Ahmed Khan, &c. See *A Diſſertation concerning the Landed Property of Bengal*, by Sir Charles Rouſe Boughton.

TALOOKDAR, the poſſeſſor of a talook.

TALOOKDARY, tenure of a talookdar.

TALUS, or Talun, in architecture, the inclination or ſlope of a work; as of the outſide of a wall, when its thickneſs is diminiſhed by degrees, as it riſes in height, to make it the firmer.

Talus, in fortification, means alſo the ſlope of a work, whether of earth or maſonry.

TAMALEQUE, an inland city, in the province of St Martha, on the coaſt of Terra Firma. It is ſituated on the banks of Magdalena river, and carries on a trade on that river from New Granada to Carthagena, from whence it is diſtant above 150 miles.—*Morſe.*

TAMAR, *Cape*, is the N. W. point of a large bay and harbour on the N. ſhore of the Straits of Magellan, within the cape. The ſouth eaſt point of the bay is named Providence. S. lat. 52 51, W. long. 75 40. —*ib.*

TAMARIKA, an iſland on the coaſt of Brazil, northward of Pernambuco, and about 24 miles in length. It is 2 miles N. of Pornovello, and has a harbour and good freſh water. S. lat. 7 56, W. long. 35 5.—*ib.*

TAMASCAL, the name given in California to a kind of ſand bath employed by the natives in the cure of the venereal diſeaſe. It is prepared by ſcooping a trench in the ſand, two feet wide, one foot deep, and of a length proportioned to the ſize of the patient; a fire is then made through the whole extent of it, as well as upon the ſand which was dug out of the hollow. When the whole is thoroughly heated, the fire is removed, and the ſand ſtirred about, that the warmth may be equally diffuſed. The ſick perſon is then ſtripped, laid down in the trench, and covered up to his chin with heated ſand. In this poſition a very profuſe ſweat ſoon breaks out, which gradually diminiſhes according as the ſand cools. The patient then riſes and bathes in the ſea, or the neareſt river. This proceſs is repeated till a complete cure is obtained. While the patient is undergoing the operation of the tamaſcal, he drinks a conſiderable quantity of a warm ſudorific, prepared by the decoction of certain herbs, chiefly of the ſhrub called by the Spaniards GOUVERNANTE, which ſee in this *Supplement*.

TAMATAMQUE, called by the Spaniards, *Villa de las Palmas*, a town of Santa Martha, in Terra Firma, S. America; ſituated on the eaſtern bank of Santa Martha river, about 28 miles above Teneriffe.—*Morſe.*

TAMBO *Land*, on the coaſt of Peru, extends about 9 miles from Cape Remate to Playa de los Perdrices, or the Partridge Strand, about 9 miles. There is clear and good anchorage upon this ſtrand, under a row of high, ridgy, and ſandy hills. On making them from the ſea, they reſemble a covey of partridges juſt riſing; hence the name of the coaſt.—*ib.*

TAMMANY's, *St*, a village on Dan river, in Virginia, 15 miles from Gill's Bridge, 7 from Mecklenburg court-houſe, 42 from Halifax court-houſe, in North-Carolina, and 398 from Philadelphia.—*ib.*

TAMMANY, *Fort St*, or *St Mary's*, at the mouth of St Mary's river, on the S. line of Georgia.—*ib.*

TAMMATA-PAPPA, a low iſland of the N. Pacific Ocean, ſaid to be near the Sandwich Iſlands.—*ib.*

TAMOU *Iſland*, one of the ſmall iſlets which form part of the reef on the E. ſide of Ulietea Iſland, one of the Society Iſlands.—*ib.*

TAMWORTH, a townſhip in the northern part of Strafford county, New-Hampſhire. It was incorporated in 1766, and contains 266 inhabitants.—*ib.*

TAN is a ſubſtance found in moſt vegetables, which, not having hitherto been reſolved into component parts, is therefore conſidered as ſimple. See *Vegetable and Animal* SUBSTANCES in this *Suppl.*

TANBANTY *Bay*, on the coaſt of Brazil, has a good road, ſheltered by the ſands that lie off within 3 miles of the ſhore. It is one of thoſe places between Point Negro and Point Lucna.—*Morſe.*

TANEYTOWN, a ſmall poſt-town of Maryland, in Frederick county, between Piney Run and Pine Creek, on which are a number of mills and ſome iron-works. It lies 27 miles N. by E. of Frederickſtown, and 121 W. S. W. of Philadelphia.—*ib.*

TANELA, or *Tonela*, a tract of ſhore on the weſt coaſt of Mexico, on the N. Pacific Ocean, commencing near the Sugar Loaf Hill, about 6 miles within the land, bearing N. E. and S. W. with the burning mountain of Lacatecolula, about 18 miles up the river Limpa —*ib.*

TANGOLA, an iſland in the N. Pacific Ocean, and on the weſt coaſt of New Mexico; affording good anchorage and plenty of wood and water. It is about 60 miles weſtward of Guatimala. It is alſo named *Tangolatango* —*ib.*

TANGUEY, or *Tonguey*, on the coaſt of Chili, in the S. Pacific Ocean, is 30 miles from Limari, and in lat. 30 30 S —*ib.*

TANNING is an art, of which a full account, according to the general practice in London and its vicinity, has been given under the proper title in the *Encyclopædia*. But ſince that article was written, the ſuperior knowledge which has been obtained of the tanning principle, as well as of the compoſition of the ſkins of animals (See *Vegetable and Animal* SUBSTANCES, *Suppl.*), has ſuggeſted to ſcientific artiſts various methods of ſhortening the proceſs by which leather is manufactured. M. Seguin is ſaid to have thrown much light upon the art of the tanner as it is practiſed in France; and in 1795 Mr William Deſmond obtained a patent for practiſing Seguin's method in England. He obtains the tanning principle by digeſting oak-bark, or other proper material, in cold water, in an apparatus nearly ſimilar to that uſed in the ſaltpetre works. That is to ſay, the water which has remained upon the powdered bark for a certain time, in one veſſel, is drawn off by a cock, and poured upon freſh tan. This is again to be drawn off, and poured upon other freſh tan; and in this way the proceſs is to be continued to the fifth veſſel. The liquor is then highly coloured, and marks, as Mr Deſmond ſays, from ſix to eight degrees on the hydrometer for ſalts. He calls this the tanning lixivium. The criterion to diſtinguiſh its preſence is, that it precipitates glue from its aqueous ſolution, and is alſo uſeful to examine how far other vegetable ſubſtances, as well as oak bark, may be ſuitable to the purpoſe of tanning. The ſtrong tanning liquor is to be kept by itſelf. It is found by trials with the glue, that the tanning principle of the firſt digeſter which receives the clear water, is, of courſe, firſt exhauſted. But the ſame tan will ſtill give a certain portion of the aſtringent principle, or gallic lixivium, to water. The preſence of this principle is aſcertained by its ſtriking a black colour when added to a ſmall quantity of the ſolution of vitriol of iron or green copperas. As ſoon as the water from the digeſter ceaſes to exhibit this ſign, the tan is exhauſted, and muſt be replaced with new. The gallic lixivium is reſerved for the purpoſe of taking the hair off from hides.

Strong hides, after waſhing, cleaning, and fleſhing, in ning.

in the uſual way, are to be immerſed for two or three days in a mixture of gallic lixivium and one thouſandth part by meaſure of denſe vitriolic acid. By this means the hair is detached from the hides, ſo that it may be ſcraped off with a round knife. When ſwelling or raiſing is required, the hides are to be immerſed for ten or twelve hours in another vat filled with water and one five-hundredth part of the ſame vitriolic acid. The hides being then repeatedly waſhed and dreſſed, are ready for tanning; for which purpoſe they are to be immerſed for ſome hours in a weak tanning lixivium of only one or two degrees; to obtain which, the latter portions of the infuſions are ſet apart; or elſe ſome of that which has been partly exhauſted by uſe in tanning. The hides are then to be put into a ſtronger lixivium, where in a few days they will be brought to the ſame degree of ſaturation with the liquor in which they are immerſed. The ſtrength of the liquor will by this means be conſiderably diminiſhed, and muſt therefore be renewed. When the hides are by this means completely ſaturated, that is to ſay, perfectly tanned, they are to be removed, and ſlowly dried in the ſhade.

Calf ſkins, goat-ſkins, and the like, are to be ſteeped in lime-water after the uſual fleſhing and waſhing. Theſe are to remain in the lime water, which contains more lime than it can diſſolve, and requires to be ſtirred ſeveral times a day. After two or three days, the ſkins are to be removed, and perfectly cleared of their lime by waſhing and preſſing in water. The tanning proceſs is then to be accompliſhed in the ſame manner as for the ſtrong hides, but the lixivium muſt be conſiderably weaker. Mr Deſmond remarks, that lime is uſed inſtead of the gallic lixivium for ſuch hides as are required to have a cloſe grain; becauſe the acid mixed with that lixivium always ſwells the ſkins more or leſs; but that it cannot with the ſame convenience be uſed with thick ſkins, on account of the conſiderable labour required to clear them of the lime; any part of which, if left, would render them harſh and liable to crack. He recommends, likewiſe, as the beſt method to bring the whole ſurface of the hides in contact with the lixivium, that they ſhould be ſuſpended vertically in the fluid by means of tranſverſe rods or bars, at ſuch a diſtance as not to touch each other. By this practice much of the labour of turning and handling may be ſaved.

Mr Deſmond concludes his ſpecification, by obſerving, that in ſome caſes it will be expedient to mix freſh tan with the lixivium; and that various modifications of ſtrength, and other circumſtances, will preſent themſelves to the operator. He affirms that, in addition to the great ſaving of time and labour in this method, the leather, being more completely tanned, will weigh heavier, wear better, and be leſs ſuſceptible of moiſture than leather tanned in the uſual way; that cords, ropes, and cables, made of hemp or ſpeartery, impregnated with the tanning principle, will ſupport much greater weights without breaking, be leſs liable to be worn out by friction, and will run more ſmoothly on pulleys; inſomuch that, in his opinion, it will render the uſe of tar in many caſes, particularly in the rigging of ſhips, unneceſſary; and, laſtly, that it may be ſubſtituted for the preſervation of animal food inſtead of ſalt.

Mr Nicholſon, from whoſe Philoſophical Journal we have taken this account of Mr Deſmond's method of tanning, made ſome very proper enquiries at one of the firſt manufacturing houſes in the borough of Southwark, concerning its value. He was told by one of the partners, that the principle upon which the new proceſs is founded had been long known to them; but that they preferred the old and ſlower method, becauſe the hides are found to feed and improve in their quality by remaining in the pit. He could gain no ſatisfactory information of what is meant by this feeding and improving; and, without taking upon us to decide between the advantages peculiar to Deſmond's method and thoſe of the common practice, we cannot help ſaying that this objection of the tanner at Southwark appears to us to be that of a man who either underſtands not the principles of his own art, or has ſome reaſon for oppoſing the progreſs of improvement, if it do not originate in his own houſe.

Tanſa,
||
Tappan.

TANSA, a branch of the river Mobile, 3 leagues below the Alabama branch.—*Morſe.*

TAOO, the moſt ſoutherly of the Friendly Iſlands, in the South Pacific Ocean, is about 10 leagues in circuit, and ſo elevated as to be ſeen at the diſtance of 12 leagues.—*ib.*

TAOUKA, an iſland in the S. Pacific Ocean, one of the Society Iſlands. S. lat. 14 30, W. long. 145 9.—*ib.*

TAPANATEPEQUE, a town of Guaxaca, and audience of Mexico. It ſtands at the foot of the mountains Quelenos, at the bottom of a bay in the South Sea; and is repreſented as one of the pleaſanteſt places in this country, and the beſt furniſhed with fleſh, fowl and fiſh, being contiguous both to the ſea and a river, amidſt rich farms, each of which being ſtocked with between 1000 and 4000 head of cattle. Here are delightful walks of orange, lemon, citron, fig and other fruit trees.—*ib.*

TAPARICA, a long iſland on the weſt ſide of the entrance into the Bay of All Saints, in Brazil.—*ib.*

TAPAYO, a town of S. America, on the ſouth bank of Amazon river, eaſterly from the mouth of Madeira river.—*ib.*

TAPPAHANNOCK, a poſt-town and port of entry of Virginia, in Eſſex county, between Dangerfield on the north and Hoſkin's creek on the ſouth, and on the ſouth-weſt bank of Rappahannock river, 54 miles from Richmond, 67 from Williamſburg, and 263 from Philadelphia. It is alſo called *Hobbes' Hole*. It is laid out regularly, on a rich plain, and contains about 100 houſes, an epiſcopal church, a court-houſe, and gaol; but is rather unhealthy. The exports for one year, ending Sept. 30, 1794, amounted to the value of 160,673 dollars.—*ib.*

TAPPAN, a town of New-York, in the ſouth-eaſt part of Orange county, about 4 miles from the north bank of Hudſon's river, and at the ſouth end of the Tappan ſea. Here is a reformed Proteſtant Dutch church. Major Andre, adjutant-general of the Britiſh army ſuffered here as a ſpy, Oct. 2, 1780; having been taken on his way to New-York, after concerting a plan with major-general Arnold for the delivering up Weſt Point to the Britiſh.—*ib.*

TAPPAN *Sea*, or *Bay*, a dilatation of Hudſon's river, in the State of New-York, oppoſite the town of Tappan, and 35 miles north of New-York city; immediately ſouth of and adjoining Haverſtraw Bay. It is 10 miles long and 4 wide; and has on the north ſide fine quarries of a reddiſh free-ſtone, uſed for buildings and grave-ſtones; which are a ſource of great wealth to the proprietors.—*ib.*

TAPUYES, or *Tapayos*, the moſt conſiderable nation of the native Brazilians, in S. America, that have not yet been conquered by the Portugueſe. They ſpread themſelves a great way inland to the weſt, and are divided into a great number of tribes or cantons, all governed by their own kings.—*ib.*

TARAHUMARY, a province of New Spain, 1200 miles diſtant from the capital.—*ib.*

TARBOROUGH, a poſt-town of N. Carolina; ſituated on the weſt ſide of Tar river, about 85 miles from its mouth, 140 from Ocrecock Inlet, 110 north by eaſt of Fayetteville, 37 ſouth of Halifax, 112 ſouth by weſt of Peterſburg in Virginia, and 420 ſouth-weſt of Philadelphia. It contains about 50 houſes, a court-houſe and gaol. Large quantities of tobacco, of the Peterſburg quality, pork, beef, and Indian corn are collected here for exportation.—*ib.*

TARIJA, or *Chichas*, one of the fourteen juriſdictions belonging to the archbiſhopric of Plata, in Peru. It lies about 90 miles ſouth of Plata; and its greateſt extent being about 105 miles. The temperature of the air is various: in ſome parts hot, and in others cold; ſo that it has the advantage of corn, fruits and cattle. This country abounds every where in mines of gold and ſilver; but eſpecially that part called Chocayas. Between this province and the country inhabited by the wild Indians, runs the large river Tipuanys, the ſands of which being mixed with gold, are waſhed, in order to ſeparate the grains of that metal.—*ib.*

TAR, or *Pamlico River*, a conſiderable river of N. Carolina, which purſues a ſouth-eaſt courſe, and paſſing by Waſhington, Tarborough and Greenville, enters Pamlico Sound in lat. 35 22 N. It is navigable for veſſels drawing 9 feet water to the town of Waſhington, 40 miles from its mouth; and for ſcows or flats carrying 30 or 40 hhds. 50 miles farther to the town of Tarborough. According to the report of a committee, appointed by the legiſlature of N. Carolina, to inquire into the practicability of improving the inland navigation of the State, it is ſuppoſed that this river, and Fiſhy Creek, a branch of it, may be made navigable 40 miles above Tarborough.—*ib.*

TARPAULIN *Cove*, on the coaſt of Maſſachuſetts, lies about 3 leagues N. N. W. of Holmes's Hole, in Martha's Vineyard. It is high water here, at full and change, two minutes after 10 o'clock; 5 fathoms water.—*ib.*

TARRYTOWN, a conſiderable village in Phillips's Manor, New-York, on the eaſt ſide of Hudſon's river, 30 miles N. of New-York city. Under a large tree, which is ſhewn to travellers as they paſs the river, is the ſpot where the unfortunate Major Andre was taken; who was afterwards executed at Tappan.—*ib.*

TARTE's *Rapids, La*, on the river Ohio, lie 40 miles above the mouth of the Great Kanhaway.—*ib.*

TASSIE (James) modeller, whoſe hiſtory is intimately connected with a branch of the fine arts in Britain, was born in the neighbourhood of Glaſgow of obſcure parents; and began his life as a country ſtone maſon, without the expectation of ever riſing higher. Going to Glaſgow on a fair day, to enjoy himſelf with his companions, at the time when the Foulis's were attempting to eſtabliſh an academy for the fine arts in that city, he ſaw their collection of paintings, and felt an irreſiſtible impulſe to become a painter. He removed to Glaſgow; and in the academy acquired a knowledge of drawing, which unfolded and improved his natural taſte. He was frugal, induſtrious, and perſevering; but he was poor, and was under the neceſſity of devoting himſelf to ſtone-cutting for his ſupport: not without the hopes that he might one day be a ſtatuary if he could not be a painter. Reſorting to Dublin for employment, he became known to Dr Quin, who was amuſing himſelf in his leiſure hours with endeavouring to imitate the precious ſtones in coloured paſtes, and take accurate impreſſions of the engravings that were on them.

That art was known to the ancients; and many ſpecimens from them are now in the cabinets of the curious. It ſeems to have been loſt in the middle ages; was revived in Italy under Leo X. and the Medici family at Florence; became more perfect in France under the regency of the Duke of Orleans, by his labours and thoſe of Homberg. By thoſe whom they inſtructed as aſſiſtants in the laboratory it continued to be practiſed in Paris, and was carried to Rome. Their art was kept a ſecret, and their collections were ſmall. It is owing to Quin and to Taſſie that it has been carried to ſuch high perfection in Britain, and attracted the attention of Europe.

Dr Quin, in looking out for an aſſiſtant, ſoon diſcovered Taſſie to be one in whom he could place perfect confidence. He was endowed with fine taſte: he was modeſt and unaſſuming: he was patient; and poſſeſſed the higheſt integrity. The Doctor committed his laboratory and experiments to his care. The aſſociates were fully ſucceſsful; and found themſelves able to imitate all the gems, and take accurate impreſſions of the engravings.

As the Doctor had followed the ſubject only for his amuſement, when the diſcovery was completed, he encouraged Mr Taſſie to repair to London, and to devote himſelf to the preparation and ſale of thoſe paſtes as his profeſſion.

In 1766 he arrived in the Capital. But he was diffident and modeſt to exceſs; very unfit to introduce himſelf to the attention of perſons of rank and of affluence: beſides, the number of engraved gems in Britain was ſmall; and thoſe few were little noticed. He long ſtruggled under difficulties which would have diſcouraged any one who was not poſſeſſed of the greateſt patience, and the warmeſt attachment to the ſubject. He gradually emerged from obſcurity, obtained competence; and what to him was much more, he was able to increaſe his collection, and add higher degrees of perfection to his art. His name ſoon became reſpected, and the firſt cabinets in Europe were open for his uſe; and he uniformly preſerved the greateſt attention to the exactneſs of the imitation and accuracy of the engraving, ſo that many of his paſtes were ſold on the Continent by the fraudulent for real gems. His fine taſte led him to be peculiarly careful of the impreſſion; and he uniformly deſtroyed thoſe with which he was in the leaſt diſſatisfied. The art has been practiſed of late by others; and many thouſands of paſtes have been ſold as Taſſie's, which he would have conſidered as injurious to his fame. Of the fame of others he was not envious; for

for he uniformly ſpake with frankneſs in praiſe of thoſe who executed them well, though they were endeavouring to rival himſelf.

To the ancient engravings he added a numerous collection of the moſt eminent modern ones; many of which approach in excellence of workmanſhip, if not in ſimplicity of deſign and chaſtity of expreſſion, to the moſt celebrated of the ancient. Many years before he died he executed a commiſſion for the late Empreſs of Ruſſia, conſiſting of about 15,000 different engravings (See Gem, *Encycl.*). At his death, in 1799, they amounted to near 20,000; a collection of engravings unequalled in the world. Every lover of the fine arts muſt be ſenſible of the advantage of it for improvement in knowledge and in taſte. The collection of Feloix at Paris conſiſted of 1800 articles; and that of Dehn at Rome of 2500.

For a number of years, Mr Taſſie practiſed the modelling of portraits in wax, which he afterwards moulded and caſt in paſte. By this, the exact likeneſs of many eminent men of the preſent age will be tranſmitted to poſterity as accurately as thoſe of the philoſophers and great men have been by the ancient ſtatuaries. In taking likeneſſes he was, in general, uncommonly happy; and it is remarkable, that he believed there was a certain kind of inſpiration (like that mentioned by the poets) neceſſary to give him full ſucceſs. The writer of this article, in converſing with him repeatedly on the ſubject, always found him fully perſuaded of it. He mentioned many inſtances in which he had been directed by it; and even ſome, in which, after he had laboured in vain to realize his ideas on the wax, he had been able, by a ſudden flaſh of imagination, to pleaſe himſelf in the likeneſs ſeveral days after he had laſt ſeen the original.

He poſſeſſed alſo an uncommonly fine taſte in architecture, and would have been eminent in that branch if he had followed it.

In private life Mr Taſſie was univerſally eſteemed for his uniform piety, and for the ſimplicity, the modeſty, and benevolence, that ſhone in the whole of his character.

TASTELESS Earth (*aguſt erde*), the name given by Profeſſor Trommſdorff to a new ſimple earth, which he diſcovered in the Saxon beryl. It is diſtinguiſhed (he ſays) from other earths by the following properties: It is white, and totally inſoluble in water. In a freſh ſtate, when moiſtened with water, it is ſomewhat ductile. In the fire it becomes tranſparent and very hard, ſo as to ſcratch glaſs, but remains inſipid and inſoluble in water. The burnt earth diſſolves very eaſily in acids, and produces with them peculiar ſalts; which are entirely devoid of taſte; and hence he gave it the name of *taſteleſs earth*. Fixed alkalies do not diſſolve this earth either in the dry or in the wet way; and it is equally inſoluble with the carbonic acid and with cauſtic ammonia. It has a greater affinity to the oxalic than to other acids. Profeſſor Trommſdorff informs us, that a full account of this earth, accompanied with an accurate deſcription, by Dr Bernhardi, of the foſſil in which it is found, will appear in the firſt part of the eighth volume of his *Journal of Pharmacy*.

TATMAGOUCHE, or *Tatamagouche*, a place in Nova Scotia, on a ſhort bay which ſets up ſoutherly from the Straits of Northumberland; about 25 miles from Onſlow, and 21 from the iſland of St John's. It has a very good road for veſſels, and is known alſo under the name *Tatamaganabou*.—*Morſe.*

TATNAM *Cape*, the eaſtern point of Haye's river, in Hudſon's Bay. N. lat. 57 35, W. long. 91 30.—*ib.*

TATOO-E-TEE, an iſland in the S. Pacific Ocean, one of the Ingraham Iſles, called by Capt. Ingraham, *Franklin*, and by Capt. Roberts, *Blake*. It lies 7 or 8 leagues W. by N. of Nooheeva.—*ib.*

TAUMACO, an iſland about 1250 leagues from Mexico, where De Quiros ſtayed ten days. One of the natives named above 60 iſlands round it. Some of the names follow, viz. Manicola, Chicayano, larger than Taumaco, and about 300 miles from it; Guatopo, 150 miles from Taumaco; Tucopia, at 100, where the country of Manicola lay. The natives had, in general, lank hair; ſome were white, with red hair; ſome mulattoes, with curled hair; and ſome woolly like negroes. De Quiros obſerves that in the bay of Philip and James, were many black ſtones, very heavy, ſome of which he carried to Mexico, and upon aſſaying them, they found ſilver.—*ib.*

TAUNTON, a river which empties into Narraganſet Bay, at Tiverton, oppoſite the N. end of Rhode-Iſland. It is formed by ſeveral ſtreams which riſe in Plymouth county, Maſſachuſetts. Its courſe is about 50 miles from N. E. to S. W. and it is navigable for ſmall veſſels to Taunton.—*ib.*

Taunton, a poſt-town of Maſſachuſetts, and the capital of Briſtol county, ſituated on the W. ſide of Taunton river, and contains 40 or 50 houſes, compactly built, a church, court-houſe, gaol, and an academy, which was incorporated in 1792. It is 36 miles S. by E. of Boſton, 21 E. of Providence, 21 northerly of Bedford, and 312 N. E. of Philadelphia. The townſhip of Taunton was taken from Raynham, and incorporated in 1639, and contains 3,804 inhabitants. A ſlitting-mill was erected here in 1776, and for a conſiderable time the only one in Maſſachuſetts, and was then the beſt ever built in America. The annual production of 3 mills now in this townſhip is not leſs than 800 tons of iron; about 50 tons are cut, and 300 hammered into nails, and the remainder is wrought into ſpades and ſhovels; of which laſt article 200 dozen are rolled annually. Mr Samuel Leonard rolled the firſt ſhovel ever done in America. This invention reduces the price one half. Wire-drawing, and rolling ſheet-iron for the tin manufacture, are executed here. There is alſo a manufactory of a ſpecies of ochre, found here, into a pigment of a dark yellow colour.—*ib.*

Taunton *Bay*, in the Diſtrict of Maine, is ſix miles from Frenchman's Bay.—*ib.*

TAVERNIER *Key*, a ſmall iſle, one of the Tortugas, 2 miles from the S. W. end of Key Largo, and 5 N. E. of Old Matacombe. To the northward of this laſt iſland is a very good road.—*ib.*

TAWANDEE *Creek*, in Northumberland county, Pennſylvania, runs N. E. into the eaſt branch of Suſquehannah, 12 miles ſouth eaſt of Tioga Point.—*ib.*

TAWAS, an Indian tribe in the N. W. Territory, 18 miles up the Miami of the Lake. Another tribe of this name, inhabit higher up the ſame river, at a place called the Rapids.—*ib.*

TAWIXTWI, *The Engliſh*, or *Pique Town*, in the N. W. Territory, is ſituated on the N. W. bank of the Great

Teaches, ‖ Telica.

Tellic ‖ Tempe-ment of Scale Muſic

Great Miami, 35 miles below the 5 mile portage, to the Miami of the Lake, and 68 S. W. by S. of Miami Fort. It was taken in 1752, by the French. N. lat. 40 41, W. long. 84 48.—*ib.*

TEACHES, a ſmall iſland cloſe to the eaſt ſhore of Northampton county, Virginia, and N. by E. of Parramore Iſland.—*ib.*

TECOANTEPEC, or *Tecuantepeque*, or *Teguantepeque*, a large bay on the weſt coaſt of New-Mexico, on the ſouth ſide of the Iſthmus from the Bay or Gulf of Campeachy, in the S. W. part of the Gulf of Mexico; and bounded weſt by Point Angelos. The port town of its name, lies in lat. 15 28 N. and long. 96 15 W.—*ib.*

TEETH, of various ſorts of machines, as of mill wheels, &c. Theſe are often called cogs by the workmen; and by working in the pinions, rounds, or trundles, the wheels are made to turn one another. Mr Emerſon (in his Mechanics, prop. 25.) treats of the theory of teeth, and ſhews that they ought to have the figure of epicycloids, for properly working in one another.

TEHUACAN, a city of New-Spain, 120 miles S. E. of Mexico.—*Morſe.*

TEKAWY, in Bengal, money advanced by government to the proprietors or cultivators of land to aſſiſt them under circumſtances of diſtreſs.

TEKY *Sound*, on the coaſt of Georgia, to the ſouth of Savannah river, is a capacious road, where a large fleet may anchor in from 10 to 14 fathoms water, and be land-locked, and have a ſafe entrance over the bar of the river. The flood tide is generally 7 feet.—*Morſe.*

TELESCOPE, is an inſtrument which has been ſo completely deſcribed in the *Encyclopædia*, that it is introduced into this place merely to notice an ingenious ſuggeſtion of Mr Nicholſon's for improving the achromatic teleſcope, by adding an artificial iris to the object glaſs. Suppoſe (ſays he) a braſs ring to ſurround the object end of the teleſcope, and upon this let eight or more triangular ſlips of braſs be fixed, ſo as to revolve on equi-diſtant pins paſſing through each triangle near one of its corners. If the triangles be ſlided inwards upon each other, it may readily be apprehended that they will cloſe the aperture; and if they be all made to revolve or ſlide backwards alike, it is clear that their edges will leave an octagonal aperture, greater or leſs according to circumſtances. The equable motion of all the triangles may be produced either by pinions and one concave toothed wheel, or by what is called ſnail-work. Another kind of iris, more compact, may be made, by cauſing thin elaſtic ſlips of braſs to ſlide along parallel to the tube, and be conducted each through a ſlit in a braſs cap which ſhall lead them acroſs the aperture in a radical direction. It is probable alſo that the artiſt, who ſhall carry theſe hints into effect, may alſo think of ſeveral other methods.

This thought occurred to the author, from contemplating the contraction and dilatation of the iris of the eye, according as we look at an object more or leſs luminous. Theſe variations are ſo great, that in the obſervable variations of the human eye, the aperture is thirty times as large at one time as at another, whilſt in the cat the proportion is greater than a hundred to one.

TELICA, a burning mountain on the weſt coaſt of New-Mexico, ſeen at N. N. E. over the ridge of Toſta. It is one of the range of volcanoes which are ſeen along the coaſt from Fort St John's to Tecaantepeck, and is 18 miles from Volcano del Vejo, or Old Man's Burning Mountain; and there are two others between them, but not ſo eaſily diſcerned, as they do not often emit ſmoke.—*Morſe.*

TELLICO *Block-Houſe*, in Tenneſſee, ſtands on the north bank of Tenneſſee river, immediately oppoſite the remains of Fort Loudon; and is computed to be 900 miles, according to the courſe of the river, from its mouth, and 32 miles ſouth of Knoxville in Tenneſſee. It was erected in 1794, and has proved a very advantageous military poſt. It has lately been eſtabliſhed, by the United States, as a trading poſt with the Indians.—*ib.*

TELLIGUO, *Great*, in the State of Tenneſſee, was ſituated on the eaſt ſide of the Chota branch of Tenneſſee river, about 25 miles N. E. of the mouth of Holſton river, and 5 ſouth of the line which marked Lord Granville's limits of Carolina. This was a Britiſh factory, eſtabliſhed after the treaty of Weſtminſter, in 1729.—*ib.*

TELLIGUO *Mountains*, lie ſouth of the above place, and ſeem to be part of what are now called the Great Iron Mountains, in the lateſt maps.—*ib.*

I Introduction.

TEMPERAMENT OF THE SCALE OF MUSIC. When the conſiderate reader reflects on the large and almoſt numberleſs diſſertations on this ſubject, by the moſt eminent philoſophers, mathematicians, and artiſts, both of ancient and modern times, and the important points which divided, and ſtill divide, their opinions, he will not ſurely expect, in a Work like our's, the deciſion of a queſtion which has hitherto eluded their reſearches. He will rather be diſpoſed, perhaps, to wonder how a ſubject of this nature ever acquired ſuch importance in the minds of perſons of acknowledged talents (for ſurely no perſon will refuſe this claim to Pythagoras, to Ariſtotle, Euclid, Ptolemy, Galileo, Wallis, Euler, and many others, who have written elaborate treatiſes on the ſubject); and his ſurpriſe will increaſe, when he knows that the treatiſes on the ſcale of muſic are as numerous and voluminous in China, without any appearance of their being borrowed from the ingenious and ſpeculative Greeks.

The ingenious, in all cultivated nations, have remarked the great influence of muſic; and they found no difficulty in perſuading the nations that it was a gift of the gods. Apollo and his ſacred choir are perhaps the moſt reſpectable inhabitants of the mythological heavens of the Greeks. Therefore all nations have conſidered muſic as a proper part of their religious worſhip. We doubt not but that they found it fit for exciting or ſupporting thoſe emotions and ſentiments which were ſuited to adoration, thanks, or petition. Nor would the Greeks have admitted muſic into their ſerious dramas, if they had not perceived that it heightened the effect. The ſame experience made them employ it as an aid to military enthuſiaſm; and it is recorded as one of the reſpectable accompliſhments of Epaminondas, that he had the muſical inſtructions of the firſt maſters, and was eminent as a performer.

Thus was the ſtudy of muſic ennobled, and recommended to the attention of the greateſt philoſophers. Its cultivation was held an object of national concern, and its profeſſors were not allowed to corrupt it in order to gratify the faſtidious taſte of the luxurious or the ſenſualiſt, who ſought from it nothing but amuſement. But its influence was not confined to theſe public purpoſes; and, while the men of ſpeculation found in muſic an inexhauſtible fund of employment for their genius and penetration, and their poets felt its aid in their compoſitions, it was hailed by perſons of all ranks as the ſoother of the cares and anxieties, and ſweetener of the labours of life. *O Phœbi decus!—laborum dulce lenimen.* Poor Ovid, the victim of what remained of good in the cold heart of Octavius, found its balm.

Exul eram (ſays he): *requieſque mihi, non fama petita eſt.*
Mens intenta ſuis ne foret uſque malis.
Hoc eſt cur cantet vinctus quoque compede foſſor,
Indocili numero cum grave mollit opus.
Cantet et innitens limoſæ pronus arenæ
Adverſo tardam qui trahit amne ratem,
Quique ferens pariter lentos ad pectora remos,
In numerum pulſâ brachia verſat aquâ.
Feſſus ut incubuit baculo, ſaxove reſedit
Paſtor; arundineo carmine mulcet oves.
Cantantis pariter, pariter data penſa trahentis
Fallitur ancillæ, decipiturque labor.

It is chiefly in this humble department of muſical influence that we propoſe at preſent to lend our aid. What has been ſaid in the article Music, *Encycl.* is ſufficient for informing the reader of what is received as the ſcale of muſic, and the inequality of its different ſteps, the tones major and minor, ſemitone, comma, &c. We ſhall only obſerve, that what is there delivered on temperament by M. d'Alembert, after Rameau, bears the evident mark of uncertainty or want of confidence in the principle adopted as the rule of temperament; and we have learned, ſince the printing of that article, that the inſtructions there delivered have not that perſpicuity and preciſion that are neceſſary for enabling a perſon to execute the temperament recommended by Rameau; that is, to tune a keyed inſtrument with certainty, according to that ſyſtem or conſtruction of the ſcale.

If ſuch be the caſe, we are in ſome meaſure diſappointed; becauſe we ſelected that treatiſe of D'Alembert as the performance of a man of great eminence as a mathematician and philoſopher, aiming at public inſtruction more than his own fame, by this elementary abſtract of the great work of the moſt eminent muſician in France.

To be able to tune a harpſichord with certainty and accuracy, ſeems an indiſpenſable qualification of any perſon worthy of the name of a *muſician.* It would certainly be thought an unpardonable deficiency in a violin performer if he could not tune his inſtrument; yet we are well informed, that many profeſſional performers on the harpſichord cannot do it, or cannot do it any other way than by uncertain and painful trial, and, as it were, groping in the dark; and that the tuning of harpſichords and organs is committed entirely to tuners by profeſſion. This is a great inconvenience to perſons reſiding in the country; and therefore many take leſſons from the profeſſed harpſichord tuners, who alſo profeſs to teach this art. We have been preſent during ſome of theſe leſſons; but it did not appear to us that the inſtructions were ſuch as could enable the ſcholar to tune an inſtrument when alone, unleſs the leſſons had been ſo frequent as to form the ear to an inſtantaneous judgment of tune by the ſame habit that had inſtructed the teacher. There ſeemed to be little principle that could be treaſured up and recollected when wanted.

Temperament of the Scale of Muſic.

3
Yet Nature furniſhes abundant means of doing this.

Yet we cannot help thinking that there are phenomena or facts in muſic, ſufficiently preciſe to furniſh principles of abſolute certainty for enabling us to produce temperaments of the ſcale which ſhall have determined characters, and among which we may chooſe ſuch a one as ſhall be preferable to the others, according to the purpoſes we have in view; and we think that theſe principles are of ſuch eaſy application, that any perſon, of a moderate ſenſibility to juſt intonation, may, without much knowledge or practice in muſic, tune his harpſichord with all deſirable accuracy. We propoſe to lay theſe before the reader. We might content ourſelves with ſimply giving the practical rules deduced from the principles; but it is ſurely more deſirable to perceive the validity of the principles. This will give us confidence in the deduced rules of practice. In the employment of ſacred muſic, an inſpired writer counſels us to ſing, not only "with the heart, but with the underſtanding alſo." We may, without irreverence, recommend the ſame thing here. Let us therefore attend a little to the dictate of untutored Nature, and ſee how ſhe teaches all mankind to form the ſcale of melody.

4
All nations ſing by one ſcale.

It is a moſt remarkable fact, that, in all nations, however they may differ in the ſtructure of that chaunt which we call the accent, or tone, or twang, in the colloquial language of a particular nation, or in the favourite phraſes or paſſages which are moſt frequent in their ſongs, all men make uſe of the ſame riſes and falls, or inflections of voice, in their muſical language or airs. We have heard the ſongs of the Iroquois, the Cherokee, and the Eſquimaux, of the Carib, and the inhabitant of Paraguay; of the African of Negroland and of the Cape, and of the Hindoo, the Malay, and the native of Otaheite—and we found none that made uſe of a different ſcale from our own, although ſeveral ſeemed to be very ſorry performers by any ſcale. There muſt be ſome natural foundation for this uniformity. We may never diſcover this; but we may be fortunate enough to diſcover facts in the phenomena of ſound which invariably accompany certain modifications of muſical ſentiment. If we ſucceed, we are intitled to ſuppoſe that ſuch inſeparable companions are naturally connected; and to conclude, that if we can inſure the appearance of thoſe facts in ſound, we ſhall alſo give occaſion to thoſe muſical ſentiments or impreſſions.

5
Muſical pitch, what?

There is a quality in lengthened or continued ſound which we call its pitch or note, by which it may be accounted ſhrill or hoarſe. It may be very hoarſe in the beginning, and during its continuance it may grow more and more ſhrill by imperceptible gradations. In this caſe we are ſenſible of a kind of progreſs from the one ſtate of ſound to the other. Thus, while we gently draw the bow acroſs the ſtring of a baſs viol, if we at the ſame time ſlide the finger ſlowly along the ſtring, from the nut towards the bridge, the ſound, from being hoarſe, becomes gradually acute or ſhrill. Hoarſe and ſhrill therefore are not different qualities, although they have different names, but are different ſtates or degrees of the ſame quality, like cold and heat, near and far,

early

early and late, or, what is common to all theſe, little and great. A certain ſtate of the air is accounted neither hot nor cold. All ſtates on one ſide of this are called warm, or hot; and all on the other are cold. In like manner, a certain ſound is the boundary between thoſe that are called hoarſe and thoſe called ſhrill. The chemiſt is accuſtomed to ſay, that the temperature of a body is higher when it is warmer, and lower when colder. In like manner, we are accuſtomed to ſay, that a perſon raiſes or depreſſes the pitch of his voice when it becomes more ſhrill or more hoarſe. The ancient Greeks, however, called the ſhriller ſounds *low*, and the hoarſer ſounds *high*; probably becauſe the hoarſer ſounds are generally ſtronger or louder, which we are alſo accuſtomed to conſider as higher. In common language, a low pitch of voice means a faint ſound, but in muſical language it means a hoarſer ſound. The ſound that is neither hoarſe nor ſhrill is ſome ordinary pitch of voice, but without any preciſe criterion.

6 The change obſerved in the pitch of a violin ſtring, when the finger is carried along the finger-board with a continued motion, is alſo continuous; that is, not by ſtarts: we call it gradual, for want of a better term, although gradual properly means *gradatim*, by degrees, ſteps, or ſtarts, which are not to be diſtinguiſhed in this experiment. But we may make the experiment in another way. After ſounding the open ſtring, and while the bow is yet moving acroſs it, we may put down the finger about $1\frac{2}{3}$ inches from the nut. This will change the ſound into one which is *ſenſibly* ſhriller than the former, and there is a manifeſt ſtart from the one to the other. Or we may put down the finger $2\frac{1}{2}$ inches from the nut; the ſound of the open ſtring will change to a ſhriller ſound, and we are ſenſible that this change or ſtep is greater than the former. Moreover, we may, while drawing the bow acroſs the ſtring, put down one finger at $1\frac{2}{3}$ inches, and, immediately after, put down another finger at $2\frac{1}{2}$ inches from the nut. We ſhall have three ſounds in ſucceſſion, each more ſhrill than the preceding, with two manifeſt ſteps, or ſubſultory changes of pitch.

7 Now ſince the laſt ſound is the ſame as if the ſecond had not been ſounded, we muſt conceive the ſum of the two ſucceſſive changes as equivalent or equal to the change from the firſt to the third. This change ſeems ſomehow to include the other two, and to be made up of them, as a whole is made up of its parts, or as $2\frac{1}{2}$ inches are made up of $1\frac{2}{3}$ and $\frac{5}{6}$ of an inch, or as the ſum 15 is made up of 10 and 5.

8 We have a notion of ſomething like an interval between the notes of muſic.

Thus it happens that thinking perſons conceive ſomething like or analogous to a diſtance, or interval, between theſe ſounds. It is plain, however, that there can be no real diſtance or ſpace interpoſed between them; and it is not eaſy to acquire a diſtinct notion of the bulk or magnitude of theſe intervals. This conception is purely figurative and analogical; but the analogy is very good, and the obſervation of it, or conjecture about it, has been of great ſervice in the ſcience of muſic, by making us ſearch for ſome preciſe meaſure of thoſe manifeſt intervals of muſical ſounds.

9 It muſt now be remarked, that it is in this reſpect alone that ſounds are ſuſceptible of muſic. Nor are all ſounds poſſeſſed of this quality. The ſmack of a whip, the exploſion of a muſket, the ruſhing of water or wind, the ſcream of ſome animals, and many other ſounds, both momentary and continuous, are mere noiſes; and can neither be called hoarſe nor ſhrill. But, on the other hand, many ſounds, which differ in a thouſand circumſtances of loudneſs, ſmoothneſs, mellowneſs, &c. which make them pleaſant or diſagreeable, have this quality of muſical pitch, and may thus be compared. The voice of a man or woman, the ſound of a pipe, a bell, a ſtring, the voice of an animal, nay, the ſingle blow on an empty caſk—may all have one pitch, or we may be ſenſible of the interval between them. We can, in all caſes, tighten or ſlacken the ſtring of a violin, till the moſt uninformed hearer can pronounce with certainty that the pitch is the ſame. We are indebted to the celebrated Galileo for the diſcovery of that phyſical circumſtance in all thoſe ſounds which communicates this remarkable quality to them, and even enables us to induce it on any noiſe whatever, and to determine, with the utmoſt preciſion, the muſical pitch of the ſound, and the interval between any two ſuch ſounds. Of this we ſhall ſpeak fully hereafter; and at preſent we only obſerve, that two ſounds, having the ſame pitch, are called UNISONS by muſicians, or are ſaid to be in *uniſon* to one another.

10 When two untaught men attempt to ſing the ſame air together, they always ſing in uniſon, unleſs they expreſsly mean to ſing in different pitches of voice. Nay, it is an extremely difficult thing to do otherwiſe, except in a few very peculiar caſes. Alſo, when a man and woman, wholly uninſtructed in muſic, attempt to ſing the ſame air, they alſo *mean* to ſing the ſame muſical notes through the whole air; and they generally imagine that they do ſo. But there is a manifeſt difference in the ſounds which they utter, and the woman is ſaid to ſing more SHRILL, and the man more HOARSE. A very plain experiment, however, will convince them that they are miſtaken. *N. B.* We are now ſuppoſing that the performers have ſo much of a muſical ear, and flexible voice, as to be able to ſing a common ballad, or a pſalm tune, with tolerable exactneſs, and that they can prolong or dwell upon any particular note when deſired.

Let them ſing the common pſalm tune called St David's, in the ſame way that they practiſe at church; and when they have done it two or three times, in order to fix their voices in tune, and to feel the general impreſſion of the tune, let the woman hold on in the firſt note of the tune, which we ſuppoſe to be *g*, while the man ſings the firſt three in ſucceſſion, namely *g*, *d*, $\bar{g}$. He will now perceive, that the laſt note ſung by himſelf is the ſame with that ſung by the woman, and which ſhe thinks that ſhe is ſtill holding on in the firſt note of the tune. Let this be repeated till the performance becomes eaſy. They will then perceive the perfect ſameneſs, in reſpect of muſical pitch, of the woman's firſt note of this tune and the man's third note. Some difference, however, will ſtill be perceived; but it will not be in the pitch, but in the ſmoothneſs, or clearneſs, or other agreeable quality of the woman's note.

11 There ſeven ſ in the tural ſ and eig notes.

When this is plainly perceived, let the man try by what continued ſteps he muſt raiſe his pitch, in order to arrive at the woman's note from his own. If he is accuſtomed to common ballad ſinging, he will have no great difficulty in doing this; and will find that, beginning with his own note, and ſinging gradually up, his eighth note will be the woman's note. In ſhort, if two flutes be taken, one of which is twice as long as the

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the other, and if the man ſing in uniſon with the large flute, the woman, while ſinging, as ſhe thinks, the ſame notes with the man, will be found to be ſinging in uniſon with the ſmaller flute.

ave.

This is a remarkable and moſt important fact in the phenomena of muſic. This interval, comprehending and made up of ſeven ſmaller intervals, and requiring eight ſounds to mark its ſteps, is therefore called an OCTAVE. Now, ſince the female performer follows the ſame dictates of natural ear in ſinging her tune that the man follows in ſinging his, and all hearers are ſenſible that they are ſinging the ſame tune, it neceſſarily follows, that the two ſerieſes of notes are perfectly ſimilar, though not the ſame: For there muſt be the ſame interval of an octave between any ſtep of the lower octave and the ſame ſtep of the upper one. In whatever way, therefore, we conceive one of theſe octaves to be parcelled out by the different ſteps, the partition of both muſt be ſimilar. If we repreſent both by lines, theſe lines muſt be ſimilarly divided. Each partial interval of the one muſt bear the ſame relation to the whole, or to any other interval, as its ſimilar interval in the other octave bears to the whole of that octave, or to the other correſponding interval in it.

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Farther, we muſt now obſerve, that although this ſimilarity of the octaves was firſt obſerved or diſcovered by means of the ordinary voices of man and woman, and is a legitimate inference from the perfect ſatiſfaction that each feels in ſinging what they think the ſame notes, this is not the only foundation or proof of the ſimilarity. Having acquired the knowledge of that phyſical circumſtance, on which the pitch of muſical ſounds depends, we can demonſtrate, with all the rigour of geometry, that the ſeveral notes in the man and woman's octave *muſt* have the ſame relation to their reſpective commencements, and that theſe two great intervals are ſimilarly divided. But farther ſtill, we can demonſtrate that this ſimilarity is not confined to theſe two octaves. This may even be proved, to a certain extent, by the ſame original experiment. Many men can ſing two octaves in ſucceſſion, and there are ſome rare examples of perſons who can ſing three. This is more common in the female voice. This being the caſe, it is plain that there will be two octaves common to both voices; and therefore four octaves in ſucceſſion, all ſimilar to each other. The ſame ſimilarity may be obſerved in the ſounds of inſtruments which differ only by an octave. And thus we demonſtrate that all octaves are ſimilar to each other. This ſimilarity does not conſiſt merely in the ſimilarity of its diviſion. The ſound of a note and its octave are ſo like each other, that if the ſtrength or loudneſs be properly adjuſted, and there be no difference in kind, or other circumſtances of clearneſs, ſmoothneſs, &c. the two notes, when ſounded together, are indiſtinguiſhable, and appear only like a more brilliant note. They coaleſce into one ſound. Nay, moſt clear mellow notes, ſuch as theſe of a fine human voice, really contain each two notes, one of which is octave to the other.

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We ſaid that this reſemblance of octaves is an important fact in the ſcience of muſic. We now ſee why it is ſo. The whole ſcale of muſic is contained in one octave, and all the reſt are only repetitions of this ſcale. And thus is the doctrine of the ſcale of melody brought within a very moderate compaſs, and the problem is reduced to that of the repartition of a ſingle octave, and ſome attention to the junction with the ſimilar ſcales of the adjoining octaves. This partition is now to be the ſubject of diſcuſſion.

Temperament of the Scale of muſic.

15
Melodies, or tunes or airs, were the firſt muſic.

In the infancy of ſociety and cultivation, it is probable that the melodies or tunes, which delighted the ſimple inhabitants were equally ſimple. Being the ſpontaneous effuſions of individuals, perhaps only occaſional, and never repeated, they would periſh as faſt as produced. The airs were probably connected with ſome of the rude rhimes, or gingles of words, which were bandied about at their feſtivals; or they were aſſociated with dancing. In all theſe caſes they muſt have been very ſhort, conſiſting of a few favourite paſſages or muſical phraſes. This is the caſe with the common airs of all ſimple people to this day. They ſeldom extend beyond a ſhort ſtanza of poetry, or a ſhort movement of dancing. The artiſt who could compoſe and keep in mind a piece of conſiderable length, muſt have been a great rarity, and a minſtrel fit for the entertainment of princes; and therefore much admired, and highly rewarded: his excellencies were almoſt incommunicable, and could not be preſerved in any other way but by repeated performance to an attentive hearer, who muſt alſo be an artiſt, and muſt patiently liſten, and try to imitate; or, in ſhort, to get the tune by heart. It muſt have been a long time before any diſtinct notion was formed of the relation of the notes to each other. It was perhaps impoſſible to recollect to day the preciſe notes of yeſterday. There was nothing in which they were fixed till inſtrumental muſic was invented. This has been found in all nations; but it appears that long continued cultivation is neceſſary for raiſing this from a very ſimple and imperfect ſtate. The moſt refined inſtrument of the Greek muſicians was very far below our very ordinary inſtruments. And, till ſome method of notation was invented, we can ſcarcely conceive how any determined partition of the octave could be made generally known.

16
KEY-NOTE or FUNDAMENTAL.

Accordingly, we find that it was not till after a long while, and by very rude and awkward ſteps, that the Greeks perceived that the whole of muſic was compriſed in the octave. The firſt improved lyre had but four ſtrings, and was therefore called a TETRACHORD; and the firſt flutes had but three holes, and four notes; and when more were added to the ſcale, it was done by joining two lyres and two flutes together. Even this is an inſtructive ſtep in the hiſtory of muſical ſcience: For the four ſounds of the inſtrument have a natural ſyſtem, and the awkward and groping attempts to extend the muſic, by joining two inſtruments, the ſcale of the one following, or being a continuation of that of the other, pointed out the DIAPASON or *totality* of the octave, and the relation of the whole to a principal ſound, which we now call the *fundamental* or *key*, it being the loweſt note of our ſcale, and the one to which the other notes bear a continual reference. It would far exceed the limits of this Work to narrate the ſucceſſive changes and additions made by the Greeks in their lyre; yet would this be a very ſure way of learning the natural formation of our muſical ſcale. We muſt refer our readers to Dr Wallis's Appendix to his edition of the Commentary of Porphyrius in Ptolemy's Harmonics, as by far the moſt perſpicuous account that is extant of the Greek muſic. We ſhall pick out from among their different

Temperament of the Scale of Muſic.

ent attempts ſuch plain obſervations as will be obvious to the feelings of any perſon who can ſing a common tune.

17
The octave is naturally divided into two TETRACHORDS.

Let ſuch a perſon firſt ſing over ſome plain and cheerful, or at leaſt not mournful, tune, ſeveral times, ſo as to retain a laſting impreſſion of the chief note of the tune, which is generally the laſt. Then let him begin, on the ſame note, to ſing in ſucceſſion the riſing ſteps of the ſcale, pronouncing the ſyllables *do, re, mi, fa, ſol, la, ſi, do*. He will perhaps obſerve, that this chaunt naturally divides itſelf into two parts or phraſes, as the muſicians term it. If he does not, of himſelf, make this remark, let him ſing it, however, in that manner, pauſing a little after the note *fa*. Thus, *do, re, mi, fa; ſol, la, ſi, do.—Do, re, mi, fa; ſol, la, ſi, do.*

Having done this ſeveral times, and then repeated it without a pauſe, he will become very ſenſible of the propriety of the pauſe, and of this natural diviſion of the octave. He will even obſerve a conſiderable ſimilarity between theſe two muſical phraſes, without being able, at firſt, to ſay in what it conſiſts.

18
The ſteps of the ſcale are unequal, and the two tetrachords are ſimilar.

Let him now ſtudy each phraſe apart, and try to compare the magnitude of the changes of ſound; or ſteps which he makes in riſing from *do* to *re*, from *re* to *mi*, and from *mi* to *fa*. We apprehend that he will have no difficulty in perceiving, after a few trials, that the ſteps *do re*, and *re mi*, are ſenſibly greater than the ſtep *mi fa*. We feel the laſt ſtep as a ſort of ſlide; as an attempt to make as little change of pitch as we can. Once this is perceived, it will never be forgotten. This will be ſtill more clearly perceived, if, inſtead of theſe ſyllables, he uſe only the vowel *a*, pronounced as in the word *hall*, and if he ſing the ſteps, ſliding or ſlurring from the one to the other. Taking this method, he cannot fail to notice the ſmallneſs of the third ſtep.

19
Let the ſinger farther conſider, whether he does not feel this phraſe muſical or agreeable, making a ſort of tune or chaunt, and ending or cloſing agreeably after this ſlide of a ſmall, or, as it were, half ſtep. It is generally thought ſo; and is therefore called a CLOSE, a CADENCE, when we end with a half ſtep aſcending.

20.
Let the ſinger now reſume the whole ſcale, ſinging the four laſt notes *ſol, la, ſi, do,* louder than the other four, and calling off his attention from the low phraſe, and fixing it on the upper one. He will now be able to perceive that this, like the other, has two conſiderable ſteps; namely, *ſol la* and *la ſi*, and then a ſmaller ſtep, *ſi do*. A few repetitions will make this clear, and he will then be ſenſible of the nature of the ſimilarity between theſe two phraſes, and the propriety of this great diviſion of the ſcale into the intervals *do, fa*, and *ſol, do*, with an interval *fa, ſol* between them.

This was the foundation of the tetrachords or lyres of four ſtrings, of the Greeks. Their earlieſt muſic or modulation ſeems to have extended no farther than this phraſe. It pleaſed them, as a ring of four bells pleaſes many country pariſhes.

21
CLOSE OR CADENCE.

The ſinger will perceive the ſame ſatisfaction with the cloſe of this ſecond phraſe as with that of the former: and if he now ſing them both, in immediate ſucceſſion, with a ſlight pauſe between, we imagine that he will think the cloſe or cadence on the upper *do* even more ſatisfactory than that on the *fa*. It ſeems to us to complete a tune. And this impreſſion will be greatly heightened, if another perſon, or an inſtrument, ſhould ſound the lower *do*, while he cloſes on the upper *do* its octave. *Do* ſeems to be expected, or looked for, or ſought after. We take *ſi* as a ſtep to *do*, and there we reſt.

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Thus does the octave appear to be naturally compoſed of ſeven ſteps, of which the firſt, ſecond, fourth, fifth, and ſixth, are more conſiderable, and the third and ſeventh very ſenſibly ſmaller. Having no direct meaſures of their quantity, nor even a very diſtinct notion of what we mean by their quantity, magnitude, or bulk, we cannot pronounce with any certainty, whether the greater ſteps are equal or unequal; and we preſume them to be equal. Nor have we any diſtinct notion of the proportion between the larger and ſmaller ſteps. In a looſe way we call them half notes, or ſuppoſe the riſe from *mi* to *fa*, or from *ſi* to *do*, to be one-half of that from *do* to *re*, or from *re* to *mi*.

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Accordingly, this ſeems to have been all the muſical ſcience attained by the Greek artiſts, or thoſe who did not profeſs to ſpeak philoſophically on the ſubject. And even after Pythagoras publiſhed the diſcovery which he had made, or more probably had picked up among the Chaldeans or Egyptians, by which it appeared, that accurate meaſures of ſounds, in reſpect to gravity and acuteneſs, were attainable, it was affirmed by Ariſtoxenus, a ſcholar of Ariſtotle, and other eminent philoſophers, that theſe meaſures were altogether artificial, had no connection with muſic, and that the ear alone was the judge of muſical intervals. The artiſt had no other guide in tuning his inſtrument; becauſe the ratios, which were ſaid to be inherent in the ſounds (though no perſon could ſay how), were never perceived by the ear. The juſtice of this opinion is abundantly confirmed by the awkward attempt of the Greeks to improve the lyre by means of theſe boaſted ratios. Inſtead of illuſtrating the ſubject, they ſeem rather to have brought an additional obſcurity upon it, and threw it into ſuch confuſion, that although many voluminous diſſertations were written on it, and on the compoſition of their muſical ſcale, the account is ſo perplexed and confuſed, that the firſt mathematicians and artiſts of Europe acknowledge, that the whole is an impenetrable myſtery. Had the philoſophers never meddled with it, had they allowed the practical muſicians to conſtruct and tune their inſtruments in their own way, ſo as to pleaſe their ear, it is ſcarcely poſſible that they ſhould not have hit on what they wanted, without all the embarraſſment of the chromatic and enharmonic ſcales of the lyre. It is ſcarcely poſſible to contrive a more cumberſome method of extending the ſimple ſcale of Nature to every caſe that could occur in their muſical compoſitions, than what aroſe from the employment of the muſical ratios. This ſeems a bold aſſertion; but we apprehend that it will appear to be juſt as we proceed.

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The practical muſicians could not be long of finding the want of ſomething more than the mere diatonic ſcale of their inſtruments. As they were always accompanied by the voice, it would often happen that a lyre or flute, perfectly tuned, was too low or too high for the voice that was to accompany it. A ſinger can pitch his tune on any ſound as a key; and if this be too high for the ſinger who is to accompany him, he can take it on a lower note. But a lyriſt cannot do this. Suppoſe his inſtrument two notes too low, and that his accompanyiſt can only ſing it on the key which is pera- of the e of fic.

is the *ſi* of the lyre. Should the lyriſt begin it on that key, his very firſt ſtep is wrong, being but a half ſtep, whereas it ſhould be a whole one. In ſhort, all the ſteps but one will be found wrong, and the lyriſt and ſinger will be perpetually jarring. This is an evident conſequence of the inequality of the fourth and ſeventh ſteps to the reſt. And if the other ſteps, which we imagine to be equal, be not exactly ſo, the diſcordance will be ſtill greater.

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The method of remedying this is very obvious. If the intervals *mi fa* and *ſi do*, are half notes, we need only to interpoſe other ſounds in the middle between each of the whole notes; and then, in place of ſeven unequal ſteps, we ſhall have twelve equal ones, or twelve intervals, each of them equal to a ſemitone. The lyre thus conſtructed will now ſuit any voice whatever. It will perfectly reſemble our keyed inſtruments, the harpſichord, or organ, which have twelve ſeemingly equal intervals in the octave. Accordingly, it appears that ſuch additions were practiſed by the muſicians of Greece, and approved of by Ariſtoxenus, and by all thoſe who referred every thing to the judgment of the ear. And we are confident that this method would have been adopted, if the philoſophers had had leſs influence, and if the Greeks had not borrowed their religious ceremonies along with their muſical ſcience. Both of theſe came from the ſame quarter; they came united; and it was ſacrilegious to attempt innovations. The doctrine of muſical ratios was an occupation only for the refined, the philoſophers; and by ſubjecting muſic to this myſterious ſcience, it became myſterious alſo, and ſo much the more venerable. The philoſophers ſaw, that there was in Nature a certain inſcrutable connection between mathematical ratios and thoſe intervals which the ear reliſhed and required in melody: but they were ignorant of the nature and extent of this connection.

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What is this connection, or what is meant when we ſpeak of the ratios of ſounds? Simply this:—Pythagoras is ſaid to have found, that if two muſical cords be ſtrained by equal weights, and one of them be twice the length of the other, the ſhort one will ſound the octave to the note of the other. If it be two-thirds of the length of the long ſtring, it will ſound the fifth to it. If the long ſtring ſound *do*, the ſhort one will ſound *ſol*. If it be three-fourths of the length, it will ſound the fourth or *fa*. Thus the ratio of 2 : 1 was called the ratio of the DIAPASON; that of 3 : 2 was called the DIAPENTE; and that of 4 : 3 the DIATESSARON. Moreover, if we now take all the four ſtrings, and make that which ſounds the graveſt note, and is the longeſt, twelve inches in length; the ſhort or octave ſtring muſt be ſix inches long, or one half of twelve; the diapente muſt be eight inches, or two-thirds of twelve; and the diateſſaron muſt be nine inches, which is three fourths of twelve. If we now compare the diapente, not with the graveſt ſtring, but with the octave of ſix inches, we ſee that they are in the ratio of 4 to 3, or the ratio of diateſſaron. And if we compare the diateſſaron with the octave, we ſee that their ratio is that of 9 : 6, or of 3 : 2, or the ratio of diapente. Thus is the octave divided into a fifth and a fourth *do ſol*, and *ſol do*, in ſucceſſion. Alſo the fourth *do fa*, and the fifth *fa do*, make up the octave. The note which ſtands as a fifth to one of the extreme ſounds of the octave, ſtands as a fourth to the other. And, laſtly, the two fourths *do fa*, and *ſol do*, leave an interval *fa ſol* between them; which is alſo determined by nature, and the ratio correſponding to it is evidently that of 9 to 8.

Temperament of the Scale of Muſic.

25 The diſcovery of Pythagoras is either a fable, or falſely narrated.

This is all that was known of the connection of muſic with mathematical ratios. It is indeed ſaid by Iamblicus, that Pythagoras did not make this diſcovery by means of ſtrings, but by the ſounds made by the hammers on the anvil in a ſmith's ſhop. He obſerved the ſounds to be the key, the diateſſaron, and the diapente of muſic; and he found, that the weights of the hammers were in this proportion; and as ſoon as he went home, he tried the ſounds made by cords, when weights, in the proportions above-mentioned, were appended to them. But the whole ſtory has the air of a fable, and of ignorance. The ſounds given by a ſmith's anvil have little or no dependance on the weight of the hammers; and the weights which are in the proportions of the numbers mentioned above will by no means produce the ſounds alleged. It requires *four* times the weight to make a ſtring ſound the octave, and *twice and a quarter* will produce the diapente, and *one and ſeven-ninths* will produce the diateſſaron. It is plain, therefore that they knew not of what they were ſpeaking: yet, on this ſlight foundation, they erected a vaſt fabric of ſpeculation; and in the courſe of their reſearches, theſe ratios were found to contain all that was excellent. The attributes of the Divinity, the ſymmetry of the univerſe, and the principles of morality, were all reſolvable into the harmonic ratios.

26 Conjoined and disjoined tetrachords.

In the attempts to explain, by means of the myſterious properties of the ratios 2 : 1, 3 : 2, 4 : 3, and 9 : 8, which were thus defined by Nature, it was obſerved, that their favourite lyres of four ſtrings could be combined in two principal manners, ſo as to produce an extenſive ſcale. One lyre may contain the notes *do, re, mi, fa;* and the acuter lyre may contain the notes *ſol, la, ſi, do;* and being ſet in ſucceſſion, having the interval *fa ſol* between the higheſt note of the one and the loweſt of the other, they make a complete octave. Theſe were called *disjoined tetrachords*. Again, a third tetrachord may be joined with the upper tetrachord laſt mentioned, in ſuch ſort, that the loweſt note of the third tetrachord may be the ſame with the higheſt of the ſecond. Theſe were called *conjoined* tetrachords (A).

27 The lyres were tuned entirely by the ear,

By thus conſidering the ſcale as made up of tetrachords, the tuning of the lyre was reduced to great ſimplicity. The muſician had only to make himſelf perfect in the ſhort chaunt *do, re, mi, fa*, or to get it by heart, and to ſing it exactly. This intonation would apply equally to the other *ſol, la, ſi, do*. We are well informed that this was really the practice. The directions given by Ariſtoxenus, Nicanor, and others, for varying

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(A) This is the *principle*, but not the preciſe *form*, of the disjoined and conjunct tetrachords. The Greeks did not begin the tetrachord with what we make the firſt note of our chaunt of four notes, but began one of them with *mi*, and the other with *ſi;* to which they afterwards added a note below. This beginning ſeems to have been directed by ſome of their favourite cadences; but it would be tedious to explain it.

varying the tuning, according to certain occaſional accommodations, ſhew diſtinctly that they did not tune as we do, ſounding the two ſtrings together, except in the caſe of the diapaſon or octave. It was all done by the judgment of the ear in melody. The moſt valuable circumſtance in the diſcovery of Pythagoras was the determination of the interval between the fourth and the fifth, by which the tetrachords were ſeparated. The filling up of each tetrachord was left entirely to the ear; and when the doctrine of the mathematical ratios ſhewed that the large intervals *do re, re mi, fa ſol, ſol la, la ſi,* ſhould not be preciſely equal, Ariſtoxenus refuſed the authority of the reaſons alleged for this inequality, becauſe the ear perceived none of the ratios as ratios, and could judge only of ſounds. He farther aſſerted that the inequalities which the Pythagoreans enjoined, were ſo trifling, that no ear could poſſibly perceive them. And accordingly, the theoriſts diſputed about the reſpective ſituations of the greater and ſmaller tones (ſo they named the great ſteps) ſo much ſpoken of, and had different ſyſtems on the ſubject.

28
And by melody alone:

But the ſtrongeſt proof of the indiſtinct notion that the theoriſts entertained about the influence of theſe ratios in muſic is, that they would admit no more but thoſe introduced by Pythagoras; and their reaſons for the rejection of the ratio of 5 to 4, and of 6 to 5, were either the moſt whimſical fancies about the perfections of the ſacred ratios, or aſſumptions expreſsly founded on the ſuppoſition, that the ear perceives and judges of the ratios as ratios; than which nothing can be more falſe. Had they admitted the ratio of 5 to 4, they would have obtained the third note of the ſcale, and would at once have gotten the whole ſcale of our muſic. The ratios of 6 : 5, and 16 : 15, follow of courſe; and every ſound of the tetrachords would have been determined. For 5 : 4 being the ratio of the major third, which is perfectly pleaſing to the ear, as the *mi* to the note *do*, and 3 : 2 being the ratio of the fifth *do ſol*, there is another interval *mi ſol* determined; and this ratio being the difference between *do ſol* and *do mi*, or between 3 : 2 and 5 : 4, is evidently 6 : 5. In like manner, the interval *mi fa* is determined, and its ratio, being 4 : 3—5 : 4, is 16 : 15.

But farther; we ſhall find, upon trial, that if we put in a ſound above *ſol*, having the relation 5 : 4 to *fa*, it will be perfectly ſatisfactory to the ear if ſung as the note *la*. And if, in like manner, we put in a note above *la*, having the relation 5 : 4 to *ſol*, we find it ſatisfactory to the ear when uſed as *ſi*. If we now examine the ratios of theſe artificial notes, we ſhall find the ratio of the notes *ſol la* to be 10 : 9, and that of *la ſi* to be 9 : 8, the ſame with that *fa ſol*; alſo *ſi do* will appear to be 16 : 15, like that of *mi fa*.

We have no remains of the muſic of the Greeks, by which we can learn what were their favourite paſſages or muſical phraſes; and we cannot ſee what cauſed them to prefer the fourth to the major third. Few muſicians of our times think the fourth in any degree comparable with the major third for melodiouſneſs, and ſtill fewer for harmoniouſneſs. The piece or tune publiſhed by Kircher from Alypius is very ſuſpicious, as no other perſon had ſeen the MS; and the collection found at Buda is too much disfigured, and probably of too late a date, to give us any ſolid help. In all probability, the common melodies of the Greeks abounded in eaſy leaps up and down on the third and fifth, and on the fourth and ſixth, juſt as we obſerve in the airs for dancing among all ſimple people. Their accompliſhed performers had certainly great powers both of invention and execution; and the chromatic and enharmonic diviſions of the ſcale were certainly practiſed by them, and not merely the ſpeculations of mathematicians. To us, the enharmonic ſcale appears the moſt jarring diſcord; but this is certainly owing to our not ſeeing any pieces of the muſic ſo compoſed, and becauſe we cannot in the leaſt judge by harmony what the effect of enharmonic melody would be. But we have ſufficient evidence, from the writings of the ancient Greeks, that the enharmonic muſic fell into diſuſe even before the time of Ptolemy, and was totally and irrecoverably loſt before the 5th century. Even the chromatic was little practiſed, and was chiefly employed for extending the common ſcale to keys which were ſeldom uſed. The uncertainties reſpecting even the common ſcale remained the ſame as ever; and although Ptolemy gives (among others) the very ſame that is now admitted as the only perfect one, namely, his *diatonicum intenſum*, his reaſons of preference, though good, are not urged with ſtrong marks of his confidence in them, nor do they ſeem to have prevailed.

29
But melody is quite inſufficien

Theſe obſervations ſhew clearly, that the perception of melody alone is not ſufficiently preciſe for enabling us to acquire exact conceptions of the ſcale of muſic. The whole of the practicable ſcience of the ancients ſeems to amount to no more than this, that the octave contained five greater and two ſmaller intervals, which the voice employed, and the ear reliſhed. The greater intervals ſeemed all of one magnitude; and the ſmaller intervals appeared alſo equal, but the ear cannot judge what proportion they bear to the larger ones. The muſicians thought them larger than one-half of the great intervals (and indeed the ratio 16 : 15 of the artificial *mi fa* and *ſi do*, is greater than the half of 9 : 8 or 10 : 9). Therefore they allowed the theoriſts to call them *limmas* inſtead of *hemitones*, but they, as well as the theoriſts, differed exceedingly in the magnitudes which they aſſigned them.

30
Circular preſenta tion of t ſcale.
Plate XLIV.

The beſt way that we can think of for expreſſing the ſcale of the octave is, by dividing the circumference of a circle in the points C, D, E, F, G, A, and B (fig. 1.), in the proportion we think moſt ſuitable to the natural ſcale of melody. According to the practical notion now under our conſideration, the arches CD, DE, FG, GA, and AB, are equal, containing nearly 59°; and the arches EF and BC are alſo equal, but ſmaller than the others, containing about 33⅓. Now, ſuppoſe another circle, on a piece of card paper, divided in the ſame manner, to move round their common centre, but inſtead of having its points of diviſion marked C, D, E, &c. let them be marked *do, re, mi, fa, ſol, la, ſi*. It is plain, that to whatever point of the outer circle we ſet the point *do* of the inner one, the other points of the outer circle will ſhew the common notes which are fit for thoſe ſteps of the ſcale. The ſimilarity of all octaves makes this ſimple octave equivalent to a rectilineal ſcale ſimilarly divided, and repeated as often as we pleaſe. Fig. 1. repreſents this inſtrument, and will be often referred to. A ſort of ſymmetry may be obſerved in it. The point D ſeems to occupy the middle of the ſcale, and *re* ſeems to be the middle note of

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of the octave. The oppoſite arch GA, and the correſponding interval *ſol la*, ſeems to be the middle interval of the octave. The other notes and intervals are ſimilarly diſpoſed on each ſide of theſe. This circumſtance ſeems to have been obſerved by the Greeks, by the inhabitants of India, by the Chineſe, and even by the Mexicans. The note *re*, and the interval *ſol la*, have gotten diſtinguiſhed ſituations in their inſtruments and ſcales of muſic.

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With reſpect to the diviſion of the circles, we ſhall only obſerve at preſent, that the dotted lines are conformable to the principles of Ariſtoxenus, the whole octave being portioned out into five larger and equal intervals, and two ſmaller, alſo equal. The larger are called *mean* or *medium tones*; and the ſmaller are called *limmas* or *ſemitones*. The full lines, to which the letters and names are affixed, divide the octave into the artificial portions, determined by means of the muſical ratios, the arches being made proportional to the meaſures of thoſe ratios. Thus the arches CD, FG, AB, are proportional to the meaſure or logarithm of the ratio 9 : 8; GA and DE are proportional to the logarithm of 10 : 9; and the arches EF and BC are proportional to the logarithm of 16 : 15. We have already mentioned the way in which thoſe ratios were applied, and the authority on which they were ſelected. We ſhall have occaſion to return to this again. The only farther remark that is to be made with propriety in this place is, that the diviſion on the Ariſtoxenean principles, which is expreſſed in this figure, is one of an indefinite number of the ſame kind. The only principle adopted in it is, that there ſhall be five mean tones, and two ſmall equal ſemitones; but the magnitude of theſe is arbitrary. We have choſen ſuch, that two mean tones are exactly equal to the arch CE, determined by the ratio 5 : 4. The reaſons for this preference will appear as we proceed (B).

By this little inſtrument (the invention, we believe, of a Mr D'Ormiſſon, about the beginning of laſt century), we ſee clearly the inſufficiency of the ſeven notes of the octave for performing muſic on different keys. Set the flower de luce at the Ariſtoxenean B, and we ſhall ſee that E is the only note of our lyre which will do for one of the ſteps of the octave in which we intend to ſing and accompany. We have no ſounds in the lyre for *re*, *mi*, *ſol*, *la*, *ſi*. The remedy is as clearly pointed out. Let a ſet of ſtrings be made, having the ſame relation to *ſi* which thoſe of the preſent lyre have to *do*, and inſert them in the places pointed out by the Ariſtoxenean diviſions of the moveable octave. We need only five of them, becauſe the *ſi* and *fa* of the preſent lyre will anſwer. Theſe new ſounds are marked by a +.

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But it was ſoon found, that theſe new notes gave but indifferent melody, and that either the ear could not determine the equality of the tones and ſemitones exactly enough, or that no ſuch partition of the octave would anſwer. The Pythagoreans, or partiſans of the muſical ratios, had told them this before. But they were in no better condition themſelves; for they found, that if a ſeries of ſounds, in perfect relation to the octave, be inſerted in the manner propoſed, the melody will be no better. They put the matter to a very fair trial. It is eaſy to ſee, that no ſyſtem of mean tones and limmas will give the ſame muſic on every key, unleſs the tones be increaſed, and the limmas diminiſhed, till the limma becomes juſt half a tone. Then all the intervals will be perfectly equal. The mathematicians computed the ratios which would produce this equality, and deſired the Ariſtoxeneans to pronounce on the muſic. It is ſaid, that they allowed it to be very bad in all their moſt favourite paſſages. Nothing now remained to the Ariſtoxeneans but to attempt occaſional methods of tuning. They ſaw clearly, that they were making the notes unequal which Nature made equal. The Pythagoreans, in like manner, pointed out many alterations or corrections of intervals which ſuited one tetrachord, or one part of the octave, but did not ſuit another. Both parties ſaw that they were obliged to deviate from what they thought natural and perfect: therefore they called theſe alterations of the natural or perfect ſcale a *temperament*.

Temperament of the Scale of Muſic.

The accompliſhed performers were the beſt judges of the whole matter, and they derived very little aſſiſtance from the mathematicians: For although the rigid rules delivered by them be acknowledged to be perfectly exact, the execution of thoſe rules is not ſuſceptible of the ſame exactneſs. Their lyres are tuned, not by mathematical operations, but by the ear. It does not appear that they had muſical inſtruments with divided finger-boards, like our baſs viols and guitars; and even on theſe, it is well known that the preſſure and touch of the finger may vary ſo much, that the moſt exact placing of the frets will not inſure the nice degrees of the ſounds. The flutes are the only inſtruments of the ancients that are capable of accurate ſounds. But flutemakers know very well, that they cannot be tuned by mathematical operations, but by the ear alone. This accounts for the great prices paid for a well tuned flute. Some have coſt L. 700, and L. 50 was a very common price.

33
The Greeks did not cultivate the harmony of ſimultaneous ſounds.

Such ſeems to have been the ſtate of the ancient muſic. There was little or no ſcience in it. There was, indeed, a moſt abſtruſe and refined ſcience coupled with it; but by a very ſlight connection; and it ſeems to have been nothing more than an amuſement for the ingenious and ſpeculative Greeks. Nor could it, in our opinion, be better, ſo long as they had no guide in tuning but the judgment of the ear in melody. Many writers inſiſt that the Greeks had a knowledge of what *we* call *harmony* alſo. The word ἁρμονια is conſtantly uſed by them: but it does not mean what we call harmony, the pleaſant coaleſcence of ſimultaneous ſounds. It comes from ἁρμος, or from ἁρμοζω, and ſignifies *aptitude*, *fitneſs*, and would, in general, be better tranſlated by *ſymmetry*. But we cannot conceive that they paid any marked attention to the effect of ſimultaneous ſounds, ſo as to enjoy the pleaſure of certain conſonances, and employ them in their compoſitions. We judge in this way from the rank which they gave them in their ſcale. To prefer the fourth to the major third ſeems to us to be impoſſible, if it be meant of ſimultaneous

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(B) We ſhall be abundantly exact, if we make CD=61°,72; CE=115°.9; CF=149°,42; CG=210°,58; CA=265°,3; and CB=326°,48.

neous ſounds. And the reaſon which is aſſigned for the preference can have no value in the opinion of a muſician. It is becauſe the ratio of 4 : 3 is ſimpler than that of 5 : 4. For the ſame reaſon, the fifth is preferred to both, and the octave to all the three, and uniſon to every other conſonance. They would not allow the major third 5 : 4 to be a concord at all. We have made numberleſs trials of the different concords with perſons altogether ignorant of muſic. We never ſaw an inſtance of one who thought that mere uniſon gave any poſitive pleaſure. None of all whom we examined had much pleaſure from an octave. All, without exception, were delighted with a fifth, and with a major third; and many of them preferred the latter. All of them agreed in calling the pleaſure from the fifth a *ſweetneſs*, and that from the major third a *cheerfulneſs*, or *ſmartneſs*, or by names of ſimilar import. The greater part preferred even the major ſixth to the fourth, and ſome felt no pleaſure at all from the fourth. Few had much pleaſure from the minor third or minor ſixth. *N. B.* Care was taken to ſound theſe concords without any preparation—merely as ſounds—but not as making part of any muſical paſſage. This circumſtance has a great effect on the mind. When the minor third and ſixth were heard as making part of the minor mode, all were delighted with it, and called it ſweet and mournful. In like manner, the chord $\frac{6}{4}$ never failed to give pleaſure. Nothing can be a ſtronger proof of the ignorance of the ancients of the pleaſures of harmony.

34
The pleaſures of harmony ſeem to be a modern diſcovery.

We do not profeſs to know when this was diſcovered. We think it not unlikely that the Greeks and Italians got it from ſome of the northern nations whom they called *Barbarians*. We cannot otherwiſe account for its prevalence through the whole of the Ruſſian empire—the ancient Slavi had little commerce with the empire of Rome or of Conſtantinople; yet they ſung in parts in the moſt remote periods of their hiſtory of which we have any account; and to this day, the moſt uncultivated boor in the Ruſſian empire would be aſhamed to ſing in uniſon. He liſtens a little while to a new tune, holding his chin to his breaſt; and as ſoon as he has got a notion of it, he burſts out in concert, throwing in the harmonic notes by a certain rule which he feels, but cannot explain. His harmonics are generally alternate major and minor thirds, and he ſeldom miſſes the proper cadences on the fifth and key. Perhaps the invention of the organ produced the diſcovery. We know that this was as early as the ſecond century (c). It was hardly poſſible to make much uſe of that inſtrument without perceiving the pleaſure of concordant ſounds.

35
Harmony made a great change in the ſcience of muſic.

The diſcovery of the pleaſures of harmony occaſioned a total change in the ſcience of muſic. During the dark ages of Europe, it was cultivated chiefly by the monks: the organ was ſoon introduced into the churches, and the choral ſervice was their chief and almoſt their only occupation. The very conſtruction of this inſtrument muſt have contributed to the improvement of muſic, and inſtructed men in the nature of the ſcale. The pipes are all tuned by their lengths; and theſe lengths are in the ratios of the ſtrings which give the ſame notes, when all are equally ſtretched. This muſt have revived the ſtudy of the muſical ratios. The tuning of the organ was performed by conſonance, and no longer depended on the nice judgment of ſounds in ſucceſſion. The dulleſt ear, even with total ignorance of muſic, can judge, without the ſmalleſt error, of an exact octave, fifth, third, or other concord; and a very mean muſician could now tune an organ more accurately than Timotheus could tune his lyre. Other keyed inſtruments, reſembling our harpſichord, were invented, and inſtruments with fretted finger-boards. Theſe ſoon ſupplanted the lyres and harps, being much more compendious, and allowing a much greater variety and rapidity of modulation. All theſe inſtruments were the fruits of harmony, in the modern ſenſe of that word. The deficiencies of the old diatonic ſcale were now more apparent, and the neceſſity of a number of intercalary notes. The finger-board of an organ or harpſichord, running through a ſeries of octaves, and admitting much more than the accompanyment of one note, pointed out new ſources of muſical pleaſure ariſing from the fulneſs of the harmony; and, above all, the practice of choral ſinging ſuggeſted the poſſibility of a pleaſure altogether new. While a certain number of the choir performed the Cantus or Air of the muſic, it was irkſome to the others to utter mere ſounds, ſupporting or compoſing the harmony of the Cantus, without any melody or air in their own parts. It was thought probable that the harmonic notes might be ſo portioned out among the reſt of the choir, that the ſucceſſion of ſounds uttered by each individual might alſo conſtitute a melody not unpleaſant, and perhaps highly grateful. On trial, it was found very practicable. Canons, motets, fugues, and other harmonies, were compoſed, where the airs performed by the different parts were not inferior in beauty to the principal. The notes which could not be thrown into this agreeable ſucceſſion, were left to the organiſt, and by him thrown into the baſs.

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By all theſe practices, the imperfections of the ſcale of fixed ſounds became every day more ſenſible, eſpecially in full harmony. Scientific muſic, or the properties of the ratios, now recovered the high eſtimation in which they were held by the ancient theoriſts; and as the muſicians were now very frequently men of letters, chiefly monks, of ſober characters and decent manners, muſic again became a reſpectable ſtudy. The organiſt was generally a man of ſcience, as well as a performer. At the firſt revival of learning in Europe, we find muſic ſtudied and honoured with degrees in the univerſities, and very ſoon we have learned and excellent diſſertations on the principles of the ſcience. The inventions of Guido, and the diſſertations of Salinas, Zarlino, and Xoni, are among the moſt valuable publications that are extant on muſic. The improvements introduced by Guido are founded on a very refined examination

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(c) It is ſaid that the Chineſe had an inſtrument of this kind long before the Europeans. Cauſeus ſays, that it was brought from China by a native, and was ſo ſmall as to be carried in the hand. It is certain that the Emperor Conſtantine Copronymus ſent one to Pepin king of France in 757, and that his ſon, Charlemagne got another from the Emperor Michael Paleologus. But they appear to have been known in the Engliſh churches before that time.

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examination of the ſcale; and the temperaments propoſed by the other two have ſcarcely been improved by any labours of modern date. Both theſe authors had ſtudied the Greek writers with great care, and their improvements proceed on a complete knowledge of the doctrines of Pythagoras and Ptolemy.

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At laſt the celebrated Galileo Galilei put the finiſhing hand to the doctrines of thoſe ancient philoſophers, by the diſcovery of the connection which ſubſiſts in nature between the ratios of numbers and the muſical intervals of ſounds. He diſcovered, that theſe numbers expreſs the frequency of the recurring pulſes or undulations of air which excite in us the ſenſation of ſound. He demonſtrated that if two ſtrings, of the ſame matter and thickneſs, be ſtretched by equal weights, and be twanged or pinched ſo as to vibrate, the times of their vibrations will be as their lengths, and the frequency or number of oſcillations made in a given time will be inverſely as their lengths. The frequency of the ſonorous undulations of the air is therefore inverſely as the length of the ſtring. When therefore we ſay that 2 : 1 is the ratio of the octave, we mean, that the undulations which produce the upper ſound of this interval are twice as frequent as thoſe which produce its fundamental ſound. And the ratio 3 : 2 of the diapente or fifth, indicates, that in the ſame time that the ear receives three undulations from the upper ſound, it receives only two from the lower. Here we have a natural connection, not peculiar to the ſounds produced by ſtrings; for we are now able to demonſtrate, that the ſounds produced by bells are regulated by the ſame law. Nay, the improvements which have been made in the ſcience of motion ſince the days of Galileo, ſhew us that the undulations of the air in pipes, where the air is the *only* ſubſtance moved, is regulated by the ſame law. It ſeems to be the general property of ſounds which renders them ſuſceptible of muſical pitch, of acuteneſs, or gravity; and that a certain frequency of the ſonorous undulations gives a determined and unalterable muſical note. The writer of this article has verified this by many experiments. He finds, that *any noiſe whatever*, if repeated 240 times in a ſecond, at equal intervals, produces the note C *ſol fa ut* of the Gindonian gamut. If it be repeated 360 times, it produces the G *ſol re ut*, &c. It was imagined, that only certain regular agitations of the air, ſuch as are produced by the tremor or vibration of elaſtic bodies, are fitted for exciting in us the ſenſation of a muſical note. But he found, by the moſt diſtinct experiments, that any noiſe whatever will have the ſame effect, if repeated with due frequency, not leſs than 30 or 40 times in a ſecond. Nothing ſurely can have leſs pretenſion to the name of a muſical ſound than the ſolitary ſnap which a quill makes when drawn from one tooth of a comb to another: but when the quill is held to the teeth of a wheel, whirling at ſuch a rate, that 720 teeth paſs under it in a ſecond, the ſound of *g in alt.* is heard moſt diſtinctly; and if the rate of the wheel's motion be varied in any proportion, the noiſe made by the quill is mixed in the moſt diſtinct manner with the muſical note correſponding to the frequency of the ſnaps. The *kind* of the original noiſe determines the kind of the continuous ſound produced by it, making it harſh and fretful, or ſmooth and mellow, according as the original noiſe is abrupt or gradual: but even the moſt abrupt noiſe produces a tolerably ſmooth ſound when ſufficiently frequent. Nothing can be more abrupt than the ſnap juſt now mentioned; yet the *g* produced by it has the ſmoothneſs of a bird's chirrup. An experiment was made, which was leſs promiſing of a ſound than any that can be thought of. A ſtop cock was ſo conſtructed, that it opened and ſhut the paſſage through a pipe 720 times in a ſecond. This apparatus was fitted to the pipe of a conduit leading from the bellows to the wind cheſt of an organ. The air was ſimply allowed to paſs gently along this pipe by the opening of the cock. When this was repeated 720 times in a ſecond, the ſound *g in alt.* was moſt ſmoothly uttered, equal in ſweetneſs to a clear female voice. When the frequency was reduced to 360, the ſound was that of a clear but rather harſh man's voice. The cock was now altered in ſuch a manner, that it never ſhut the hole entirely, but left about one-third of it open. When this was repeated 720 times in a ſecond, the ſound was uncommonly ſmooth and ſweet. When reduced to 360, the ſound was more mellow than any man's voice at the ſame pitch. Various changes were made in the form of the cock, with the intention of rendering the primitive noiſe more analogous to that produced by a vibrating ſtring. Sounds were produced which were pleaſant in the extreme. The intelligent reader will ſee here an opening made to great additions to practical muſic, and the means of producing muſical ſounds, of which we have at preſent ſcarcely any conception; and this manner of producing them is attended with the peculiar advantage, that an inſtrument ſo conſtructed can never go out of tune in the ſmalleſt degree. But of this enough at preſent.

Temperament of the Scale of Muſic.

38
This frequency is expreſſed by the muſical ratios of Pythagoras.

This diſcovery of Galileo's completed the Pythagorean theories, by ſupplying the only thing wanted for procuring confidence in them. We now ſee that the muſic of ſounds depends on principles as certain and as plain as the elements of Euclid, and that every thing relating to the ſcale of muſic is attainable by mathematics. It is very true that we do not perceive the ratio 3 : 2 in the diapente, as having any relation to the numbers 3 and 2. But we perceive the ſweetneſs of ſound which characteriſes this concord. This is undoubtedly the perception of a certain phyſical fact involving this ratio, as much as the ſweetneſs on our tongue is the perception of a certain manner of acting of the particles of ſugar during their diſſolution in the ſaliva.

CONCORD, DISCORD, are properties of particular ratios of frequency.

The pleaſure ariſing from certain conſonances, ſuch as *do ſol*, is not more diſtinctly perceived than is the diſagreeable feeling which other conſonances produce, ſuch as *do re*; and it was a fair field of diſquiſition to diſcover why the one pleaſed and the other diſpleaſed. We cannot ſay that this queſtion has been completely decided. It has been aſcribed to the coincidence of vibrations. In the octave, every ſecond vibration of the treble note may be made to coincide with every vibration of the baſs. But the pleaſure ariſing from the different conſonances does by no means follow the proportions of thoſe coincidences of vibrations; for when two notes are infinitely near to the ſtate which would produce a complete coincidence, the actual coincidence is then exceedingly rare; and yet we know that ſuch ſounds yield very fine harmony. In tuning any concord, when the two notes are very diſcordant, the coinciding vibrations recur very frequently; and as we ap-

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proach nearer and nearer to perfect concord, theſe coincidences become rarer and rarer; and if it be infinitely near to perfect concord, the coincidences of vibration will be infinitely diſtant from each other. This, and many other irrefragable arguments, demonſtrate that coaleſcence of ſound, which makes the pleaſing harmony of a fifth, for example, does not ariſe from the coincidence of vibration; and the only thing which we can demonſtrate to obtain in all the caſes where we enjoy this pleaſure, is a certain arrangement of the component pulſes, and a certain law of ſucceſſion of the diſlocations or intervals between the non-coinciding pulſes. We are perfectly able to demonſtrate that when, by continually ſcrewing up one of the notes of a conſonance, we render the real coincidence of pulſes leſs frequent; the diſlocations, or deviations from perfect coincidence, approach nearer and nearer to a certain definable law of ſucceſſion; and that this law obtains completely, when the perfect ratio of the duration of the pulſe is attained, although perhaps at that time not one pulſe of the one ſound coincides with a pulſe of the other. Suppoſe two organ pipes, ſounding the note C *ſol fa ut*, at the diſtance of ten feet from each other, and that their pulſes begin and end at the ſame inſtants, making the moſt perfect coincidence of pulſes—there is no doubt but that there will be the moſt perfect harmony; and we learn by experience that this harmony is perfectly the ſame, from whatever part of the room we hear it. This is an unqueſtionable fact. A perſon ſituated exactly in the middle between them will receive coincident pulſes. But let him approach one foot nearer to one of the pipes, it is now demonſtrable that the pulſes, at their arrival at his ear, will be the moſt diſtant from coincidence that is poſſible; for every pulſe of one pipe will biſect the pulſe from the other; but the law of ſucceſſion of the deviations from coincidence will then obtain in the moſt perfect manner. A muſical ſound is the ſenſation of a certain form of the aerial undulation which agitates the auditory organ. The perception of harmonious ſound is the ſenſation produced by another definite form of the agitation. This is the compoſition of two other agitations; but it is the compound agitation only that affects the ear, and it is its form or kind which determines the ſenſation, making it pleaſant or unpleaſant.

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Our knowledge of mechanics enables us to deſcribe this form, and every circumſtance in which one agitation can differ from another, and to diſcover general features or circumſtances of reſemblance, which, in fact, accompany all perceptions of harmony. We are ſurely intitled to ſay that theſe circumſtances are ſure teſts of harmony; and that when we have enſured their preſence, we have enſured the hearing of harmony in the adjuſted ſounds. We can even go farther in ſome caſes: We can explain ſome appearances which accompany imperfect harmony, and perceive the connection between certain diſtinct reſults of imperfect coincidences, and the magnitude of the deviations from perfect harmony which are then heard. Thus, we can make uſe of theſe phenomena, in order to aſcertain and meaſure thoſe deviations; and if any rules of temperament ſhould require a certain determinate deviation from perfect harmony in the tuning of an inſtrument, we can ſecure the appearance of hat phenomenon which correſponds to the deviation, and thus can produce the preciſe temperament ſuggeſted by our rules. We can, for example, deſtroy the perfect harmony of the fifth C*g*, and flatten the note *g* till it deviates from a perfect fifth in the exact ratio of 320 to 321, which the muſicians call the one-fourth of a comma. The moſt exquiſite ear for melody is almoſt inſenſible of a deviation four times greater than this; and yet a perſon who has no muſical ear at all, can execute this temperament by the rules of harmony without the error of the fortieth part of a comma.

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nances.

For this moſt valuable piece of knowledge we are indebted to the late Dr Robert Smith of Cambridge, a very eminent geometer and philoſopher, and a good judge of muſic, and very pleaſing performer on the organ and harpſichord. This gentleman, in his diſſertation on the Principles of Harmonics, publiſhed for the firſt time in 1749, has paid particular attention to a phenomenon in coexiſtent ſounds, called a *beating*. This is an alternate enforcement and diminution of the ſtrength of ſound, ſomething like what is called a cloſe ſhake, but differing from it in having no variation in the pitch of the ſounds. It is a ſort of undulation of the ſound, in which it becomes alternately louder and fainter. It may be often perceived in the ſound of bells and muſical glaſſes, and alſo in the ſounds of particular ſtrings. It is produced in this way: Suppoſe two uniſons quite perfect; the vibrations of each are either perfectly coincident, or each pulſe of one ſound is interpoſed in the ſame ſituation between each pulſe of the other. In either caſe they ſucceed each other with ſuch rapidity, that we cannot perceive them, and the whole appears an uniform ſound. But ſuppoſe that one of the ſounds has 240 pulſes in a ſecond, which is the undulation that is produced in a pipe of 24 inches long; ſuppoſe that the other pipe is only 23 inches and $\frac{7}{10}$ths long. It will give 243 pulſes in a ſecond. Therefore the 1ſt the 80th, the 160th, and the 240th pulſe of the firſt pipe will coincide with the 1ſt, the 81ſt, the 162d, and the 243d pulſe of the other. In the inſtants of coincidence, the agitation produced by one pulſe is increaſed by that produced by the other. The commencement of the next two pulſes is ſeparated a little, and that of the next is ſeparated ſtill more, and ſo on continually: the *diſlocations* of the pulſes, or their deviations from perfect coincidence, continually increaſing, till we come to the 40th pulſe of the one pipe, which will commence in the middle of the 41ſt pulſe of the other pipe; and the pulſes will now biſect each other, ſo that the agitations of the one will counteract or weaken thoſe of the other. Thus the compounded ſound will be ſtronger at the coincidences of the pulſes, and fainter when they biſect each other. This reinforcement of ſound will therefore recur thrice in every ſecond. The frequency of the pulſes are in the ratio of a comma, or 81 : 80. Therefore this conſtitutes an *uniſon imperfect by a comma*. If therefore any circumſtance ſhould require that theſe two pulſes ſhould form an uniſon imperfect by a comma, we have only to alter one of the pipes, till the two, when ſounded together, beat thrice in a ſecond. Nothing can be plainer than this. Now let us ſuppoſe a third pipe tuned an exact fifth to the firſt of theſe two. There will be no beating obſervable; becauſe the recurrence of coincident pulſes is ſo rapid as to appear a continued ſound. They recur at every ſecond vibration of the baſs, or 120 times in a ſecond.

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But now, inſtead of ſounding the third pipe along with the firſt, let it ſound along with the ſecond. Dr Smith demonſtrates, that they will beat in the ſame manner as the uniſons did, but thrice as often, or nine times in a ſecond. When therefore the fifth C *g* beats nine times in a ſecond, we know that it is too ſharp or too flat (very nearly) by a comma.

Dr Smith ſhews, in like manner, what number of beats are made in any given time by any concord, imperfect or tempered, in any aſſigned degree. We humbly think that the moſt inattentive perſon muſt be ſenſible of the very great value of this diſcovery. We are obliged to call it *his* diſcovery. Merſennus, indeed, had taken particular notice of this undulation of imperfect conſonances, and had offered conjectures as to their cauſe; conjectures not unworthy of his great ingenuity. Mr Sauveur alſo takes a ſtill more particular notice of this phenomenon*, and makes a moſt ingenious uſe of it for the ſolution of a very important muſical problem; namely, to determine the preciſe number of pulſes which produce any given note of the gamut. His method is indeed operoſe and delicate, even as ſimplified and improved by Dr Smith. The following may be ſubſtituted for it, founded on the mechaniſm of ſounding cords. Let a violin, guitar, or any ſuch inſtrument be fixed up againſt a wall, with the finger-board downward, and in ſuch a manner, that a violin ſtring, ſtrained by a weight, may preſs on the bridge, but hang free of the lower end of the finger-board. Let another ſtring be ſtrained by one of the turning pins till it be in uniſon with ſome note (ſuppoſe C) of the harpſichord. Then hang weights on the other ſtring, till, upon drawing the bow acroſs both ſtrings, at a ſmall diſtance below the bridge, they are perfect uniſons, without the ſmalleſt beating or undulation, and taking care that the preſſure of the bow on that ſtring which is tuned by the pin be ſo moderate as not to affect its tenſion ſenſibly. Note exactly the weight that is now appended to it. Now increaſe this weight in the proportion of the ſquare of 80 to the ſquare of 81; that is, add to it its 40th part very nearly. Now draw the bow again acroſs the ſtrings with the ſame caution as before. The ſounds will now beat remarkably; for the vibrations of the loaded ſtring are now accelerated in the proportion of 80 to 81. Count the number of undulations made in ſome ſmall number (ſuppoſe 10) of ſeconds. This will give the number of beats in a ſecond; 80 times this number are the ſingle pulſes of the loweſt ſound; and 81 times the ſame number gives the pulſes of the higheſt of theſe imperfect uniſons.

If this experiment be tried for the C in the middle of our harpſichords, it will be found to contain 240 pulſes very nearly; for the ſtrings will beat thrice in a ſecond. The beats are beſt counted by means of a little ball hung to a thread, and made to keep time with the beats.

Here, then, is a phenomenon of the moſt eaſy obſervation, and requiring no ſkill in muſic, by which the pitch of any ſound, and the imperfection of any concord, may be diſcovered with the utmoſt preciſion; and by this method may concordant ſounds be produced, which are abſolutely perfect in their harmony, or having any degree of imperfection or temperament that we pleaſe. An inſtrument may generally be tuned to perfect harmony, in ſome of its notes, without any difficulty, as we ſee done by every blind Crowder. But if a certain determinate degree of imperfection, different perhaps in the different concords, be neceſſary for the proper performance of muſical compoſitions on inſtruments of fixed ſounds, ſuch as thoſe of the organ or harpſichord kind, we do not ſee how it can be diſputed, that Dr Smith's theory of the beating of imperfect conſonances is one of the moſt important diſcoveries, both for the practice and the ſcience of muſic, that have been offered to the public. We are inclined to conſider it as the moſt important that has been made ſince the days of Galileo. The only rivals are Dr Brook Taylor's mechanical demonſtration of the vibrations of an elaſtic cord, and its companion, and of the undulations of the air in an organ pipe, and the beautiful inveſtigations of Daniel Bernoulli of the harmonic ſounds which frequently accompany the fundamental note. The muſical theory of Rameau we conſider as a mere whim, not founded in any natural law; and the theory of the grave harmonics by Tartini or Romieu is included in Dr Smith's theory of the beating of imperfect conſonances. This theory enables us to execute any harmonic ſyſtem of temperament with preciſion, and certainty, and eaſe, and to decide on its merit when done.

We are therefore ſurpriſed to ſee this work of Dr Smith greatly undervalued, by a moſt ingenious gentleman in the Philoſophical Tranſactions for 1800, and called a large and obſcure volume, which leaves the matter juſt as it was, and its reſults uſeleſs and impracticable. We are ſorry to ſee this; becauſe we have great expectations from the future labours of this gentleman in the field of harmonics, and his late work is rich in refined and valuable matter. We preſume humbly to recommend to him attention to his own admonitions to a very young and ingenious gentleman, who, he thinks, proceeded too far in animadverting on the writings of Newton, Barrow, and other eminent mathematicians. We alſo beg his leave to obſerve, that Dr Smith's application of his theory may be very erroneous (we do not ſay that it is perfect), in conſequence of his notion of the proportional effects produced on the general harmony by equal temperaments of the different concords. But the theory is untouched by this improper uſe, and ſtands as firmly as any propoſition in Euclid's Elements. We are bound to add to theſe remarks, that we have oftener than once heard muſic performed on the harpſichord deſcribed in the ſecond edition of Dr Smith's Harmonics, both before it was ſent home by the maker (the firſt in his profeſſion), and afterwards by the author himſelf, who was a very pleaſing performer, and we thought its harmony the fineſt we ever heard. Mr Watt, the celebrated engineer, and not leſs eminent philoſopher, built a handſome organ for a public ſociety, and, without the leaſt ear or reliſh for muſic, tuned three octaves of the open diapaſon by one of Dr Smith's tables of beats, with the help of a variable pendulum. Signior Doria, leader of the Edinburgh concert, tried it in preſence of the writer of this article, and ſaid, "Belliſſima—ſopra modo belliſſima!" Signiora Doria attempted to ſing along with it, but would not continue, declaring it impoſſible, becauſe the organ was ill tuned. The truth was, that, on the major key of E^b, the tuning was exceedingly different from what ſhe was accuſtomed to, and ſhe would not try another key. We mention this particular, to ſhew how accurately

Temperament of the Scale of Muſic.

Mr Watt had been able to execute the temperament he intended.

43 And accurate methods of temperament.

This theory is valuable, therefore, by giving us the management of a phenomenon intimately connected with harmony, and affording us preciſe and practicable meaſures of all deviations from it. It bids fair, for this reaſon, to give us a method of executing any ſyſtem of temperament which we may find reaſon to prefer. But we have another ground of eſtimation of this theory. By its aſſiſtance, we are able to aſcertain with certainty and preciſion the true untempered ſcale of muſic, which eluded all the attempts of the ingenious Greeks; and we determine it in a way ſuited to the favourite muſic of modern times, of which almoſt all the excellencies and pleaſures are derived from harmony. We do not ſay that this *total* innovation in the principle of muſical pleaſure is unexceptionable; we rather think it very defective, believing that the thrilling pleaſures of muſic depend more upon the melody or air. We appeal even to inſtructed muſicians, whether the heart and affections are not more affected *(and with much more diſtinct variety of emotion)* by a fine melody, ſupported, but not obſerved, by harmonies judiciouſly choſen? It appears to us that the effect of harmony, always filled up, is more uniformly the ſame, and leſs touching to the ſoul, than ſome ſimple air ſung or played by a performer of ſenſibility and powers of utterance. We do not wonder, then, that the ingenious Greeks deduced all their rules from this department of muſic, nor at their being ſo ſatisfied with the pleaſures which it yielded, that they were not ſolicitous of the additional ſupport of harmony. We ſee that melody has ſuffered by the change in every country. There is no Scotchman, Iriſhman, Pole, or Ruſſian, who does not lament that the ſkill in compoſing heart-touching airs is degenerated in his reſpective nation; and all admire the productions of their muſe of "the days that are paſt." They are "pleaſant and mournful to the ſoul."

But we ſtill prefer the harmonical method of forming the ſcale, on account of its preciſion and facility: and we prefer the theory of beats, *becauſe it alſo gives us the moſt ſatisfactory ſcale of melody;* and this, not by repeated corrections and recorrections, but by a direct proceſs. By a table of beats, every note may be fixed at once, and we have no occaſion to return to it and try new combinations; for the beatings of the different concords to one baſs being once determined, every beating of any one note with any other is alſo fixed.

44 Fundamental experiment.

We therefore requeſt the reader's patient attention to the experiment which we have now to propoſe. This experiment is beſt made with two organ pipes equally voiced, and pitched to the note C in the middle of our harpſichords. Let one of them at leaſt be a ſtopped pipe, its piſton being made extremely accurate, and at the ſame time eaſily moved along the pipe. Let the ſhank of it be divided into 240 equal parts. The advantage of this form of the experiment is, that the ſounds can be continued, with perfect uniformity, for any length of time, if the bellows be properly conſtructed. In default of this apparatus, the experiment may be made with two harpſichord wires in perfect uniſon, and touched by a wheel rubbed with roſin inſtead of a bow, in the way the ſounds of the vielle or hurdygurdy are produced. This contrivance alſo will continue the ſounds uniformly at pleaſure. A ſcale of 240 parts muſt be adapted to one ſtring, and numbered from that end of the ſtring where the wheel or bow is applied to it. Great care muſt be taken that the ſhifting of the moveable bridge do not alter the ſtrain on the wire. We may even do pretty well with a bow in place of the wheel; but the ſound cannot be long held on in any pitch. In deſcribing the phenomena, we ſhall rather abide by the ſtring, becauſe the numbers of the ſcale, or length of the ſounding part of the wire, correſpond, in fact, much more exactly with the ſounds. The deviations of the ſcale of the pipe do not in the leaſt affect the concluſions we mean to draw, but would require to be mentioned in every inſtance, which would greatly complicate the proceſs.

Temp ment c Scale Muſ

Having brought the two open ſtrings into perfect uniſon, ſo that no beating whatever is obſerved in the conſonance, ſlide the moveable bridge ſlowly along the ſtring while the wheel is turning, beginning the motion from the end moſt remote from the bow. All the notes of the octave, and all kinds of concords and diſcords, will be heard; each of the concords being preceded and followed by a ruffling beating, and that ſucceeded by a grating diſcord. After this general view of the whole, let the particular harmonious ſtations of the bridge be more carefully examined as follows.

45 Deter tion of octave charac of con

I. Shift the moveable bridge to the diviſion 120. If it has been exactly placed, we ſhall hear a perfect octave without any beating. It is, however, ſeldom ſo exactly ſet, and we generally hear ſome beating. By gently ſhifting the bridge to either ſide, this beating becomes more or leſs rapid; and when we have found in which direction the bridge muſt be moved, we can then ſlide it along till the beating ceaſe entirely, and the ſounds coaleſce into one ſound. We can ſcarcely hear the treble or octave note as diſtinguiſhable from the baſs or fundamental afforded by the other ſtring. If the notes are duly proportioned in loudneſs, we cannot hear the two as diſtinct ſounds, but a note ſeemingly the ſame with the fundamental, only more brilliant. (*N. B.* It would be a great improvement of the apparatus to have a micrometer ſcrew for producing thoſe ſmall motions of the bridge.)

Having thus produced a fine octave, we can now perceive that, as we continue to ſhift the bridge from its proper place, in either direction, the beating becomes more and more rapid, changes to a violent rattling flutter, and then degenerates into a moſt diſagreeable jar. This phenomenon is obſerved in the deviation of every concord whatever from perfect harmony, and muſt be carefully kept in remembrance.

4 Harm more than m dy.

Before we quit this concord, the octave, produced by the biſection of the pipe or ſtring, we muſt obſerve, that, with reſpect to ourſelves, the octave $c\bar{c}$ muſt beat almoſt twice in a ſecond, before we can obſerve clearly any mis-tune in it, by ſounding the notes in ſucceſſion, or as ſteps in the ſcale of melody. We never knew any ear ſo nice as to diſcover a mis-tuning when it beats but once in three ſeconds. We think ourſelves intitled therefore to ſay, that we are inſenſible of a temperament in melody amounting to one-third of a comma; and we never knew a perſon ſenſible of a temperament half this bulk.

When the imperfection of the octave is clearly ſenſible by ſounding the notes in ſucceſſion, it is extremely diſagreeable, feeling like a ſtruggle or endeavour to attain pera- of the e of ſic.

tain a certain note, and a failure in the attempt. This ſeems owing to the familiar ſimilarity of octaves, in the habitual talking and ſinging of men and women together. But when the notes are ſounded together, although we are not much more ſenſible of the imperfection of the harmony directly, as a failure in the ſweetneſs of the concord, we are very ſenſible of this phenomenon of beating; and any perſon who can diſtinguiſh a weak ſound from a ſtronger one, can eaſily perceive, in this indirect manner, any fraction of a comma, however minute. This makes the tuning by harmony much more exact than by melody alone. It is alſo much more accommodated to the genius of modern muſic. The ancients had favourite paſſages, which were frequently introduced into their airs, and they were ſolicitous to have theſe in good tune. It appears from paſſages in the writings of Galen, that different performers excelled chiefly in their ſkill in making thoſe occaſional temperaments which their muſic required. Our muſic is much more ſtrict, by reaſon of our harmonic accompaniments, which are an abominable noiſe when mis-tuned in a degree, which would have paſſed with the ancients for very good melody. Ariſtoxenus ſays, that the ear cannot diſcover the error of a comma. This would now be intolerable.

7 es the cale elody.

But another advantage attends our method. We obtain by its aſſiſtance, the moſt perfect ſcale of melody; perfect in a degree attainable only by chance by the Greeks. This is now to be our buſineſs to unfold.

8 mina- f the

II. Set the moveable bridge at 158, and ſound the two ſtrings. They will beat very diſagreeably, being plainly out of tune. Slide it gradually toward 160, and the beats will grow ſlower and ſlower; will change to a gentle and not unpleaſant undulation; and at laſt, when the bridge is at 160, will vaniſh entirely, and the two ſounds will coaleſce into one ſweet concord, in which neither of the component ſounds can be diſtinguiſhed. If the ſound given by the ſhort ſtring be now examined as a ſtep in the ſcale of melody, it will be found a fifth to the ſound of the long ſtring or fundamental note, perfectly ſatisfactory to the niceſt ear. Thus one ſtep of the ſcale has been aſcertained.

III. Slide the bridge ſlowly along the ſtring. The beating will recommence, and will become a flutter, and then a jarring noiſe; and will again change to an angry flutter, beating about eight times in a ſecond, when the bridge ſtands at 169 nearly. Puſhing it ſtill on, but very ſlowly, the flutter will become an indiſtinct jarring noiſe; which, by continuing the motion, will again become a flutter, or beat about ſix in the ſecond. The bridge is now about 171.

9 mina- of the

IV. Still continuing the motion, the flutter becomes a jarring noiſe, which continues till the bridge is near to 180, when the rapid flutter will again be heard. This will become ſlower and ſlower as we approach to 180: and when the bridge reaches that point, all beating vaniſhes, and we have a ſoft and agreeable concord, but far inferior to the former concord in that cheering ſweetneſs which characteriſes the fifth. When this note is compared with that of the fundamental ſtring as a ſtep in the ſcale of melody, it is found to correſpond to the note *fa*, or the fourth ſtep in the ſcale, and in that employment to give complete ſatisfaction to the ear.

Tempera-ment of the Scale of Muſic.

50 Determination of the IIId.

V. Still advancing the moveable bridge toward the nut, we ſhall hear the beatings return again; and after fluttering and degenerating to a jarring noiſe, by a very ſmall motion of the bridge, they will again be heard, will grow ſlower, accompanied with a ſort of angry expreſſion, and will ceaſe entirely when the bridge reaches the 192d diviſion of our ſcale. Here we have another concord of very peculiar character, being remarkably enlivening and gay. This ſound gives perfect ſatisfaction to the ear, if employed as the third ſtep in the ſcale of melody, being the note *mi* of that ſeries, at leaſt in all gay or cheerful airs.

51.

VI. As we move the bridge from 192 to 200, we hear again the ſame beatings, which, in the immediate vicinity to 192, have a peeviſh fretful expreſſion, inſtead of the angry waſpiſh expreſſion before mentioned. When the bridge has paſſed that ſituation which produces only grating diſcordance, we hear the beatings again, and they become ſlower, and ceaſe altogether when the bridge arrives at 200. Here we have another conſonance, which muſt be called a *concord*, becauſe it is rather agreeable than otherwiſe, but ſtrongly marked by a mournful melancholy in the expreſſion. In the ſcale of melody, it forms the third ſtep in thoſe airs which expreſs lamentation or grief. It is called the *minor third*, to diſtinguiſh it from the laſt enlivening concord, which, being a larger interval, is called the *major third*.

52 Determination of the 3d.

It is well known, that theſe two thirds give the diſtinguiſhing characters to the only two modes of melodious compoſition that are admitted into modern muſic. The ſeries containing the major third is called the *major*, and that containing the minor third is called the *minor mode*. It is worthy of remark, that the fanatical preachers, in their conventicles and field ſermons, affect this mode in their harangues, which are often diſtinctly muſical, modulating entirely by muſical intervals, and keeping the whole of their chaunt in ſubordination to a fundamental or key note. This is not unnatural, when we conſider the general ſcope of their diſcourſes, namely, to inſpire melancholy and humiliating thoughts, awakening ſorrow, and the like. It is not ſo eaſy to account for the uſual whine of a beggar, who generally craves charity in the major third. This is the caſe, at leaſt, in the northern parts of this iſland.

53.

If we continue to ſhift the bridge ſtill nearer to the end of the ſtring, we ſhall hear nothing but a ſucceſſion of vile diſcordant noiſes, ſomewhat leſs offenſive when the bridge is about the diviſions 213 and 216, but even there very unpleaſant.

54 Determination of the 6th.

VII. Let us therefore change our manner of proceeding a little, and again place the bridge at 160, which will give us the pleaſing concord of the fifth. Inſtead of puſhing it from that place towards the nut, let it be moved towards the wheel or bow. Without repeating what we have ſaid of the reappearance of the beatings, their acceleration, and their degenerating into a jarring diſcord, to be afterwards ſucceeded by another beating, &c. &c. we ſhall only obſerve, that when we place the bridge at 150, we have no beatings, and we hear a conſonance, which is in a ſlight degree pleaſant, and may therefore be called a *concord*. It has the other marks of a concord which we have been making ſo much uſe of; for the beatings recommence when we ſhift the bridge to either ſide of 150. This note makes the ſixth ſtep in the deſcending ſcale of mournful melody; that is, when we are paſſing from the acute to the graver notes, with the intention of putting an emphaſis on the third and the fundamental. Although not eminent as a concord with the fundamental alone, it has a moſt pleaſing effect when liſtened to in ſubordination to the whole ſeries, or when ſounded along with other proper accompaniments of the fundamental.

55 Determination of the VIth.

VIII. Placing the bridge at 144, we obtain another very pleaſing concord, differing in its expreſſion from any of the foregoing. We find it difficult to expreſs its character. It is greatly inferior to the fifth in ſweetneſs, and to the major third in gaiety, but ſeems to poſſeſs, in a lower degree, both of thoſe qualities. In the ſcale of cheerful melody, it is the ſixth note, which we have diſtinguiſhed by the ſyllable *la*. It is alſo uſed even in mournful melody, when we are aſcending, with the intention of cloſing with the octave.

56 Scale of the upper octave.

In ſhifting the bridge from 144 to 120, we obtain nothing but diſcordant, or leaſt diſagreeable conſonances. And, laſtly, if we move the bridge beyond 120, to diviſions which are reſpectively the halves of thoſe numbers which produced the concords already treated of, we obtain the ſame ſteps in the ſcale of the upper octave. Thus if the bridge be at 80, we have the fifth to the octave note, or twelfth to the fundamental. If it be at 60, we obtain the double octave, &c. &c. &c.

57 Characters of the different concords.

We have perhaps been raſh in affixing certain moral or ſentimental characters to certain concords; for we have ſeen inſtances of perſons who gave them different denominations; but theſe were never contradictory to ours, but always expreſſed ſome ſentiment allied to that which we have aſſigned. We never met with an inſtance of a perſon capable of a little diſcriminating reflection, who did not acknowledge a manifeſt ſentimental diſtinction among the different concords which could not be confounded. We doubt not but that the Greeks, a people of exquiſite ſenſibility to all the beauties of taſte and ſentiment, paid much attention to theſe characters, and availed themſelves of them in their compoſitions. We do not think it at all unlikely, that greater effects have been produced by their muſic, which was ſtudied with this expreſs view, than have ever been produced by the modern muſic, with all the addition of harmony. We have allowed too great a ſhare of our attention to mere harmony. Our great authors are much leſs ſolicitous to compoſe an enchanting air, than to conſtruct a full ſcore of rich and well conducted harmony. We do not profeſs to be nice judges in muſical compoſition, but we may tell what we ourſelves experience. We find our minds worked up by a continuance of fine harmony into a *general* ſenſibility; into a frame of mind which would prepare and fit us for receiving ſtrong impreſſions of moral ſentiment, if theſe were diſtinctly made. But we have ſeldom felt any diſtinct emotions excited by mere inſtrumental muſic. And when the harmonies have been merely to ſupport the performance of a voice, the words have been either ſo frittered by muſical diviſions, as to become in ſome meaſure ludicrous—or have been ſo indiſtinct, and made ſo trifling a part of the muſic, that there was nothing done to give a particular ſhape to the moral impreſſion on our mind. We have generally been ſtrongly affected by ſome of the anthems which were in vogue in former times; and we think that we perceived the cauſe of this difference: There was a great ſimplicity in the voice parts: the ſyllables were not drawled out into long muſical phraſes, but pronounced nearly according to their proper quantities; ſo that the ſentiment of the ſpeaker was expreſſed with all the force of good declamation, and the harmony of the accompaniment then ſtrengthened the appropriate effect of the melody. We mean not to offer theſe obſervations as of much authority, but merely to mention ſome facts, and to aſſign what we felt to be their cauſes, in order to promote, in ſome degree, however inſignificant, the cultivation of muſical ſcience. With this view, we venture to ſay, that ſome of the beſt compoſitions of Knapp of York *uniformly* affect us more than the more admired anthems of Bird and Tallis. A cadence, which Knapp gives almoſt entirely to the melody, is laboured by Bird or Tallis with all the rules of art; and you have its characters of perfect or imperfect, full or diſappointed, cadences, and ſuch an apparatus of preparation and reſolution of diſcords, that you foreſee it at the diſtance of ſeveral bars, and then the part aſſigned to the voice ſeems a very trifle, and merely to fill up a blank in the harmony. Such compoſitions ſmell of the lamp, and fail of their purpoſe, that of charming the *learned* ear. But enough of this digreſſion.

58. Thus have we found a natural relation between certain ſounds ſtrongly marked by very preciſe characters. The concordance of ſound is marked by the abſence of all undulation, and the deviations from this harmony are ſhewn to be meaſurable by the frequency of thoſe undulations. We have alſo found, that the notes, which are thus harmonious along with the fundamental, are ſteps in the ſcale of natural muſic (for we muſt acknowledge melody to be the primitive muſic, dictated by nature). We have got the notes *do—mi, fa, ſol, la—do*, aſcertained in a way that can no longer be miſtaken.

59 Ratios b longing the concords, &

Let us now examine what phyſical or mechanical relations theſe ſounds ſtand in to each other. Our monochord gives us the lengths of the ſtrings; and the diſcovery of Galileo ſhews us, that theſe are alſo the durations of the aëreal pulſes which produce the ſenſations of muſical notes. Their ratios may therefore be truly called the ratios of the ſounds. Now we ſee that the ſtrings which produce the ſounds *do ſol* are 240 and 160. Theſe are in the ratio of 3 to 2. In this manner we may ſtate all the ratios obſerved in our experiment, *viz.*

Do : *mi* have the ratio of	240 to 192, or of	5 to 4
Do : *fa*	240 : 180	4 : 3
Do : *ſol*	240 : 160	3 : 2
Do : *la*	240 : 144	5 : 3
Mi : *ſol*	192 : 160	6 : 5, = *do* : *mi*♭
Fa : *ſol*	180 : 160	9 : 8
Sol : *la*	160 : 144	10 : 9
Mi : *fa*	192 : 180	16 : 15

Here we get the ſight of all the ratios which the ingenious and unwearied ſpeculations of the Greek mathematicians enliſted into the ſervice of muſic, without being able to give a good reaſon why. The ratio 5 : 4, which their faſtidious metaphyſicians rejected, and which others wiſhed to introduce from motives of mere neceſſity to fill up a blank, is pointed out to us by one of the fineſt concords. The interval between the fourth and the fifth is, *very fortunately*, a ſtep of the ſcale.

The next ſtep *ſol la* is more important. For the ear

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for melody would have been very well ſatisfied with an interval equal to *fa ſol*, or 9 : 8; but if the moveable bridge be ſet at the diviſion 142$\frac{2}{9}$, correſponding to ſuch a ſtep, we ſhould have a very offenſive fluttering. It is reaſonable therefore to conclude, *from analogy*, that the interval *ſol la* does not correſpond to the ratio 9 : 8; and that 10 : 9, which is, at leaſt, equally ſatisfactory to the ear, is the proper ſtep, even in the ſcale of melody. If we conſider what may be called the ſcale of harmony, there is no room left for doubt. To enjoy the greateſt poſſible pleaſure of harmony, we muſt not only take each note as it is related to the fundamental, but alſo as it is related to other notes of the ſcale. It may chance to be convenient to aſſume, for the fundamental of our occaſional ſcale of modulation, the ſtring of the lyre which is tuned as *fa* to its proper fundamental; or it may increaſe the harmony (and we know that it does), if we accompany the note *do* with both of the notes *fa* and *la*. To have the fine concord of the major third, it is neceſſary that the interval *fa la* be equivalent to the ratio 5 : 4. Now *fa* is 180, and 5 : 4 = 180 : 144. Therefore, by making the ſtep *ſol la* equal to 9 : 8, we ſhould loſe this agreeable concord, and get diſcord in its place.

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And thus is evinced, in oppoſition to Ariſtoxenus, the propriety of having both a major and a minor tone; the firſt expreſſed by 9 : 8, and the laſt by 10 : 9. The difference between theſe ſteps is the ratio 81 : 80, called a comma by the Greek theoriſts.

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We ſtill want two ſteps of the ſcale, and two ſounds or notes correſponding to them, namely *re* and *ſi*; and we wiſh to eſtabliſh them on the ſame authority with the reſt. We ſee that this cannot be done by a concordance with the fundamental *do*. The ear ſufficiently informs us that the ſteps *do re* and *la ſi* muſt be tones, and not ſemitones, like *mi fa*. The ſenſible ſimilarity of the two tetrachords *do re mi fa* and *ſol la ſi do*, alſo teaches us that the ſtep *ſi do* ſhould be a ſemitone like *mi fa*. This ſeems to be all that mere melody can teach us. But we have little information whether we ſhall make *la ſi* a major or a minor tone. If we copy the tetrachord *do re mi fa* exactly, we ſhall make the ſtep *ſi do* like *mi fa*, and equivalent to the ratio 16 : 15. This requires the moveable bridge to be placed at 128. The ſound produced by this diviſion is perfectly ſatiſfactory to the ear as a ſtep of the ſcale of melody. Moreover, our ſatiſfaction is not confined to the compariſon of it with the note *do*, into which we ſlide by this gentle ſtep. It makes agreeable melody when uſed as the third to the note *ſol*. If we examine it mathematically, we find it a perfect major third to *ſol*; for *ſol* requires the 160th diviſion. Now 160 : 128 = 5 : 4, which is the ratio of the pulſes of a major third. All theſe reaſons ſeem enough to make us adopt this determination of the note *ſi*.

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It remains to conſider how we ſhall divide the interval *do—mi*. It is a perfect major third. So is *fa la*, and ſo is *ſol ſi*. But in the firſt of theſe two, we have ſeen that it muſt be compoſed of a major tone with a minor tone above it; and in the ſecond we have a minor tone followed by a major tone above. We are left uncertain therefore whether *do re* ſhall reſemble *fa la* or *ſol ſi* in the poſition of its two parts. Ariſtoxenus and his followers declared the ear to be equally pleaſed with both. Ptolemy's *Syſtema Diatonicum Intenſum* makes *do re* a major tone, and other ſyſtems make it a minor. Even in modern times it has been conſidered as uncertain; and the only reaſon which we have to offer for a preference of the major tone for the firſt ſtep is, that, ſo far as we can judge by our own feelings, the ſounds in the relation of 9 : 8 are leſs diſcordant than ſounds in the relation of 10 : 9, and becauſe all the other ſteps have been determined by means of concords with the key. We refer, for a more particular examination of the principles on which theſe arrangements are valued, to *Dr Smith's Harmonics*, Prop. I. where he ſhews how one is preferable to another, in proportion as it affords a greater number of perfect concords among the neighbouring notes, which is the favourite object in all modern muſic. Upon this principle our arrangement is by far the beſt, becauſe it admits five more concords in the octave than the other. But we have conſidered the ſubject in a different manner, merely to avail ourſelves of the phenomenon by which all the ſteps, except one, ſeem to be naturally aſcertained, and by which the connection between harmony and melody ſeems to be pointed out to us.

Tempera-
ment of the
Scale of
Muſic.

63.

It will be convenient to repreſent the tones major and minor and the hemitone, by the ſymbols T, *t*, and H. Alſo to mark the notes by the Roman numerals, or by cyphers, according as they are the extremes of major or minor intervals. By this notation the octave may be repreſented thus:

$\frac{8}{9}$ $\frac{9}{10}$ $\frac{15}{16}$ $\frac{8}{9}$ $\frac{9}{10}$ $\frac{8}{9}$ $\frac{15}{16}$ $\frac{8}{9}$ &c.

K II III 4 V VI VII VIII IX X &c.

The reader will remark, that the primary diviſions which we aſſigned to the repreſentation of an octave in fig. 1. by the circumference of a circle, are in conformity to this Ptolemaic partition of the octave. He will alſo be ſenſible, that the diviſion into five equal mean tones and two equal hemitones, which is expreſſed by the dotted lines, agreeing with the Ptolemaic diviſion only at C and E, is effected by biſecting the arch CE; and therefore the deviation of the ſound ſubſtituted for the Ptolemaic D is half the difference of CD and DE, that is, half a comma. The deviations therefore at F, G, A, and B, are each a quarter of a comma.

Logarith-
mic mea-
ſures of the
muſical in-
tervals.

It is well known, that if the logarithm of the length of one ſtring be ſubtracted from that of another, the difference is a meaſure of the ratio between them. Therefore 30103 is the meaſure of the muſical interval called the octave, and then the meaſures of the

Comma - -	540 or	54
Hemitone -	2803	280
Minor tone - -	4576	458
Major tone -	5115	512
3d - - -	7918	792
IIId - -	9691	969
4th - - -	12494	1249
Vth - - -	17609	1761
6th - - -	20412	2041
VIth - -	22185	2219
VIIth - - -	27300	2730
VIIIth - -	30103	3010

This

This is a very convenient circumſtance. If we take only the four firſt figures as integers, and make the octave conſiſt of 3010 parts, we have a ſcale more exact than the niceſt harmony requires. The circumference of a circle may be ſo divided into 301 degrees, and the moveable circle have a nonius, ſubdividing each into 10. Or it may be divided into 55,8 degrees, each of which will be a comma. Either of theſe diviſions will make it a moſt convenient inſtrument for expeditiouſly examining all temperaments of the ſcale that can be propoſed. Or a ſtraight line may be ſo divided, and repeated thrice. Then a ſliding ruler, divided in the ſame manner, and applied to it, will anſwer the ſame purpoſe. We ſhall ſee many uſeful employments of theſe inſtruments by and by.

64. Having thus endeavoured to communicate ſome plain notion of the formation and ſingular nature of that gradation of ſounds which produces all the pleaſures of muſic, and of the manner of obtaining the ſteps of this gradation with certainty and preciſion, we proceed to conſider how thoſe muſical paſſages may be performed on ſuch keyed inſtruments as the organs and harpſichords, as they are now conſtructed. Theſe inſtruments have twelve ſounds and intervals in every octave, in order that an air may be performed in any pitch; that is, taking any one of the ſounds as a key note. It is plain that this cannot be done with accuracy; for we have now ſeen that the interval *mi fa* is bigger than half of *do re* or *re mi*, &c. and therefore the intercalary ſound formerly mentioned to be inſerted between C and D, D and E, &c. will not do indiſcriminately for the ſharp of the ſound below and the flat of the ſound above it. When the tones are reduced to a mean ſize, the ear is ſcarcely ſenſible of the change in melody, and the harmony of the fifths and fourths is not greatly hurt. But when the half notes are inſerted, and employed to make up harmonious intervals, as recommended by Zarlino, the harmony is very coarſe indeed.

65 Why temperament neceſſary.

But we muſt make the reader ſenſible of the neceſſity of ſome temperament, even independent of thoſe artificial notes. Therefore

Let the ſcholar tune upwards the four Vths $c\,g$, $g\,\bar{d}$, $\bar{d}\,\bar{a}$, $\bar{a}\,\bar{\bar{e}}$, all perfect, admitting no beating whatever. This is eaſily done, either with the organ or the wheel monochord already deſcribed. Then tune downwards the perfect octaves $\bar{\bar{e}}\,\bar{e}$, $\bar{e}\,e$. Now examine the IIId $c\,e$ which reſults from this proceſs. If the inſtrument be of the pitch hitherto ſuppoſed (c making 240 pulſes in a ſecond), this IIId will be heard beating 15 times in a ſecond, which is a diſcordance altogether intolerable, the note e being too ſharp in the ratio of 81 to 80, which makes a comma. It is eaſily found, by calculation, that e makes 303$\frac{1}{4}$ pulſes, inſtead of 300, required for the IIId to c.

N. B. It may not be amiſs to inform our readers, that if any concord, whoſe perfect ratio is $\frac{m}{n}$ (m being the greateſt term of the ſmalleſt integers expreſſing that ratio), be tempered ſharp by the fraction $\frac{p}{q}$ of a comma, and if M and N be the pulſes made by the acute and grave notes of the concord during any number of ſeconds, the number b of beats made in the ſame time by this concord will be $= \frac{2\,q\,m\,\mathrm{N}}{161\,p - q}$, or $\frac{2\,q\,n\,\mathrm{M}}{161\,p + q}$; and if it be tempered flat, then $b = \frac{2\,q\,m\,\mathrm{N}}{161\,p + q}$, or $\frac{2\,q\,n\,\mathrm{M}}{161\,p - q}$ (*Smith's Harm.* 2d edit. p. 82, &c.)

66 It is impoſſible, therefore, to have perfect Vths and perfect IIIds at the ſame time. And it will be found, that the 3d $e\,g$ reſulting from this proceſs, and the VIth $\bar{c}\,a$, are ſtill more diſcordant, rattling at an intolerable rate. Now the major and minor thirds, alternately ſucceeding each other, form the greateſt part of our harmonies; and the VIth is alſo a very frequent accompaniment. It is neceſſary therefore to ſacrifice ſomewhat of the perfect harmony of the Vths, in order that we may not be diſguſted with the diſcord of thoſe other harmonies: and it is this mutual accommodation, and not the changes made neceſſary by the introduction of intercalary notes, which is properly called TEMPERAMENT. It will greatly aſſiſt us in underſtanding the effects of the temperaments of the different concords, if we examine all the diviſions of the circular repreſentation of the octave and muſical ſcale given in fig. 1. by placing the index of the moveable circle on that note of the outer circle for which we want the proper harmonies, or accompaniments, which are either the IIId and Vth, or the 4th and VIth. We ſhall thus learn, in the *firſt* place, the deviations of the different perfect notes of the ſcale from the notes required for this new fundamental; and we muſt then ſtudy what effect the ſame temperament produces on the agreeableneſs of the harmony of different concords having the ſame baſs or the ſame treble, taking it for granted that the hurt to the harmony of any individual concord is proportional to its temperament.

67 How th may be tained b the beat

It is in this delicate department of muſical ſcience that we think the great merit of Dr Smith's work conſiſts. We ſee that the deviation from perfect harmony is always accompanied with beats, and increaſes when they increaſe in frequency—whether it increaſes in the ſame proportion may be a queſtion. We think that Dr Smith's determination of the equality of imperfect harmony in his 13th propoſition includes every mathematical or phyſical circumſtance that appears to have any concern in it. What relates immediately to our ſenſations is, as yet, an impenetrable ſecret. The theory of beats, as delivered by this author, affords very eaſy, though ſometimes tedious, methods of meaſuring and of cenſuring all the varieties which can obtain in the beating of imperfect conſonances. It appears to us therefore very unjuſt to ſay, with the late writer in the Philoſophical Tranſactions, that this obſcure volume has left the matter where it found it. The author has give us *effective* principles, although he may have been miſtaken in the application; which however we are far from affirming. Our limits will not allow us to give any account of that theory; and indeed our chief aim in the preſent article is to give a method of temperament which requires no ſcientific knowledge of the ſubject. But we could not think of loſing the opportunity of communicating, by the way, to unlearned perſons, ſome more diſtinct notions of the ſcale of muſical ſounds, and of its foundation in nature, than ſcholars uſually receive from the greater number era- f the of fic.

number of mere muſic maſters. The acknowledged connection of the muſical ratios with the pleaſures of harmony and melody, has (we hope) been employed in an eaſy and not obſcure manner; and the phenomena which we have faithfully narrated, ſhew plainly that, by diminiſhing the rattling undulations of tempered concords, we are certain of improving the harmony of our inſtruments. We ſhall proceed therefore on this principle for the uſe of the mere performer, but at the ſame time introducing ſome very ſimple deductions from Smith's theory, for which we expect the thanks of all ſuch readers as wiſh to ſee a little of the reaſons on which they are to proceed.

8 od in ce.

The experiment, of which we have juſt now given an account, ſhews that four conſecutive fifths compoſe a greater interval than two octaves and a major third. Yet, in the conſtruction of our muſical inſtruments of fixed ſounds, they muſt be conſidered as of equal extent; ſince we have 7 half intervals in the Vth, and 12 in the octave, and four in the IIId, four Vths contain 28, and two octaves contain 24; and theſe, with the four which compoſe a IIId, make alſo 28. It is plain, therefore, that whatever we do with the IIIds, we muſt leſſen the Vths. If therefore we keep the IIId perfect, we muſt leſſen each of the Vths by $\frac{1}{4}$th of a comma; for we learned, by the beating of the imperfect IIId *c e*, that the whole exceſs of the four Vths was a comma. Therefore the Vth *c g* muſt be flattened $\frac{1}{4}$th of a comma. But how is this to be done with accuracy? Recollect the formula given a little ago, where the number of beats *b* in any number of ſeconds is $= \frac{2\,q\,m\,\mathrm{N}}{161 \times p + q}$. In the preſent caſe $q = 1$, $m = 3$, $\mathrm{N} = 240$ per ſecond, and $p = 4$. Therefore the formula is $= \frac{2 \times 3 \times 240}{161 \times 4 + 1} = \frac{1440}{645} = 2{,}25$ in a ſecond, or 9 beats in four ſeconds very nearly.

In like manner, the next Vth $g\,\bar{d}$ muſt be flattened $\frac{1}{4}$th of a comma, by making it beat half as faſt again, or $13\frac{1}{2}$ beats in four ſeconds (becauſe in this Vth $\mathrm{N} = 360$). But as this beating is rather too quick to be eaſily counted, it will be better to tune downwards the perfect octave *g* G, which will reduce N to 180 for the Vth G *d*. This will give us 1,68 per ſecond, or 10 beats in 6 ſeconds very nearly.

There is another way of avoiding the employment of too quick beats. Inſtead of tuning the octave *g* G, make *c* G beat as often as *c g*. This is even more exactly an octave to *g* than can be eſtimated by a good ear. Dr Smith has demonſtrated, that when a note makes a minor concord with another note below it, and therefore a major concord with the octave to that note, it beats equally with both; but if the major concord be below, it beats twice as faſt with the octave above. Now, in the preſent caſe, *c g* is a Vth, and *c* G a 4th. For the ſame reaſon *c f* would beat twice as faſt as *c* F.

In the next place, the Vth $\bar{d}\,a$ muſt be made to beat flat 15 times in 6 ſeconds.

In like manner, inſtead of tuning upward the Vth $\bar{a}\,\bar{\bar{c}}$, tune downward the octave $\bar{a}\,a$, and then tune upward the Vth *a e*, and flatten it till it beat 15 times in 8 ſeconds.

Temperament of the Scale of Muſic.

If we take 15 ſeconds for the common period of all theſe beats, we ſhall have

The beats of $c\,g = 34.$
$\mathrm{G}\,d = 25.$
$d\,\bar{a} = 37\frac{1}{2}.$
$a\,e = 28.$

69. We ſhall now find *c e* to be a fine IIId, without any ſenſible beating; and then we proceed in the ſame way, always tuning upward a perfect Vth; and when this would lead us too high, and therefore produce too quick beating, we ſhould tune downward an octave. Do this till we reach *b* ♯, which ſhould be the ſame with $\bar{c}$, or a perfect octave above *c*. This will be a full proof of our accurate performance. But the beſt proceſs of tuning is to ſtop when we get to *g* ♯. Then we tune Vths downward from *c*, and octaves upward when the Vths would lead us too low. Thus we get *c* F, F *f*, $f\,b^{b}$, b^{b}, $\bar{b}^{b}$, $\bar{b}^{b}\,eb$, and thus complete the tuning of an octave. We take this method, inſtead of proceeding upwards to $\bar{b}$ ♯; becauſe thoſe notes marked ſharp or flat are, when tuned in this way, in the beſt relation to thoſe with which they are moſt frequently uſed as IIIds.

70 Uſe of a variable pendulum.

The proceſs of temperament will be greatly expedited by employing a little pendulum, made of a ball of about two ounces weight, ſliding on a light deal rod, having at one end a pin hole through it. To prepare this rod, hang it up on a pin ſtuck into the wainſcoting, and ſlide the ball downward, till it makes 20 vibrations in 15″, by comparing it with a houſe clock. In this condition mark the rod at the upper edge of the ball. In like manner, adjuſt it for 24, 28, 32, 36, 40, 44, 48, vibrations, making marks for each, and dividing the ſpaces between them by the eye, noticing their gradual diminution. Then, having calculated the beats of the different Vths, ſet the ball at the mark ſuited to the particular concord, and temper the ſound till the beats keep pace exactly with the pendulum.

71 Abſolute number of pulſes how known.

But, previous to all this, we muſt know the number of pulſes made in a ſecond by the C of our inſtrument. For this purpoſe we muſt learn the pulſes of our tuning fork. To learn this, a harpſichord wire muſt be ſtretched by a weight till it be uniſon or octave below our fork: then, by adding $\frac{1}{40}$th of the weight to what is now appended, it will be tempered by a comma, and will beat, when it is ſounded along with the fork; and we muſt multiply the beats by 80: The product is the number of pulſes required. And hence we calculate the pulſes of the C of our inſtrument when it is tuned in perfect concord with the fork.

The uſual concert pitch and the tuning forks are ſo nearly conſonant to 240 pulſes for C, that this proceſs is ſcarcely neceſſary, a quarter of a tone never occaſioning the change of an entire beat in any of our numbers.

72 Syſtem of temperament with perfect IIId.

The intelligent reader cannot but obſerve, that this ſyſtem of tuning with perfect IIIds, which is preferred to all others by many great maſters, is the one repreſented by our circular figure of the octave. The IIId is there perfect, and the Vth C G is deficient by a quarter of a comma. We cannot here omit taking notice of a moſt valuable obſervation of Dr Smith's on this temperament, and, in general, on any diviſion of the octave into mean tones and equal limmas.

The octave being made up of five mean tones and two limmas, it is plain that by enlarging the tones, we

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73
Proportional variations of temperament.

we diminiſh the limmas, and that the increment of the tone is two-fifths of the contemporaneous diminution of the limma. If, therefore, we employ the ſymbol v to expreſs any minute variation of this temperament, and make the increment of a mean tone $= 2v$, the contemporaneous variation which thus induces on a limma will be $= -5v$; and if the tone be diminiſhed by the ſame quantity $-2v$, the limma will increaſe by the quantity $5v$. Let us ſee what are the contemporaneous changes made on all the intervals of the octave when the tone is diminiſhed by $2v$.

1. A Vth is made up of three tones and a limma. Therefore the variation of its temperament is $= -6v + 5v$, or is $= -v$. That is, the Vth is flattened from its former temperament, whatever that may have been, by the quantity $-v$. Conſequently the 4th, which is always the complement of the Vth to the octave, has its temperament ſharpened by the quantity v.

2. A IId, being a tone diſtant from the fundamental, has its temperament changed by $-2v$.

Therefore a minor 7th is raiſed by $2v$.

3. A minor 3d is made up of a tone and a limma: therefore its variation is $= -2v + 5v$, or $= 3v$.

Therefore a major VIth (its complement) loſes $-3v$.

4 A maj. IIId, or two tones, has its variation $= -4v$.

Therefore a minor 6th has its variation $= 4v$.

5. A maj. VIIth, the complement of a limma has $-5v$.

6. A tritone, or IVth, muſt have the variation $= -6v$.

Therefore the falſe 5th muſt have - - $6v$.

74
Geometrical conſtruction founded on this.

From this obſervation, Dr Smith deduces the following ſimple mathematical conſtruction: In the ſtrait line CE (fig. 2.) take the ſix equal parts C*g*, *g d*, *d a*, *a* E, E *b*, *b t*, and draw through the points of diviſion the ſix parallel lines *g* G, *d* D, &c. Let theſe lines repreſent ſo many ſcales of the octave, ſo placed that the points C, *g*, *d*, &c. may repreſent the points C, *g*, *d*, &c. of the circular ſcale in fig. 1. where it is cut by the dotted lines repreſenting the ſyſtem of mean tones and limmas. Then, 1*ſt*, take a certain length *d* G on the firſt line, to the right hand of the line CE, to repreſent a quarter of a comma. G will mark the place of the perfect Vth, while *g* repreſents that of the mean or tempered Vth. 2*dly*, Set off *d* D, double of *g* G, in like manner, to the right hand on the ſecond parallel. This will be the place of the perfect IId to the key note C. 3*dly*, Alſo ſet off *a* A, on third parallel, to the left hand, equal to *g* G. This will mark the place of A, the VIth to the key note C. 4*thly*, Place E on the point *e*, becauſe, in the ſyſtem of mean tones repreſented in fig. 1. the IIIds were kept perfect. 5*thly*, Make *b* B, to the right hand on the fifth line, equal to *g* G, to mark the place of the perfect VIIth to the key note C. And, 6*thly*, make *t* T, to the right hand on the ſixth line, equal to twice *g* G. This will ſerve for ſhewing the contemporaneous temperament of the tritone, or IVth, contained between F and B, as alſo of its complement, the falſe 5th in fig. 1.

It is evident that the temperament of all the notes of the octave, according to the above mentioned ſyſtem, are properly repreſented in this figure. The Vth is tempered flat by the quarter comma G*g*; the IId is tempered flat by the half comma D*d*; the VIth is tempered ſharp by a quarter comma A*a*; the IIId is perfect; the VIIth is flat by a quarter comma B*b*; and the 4th is ſharp by a quarter comma G*g*.

Now, let any other ſtraight line C*t'* be drawn from C acroſs theſe parallels. This will mark, by the intervals *g'*G, *d'*D, &c. the temperaments of another ſyſtem of mean tones and limmas. For it is evident, that the contemporaneous variations *g g'*, *d d'*, &c. from the former temperament, are in the juſt proportions to each other; *g g'* being $= -v$, the variation proper for the Vth, and the oppoſite temperament for its complement or 4th. In like manner, *a a'* is $= 3v$, the variation competent to the VIth; and E*e'* is $= 4v$, the proper variation for the IIId.

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ment of
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In like manner, *b b'* is $= 5v$, the variation of the VIIth and 2d. And, laſtly, *t t'* is the variation $6v$ of the tritone, and its complement, the falſe fifth.

For all theſe reaſons, any ſtraight line C*e'* or C*e''*, drawn from C acroſs the parallels, may juſtly be called the TEMPERER.

76

This is a very uſeful conſtruction: For it is plain, that the ſounds which can be placed in our organs and harpſichords, which have only twelve keys for an octave, muſt approach to a ſyſtem of mean tones. The diviſion of the octave into twelve equal intervals is ſuch a ſyſtem of mean tones exactly. Now, in ſuch ſyſtems, when a line is drawn from C acroſs the parallels, we ſee, at one glance, not only all the temperaments of the notes with the key note, but alſo the temperaments of thoſe concords which the notes employed in full harmony make with each other. Thus, in the harmony of K — III — V, the III and V make a minor 3d with each other; and in the harmony of K — 4 — VI, the 4 and VI make a major 3d with each other. Now the reader will eaſily ſee, that the firſt of theſe concords has its interval diminiſhed on both ſides, when the III is tempered ſharp, but only on one ſide when it is tempered flat. The mathematical reader will alſo eaſily ſee, that the contemporaneous temperament A*a'* of the VIth is always equal to the ſum *g'*G and E*e'*, and that A*a''* is equal to the difference of *g''*G and E*e''*. Therefore the temperament of this ſubordinate concord, in the full harmony K — III — V, is in all caſes, the ſame with the contemporaneous temperament of the VIth.

In like manner, he will perceive that the temperament of the ſubordinate IIId, in the harmony of K — 4 — VI, is equal to the contemporaneous temperament of the III.

We alſo ſee, in general, that the whole harmony is more hurt when the temperer lies in the angle ECK, with the IIId tempered ſharp, than when it is in the angle ACE, when the IIId is flat; and that the ſum of all the temperaments of the concords with the key is the ſmalleſt when the IIIds are perfect. This ſyſtem of mean tones, with perfect IIIds, would therefore be the beſt, if the harmony of different concords were equally hurt by the ſame temperament.

77
Certai
ſcales o
great u

We do not know any thing that has been publiſhed on the ſcience of muſic that gives more general and ſpeedy inſtruction than this ſimple figure. If it be drawn of ſuch a ſize as to allow the comma EK to be divided into a number of equal parts, ſufficiently ſenſible, all trouble of calculation will be ſaved.

We would therefore propoſe to accompany this figure with proper ſcales.

The *firſt* ſcale ſhould have G*g* divided into $13\frac{1}{4}$ parts. This will expreſs the logarithmic meaſures of the temperaments mentioned in nº 63. a comma being $= 54$.

The *ſecond* ſcale ſhould have *g*G divided into 36 parts.

This

This gives the beats made in 16 ſeconds by the notes c, g, when tempered by any quantity Gg'.

The *third* ſcale ſhould have gG divided into 60 parts, for the beats made by the notes c, e, or the notes c, $\bar{a}$.

The *fourth* ſcale ſhould have gG divided into 72 parts. This gives the beats made by the key note C, with its minor third e^{b}.

The *fifth* ſcale ſhould have gG divided into 48 parts, for the beats made by the notes c, f.

The *ſixth* ſcale ſhould have gG divided into 89 parts, on which Aa' is meaſured, to get the beats of the ſubordinate concord formed by g and e in the harmony of K — III — V.

And, *laſtly*, gG, divided into 80 parts, will give the beats made by f and $\bar{a}$ in the harmony of K — 4 — VI.

We are ignorant of the immediate efficient cauſes of the pleaſure we receive from certain conſonances, and ſhould therefore receive, with ſatisfaction, any thing that can help us to approximate to a meaſure of its degrees. We know that, in fact, the pleaſantneſs of any individual concord increaſes as the undulations called *beats* diminiſh in frequency. It is probable that we ſhall not deviate very far from the truth, if we ſuppoſe the harmoniouſneſs of an individual tempered concord to be proportional to the ſlowneſs of theſe undulations. But it by no means follows, that a tempered Vth and a IId are equally pleaſant, each in its kind, when they beat equally ſlow. There is a difference *in kind* in the pleaſures of theſe concords: and this muſt ariſe from the peculiar manner in which the component pulſes of each concord divide each other. We are certain that this is all the difference that obtains between them in Nature. But the harmonionſneſs here ſpoken of is the arrangement which produces this pleaſure. We are intitled to ſay, that this is equal in two given inſtances, when the arrangements are preciſely ſimilar; and when the things arranged are the ſame, nothing ſeems to remain in which the inſtances can differ.

At any rate, it is of conſequence to be able to proportion and diſtribute theſe undulations at pleaſure. They are unpleaſant; and when reinforced by uniting, muſt be more ſo. The theory puts it in our power to prevent this union: perhaps by making them very unequal; or, if this ſhould give a chance of periodical accumulation, we may find it better to make them all equal. Surely to have all this in our power is very deſirable; and this is obtained by the theory of the beats of imperfect conſonances.

But we are forgetting the proceſs of tuning, and have only tuned three or four notes of our octave. We muſt tune the reſt by conſidering their relation to notes already tuned. Thus, if gc makes 36 beats in 16 ſeconds, Fc ſhould make one third leſs, or about 24 in the ſame time; becauſe N in the formula is now 160 inſtead of 240. Proceeding in this way, we ſhall tune the octave $C\bar{\bar{c}}$ moſt accurately as a ſyſtem of mean tones with perfect IIIds, by making the notes beat as follows. A point is put over the note that is to be tuned from the other, and a +, or a —, means that the concord is to be tempered ſharp or flat. Thus g is tuned from c,

Make	$c\dot{g}$	beat —	36 times in 16 ſeconds
	$\dot{G}c$	+	36
	$G\dot{d}$	—	27, *i. e.* $\frac{3}{4}$ths of gc
Make	$c\dot{f}$		— 48
	$c\dot{\bar{a}}$	beat	+ 60 times in 16 ſeconds
	$c\dot{e}$		0, *i. e.* a perfect IIId
	$d\dot{f}\sharp$		0
	$e\dot{g}\sharp$		0
	$a\dot{\bar{c}}\sharp$		0
	$\dot{b}^{b}f$	downward	— 24, *i. e.* $\frac{2}{3}$ths of cg
	$b^{b}\dot{\bar{b}}^{b}$		0, *i, e.* a perfect octave
	$\bar{b}^{b}\dot{e}^{b}$	downward	— 43, *i. e.* $\frac{6}{5}$ths of cg
	$C\dot{\bar{c}}$		0 an octave.

Temperament of the Scale of Muſic.

Other proceſſes may be followed, and perhaps ſome of them better than the proceſs here propoſed. Thus, b^{b} and e^{b} may be tuned as perfect IIIds to d and g downwards. Alſo, as we proceed in tuning, we can prove the notes, by comparing them with other notes already tuned, &c. &c. &c.

We have directed to tune the two notes b^{b} and e^{b} by taking the leading Vth downwards. We ſhould have come at the ſame pipes in the character of $a\sharp$ and $d\sharp$ in the proceſs of tuning upwards by Vths. But this would not have produced preciſely the ſame ſounds, although, in our imperfect inſtruments, one key muſt ſerve for $a\sharp$ and b^{b}. By tuning them as here directed, they are better fitted for the places in which they will be moſt frequently employed in our uſual modulations.

80 Another ſyſtem very fit for our inſtruments.

It may reaſonably be aſked, Why ſo much is ſacrificed in order to preſerve the IIIds perfect? Were they allowed to retain ſome part of the ſharp temperament that is neceſſary for preſerving the Vths perfect, we ſhould perhaps improve the harmony. And ſince enlarging the fifth makes the tone greater, and therefore the limma *mi fa* much ſmaller, it will bring it nearer to the magnitude of a half tone; and this will be better ſuited for its double ſervice of the ſharp of the note below, and the flat of the note above. Accordingly, ſuch a temperament is in great repute, and indeed is generally practiſed, although the VIth and the ſubordinate chords of full harmony are evidently hurt by it. Even Dr Smith recommends it as well ſuited to our defective inſtruments, and gives an extremely eaſy method of executing it by means of the beats. His method is to make the Vth and IIId beat equally faſt, along with the key, the Vth flat, and the IIId ſharp. He demonſtrates (on another occaſion), that concords beat equally faſt with the ſame baſs when their temperaments are inverſely as the major terms of their perfect ratios. Therefore draw EG, and divide it in p, ſo that Ep may be to pG as 3 to 5. Fig. 2. Then draw Cp, cutting gG in g', and EK in e'; and this temperer will produce the temperament we want. It will be found, that Ee' and Gg' are each of them 32 of their reſpective ſcales.

Therefore make	cg	beat 32 times in 16 ſeconds
	Gc	32
	Gd	24
	Gb	24, and tune $b\bar{b}$
	$d\bar{a}$	36, and tune $a\bar{a}$
	$df\sharp$	36
	ac	27
	$a\bar{c}\sharp$	27
	$e\bar{b}$	$40\frac{1}{2}$, proving $b\bar{b}$
	$eg\sharp$	$40\frac{1}{2}$

Therefore make F c $21\frac{1}{3}$, and tune F f
F a beat $21\frac{1}{3}$, proving a
$b^b f$ $28\frac{1}{2}$, and tune $b^b \overline{b^b}$
$e^b \overline{b^b}$ $38\frac{1}{2}$,
$c \overline{c}$ 0.

It may be proper to add to all theſe inſtructions a caution about the manner of counting the clock while the tuner is counting the beats. If this is to continue for 16 ſeconds, let the perſon who counts the clock ſay *one* at the beat he begins with, and then telling them over *to himſelf*, let him ſay *done* inſtead of 17. Thus 16 intervals will elapſe while the tuner is counting the beats. Were he to begin to count at *one*, and ſtop when he hears ſixteen, he would get the number of beats in 15 ſeconds only.

81. We do not heſitate to ſay, that this method of tuning by beats is incomparably more exact than by the mere judgment of the ear. We cannot miſtake more than one beat. This miſtake in the concord of the Vth amounts to no more than $\frac{1}{103}$th of a comma; and in the IIId it is only $\frac{1}{180}$.

82 Practical inſtructions. It may be objected that it is fit only for the organ and inſtruments of continued ſounds, but will not do for the quickly periſhing ſounds of the harpſichord. True, it is the only method worthy of that noble inſtrument, and this alone is a title to high regard. But farther; the accuracy attainable by it, renders it the only method fit for the examination of ſyſtems of temperament. Even for the harpſichord it is much more exact, and more certain in its proceſs, than any other. It does not proceed by a random trial of a flattened ſeries of Vths, and a compariſon with the reſulting IIId, and a ſecond trial, if the firſt be unſatisfactory. It ſays at once, let the Vth beat ſo many times in 16 ſeconds. Even in the ſecond method, without counting, and merely by the quality of the beats of the Vth and IIId, the progreſs is eaſy. Both are tuned perfect. The Vth is then flattened a little, and the IIId ſharpened;—if the Vth beat faſter than the IIId, alter it firſt.

All difficulty is obviated by the ſimple contrivance of a variable pendulum, already deſcribed. This may be made exact by any perſon that will take a little pains; and when once made will ſerve for every trial. When the ball is ſet to the proper number, and the pendulum ſet a ſwinging, we can come very near the truth by a very few trials.

N. B. In tuning a piano forte, which has always two ſtrings to a key, we muſt never attempt tuning them both at once; the back uniſon of both notes of the concord muſt be damped, by ſticking in a bit of ſoft paper behind it.

We hope that the inſtructions now given, and the application of them to two very reſpectable ſyſtems of temperament, are ſufficient for enabling the attentive reader to put this method of tuning ſucceſsfully in practice, and that he perceives the efficiency of it for attaining the deſired end. But before we take leave of it, we beg leave to mention another circumſtance, which evinces the juſt value of the general theory of the beats of imperfect conſonances as delivered by Dr Smith.

83 Origin of the Tartinian ſounds. Theſe reinforcements of ſound, which are called *beatings*, are noiſes. If any noiſe whatever be repeated, with ſufficient frequency, at equal intervals, it becomes a muſical note, of a certain determinate pitch. If it recur 60 times in a ſecond, it becomes the note C *fa ut*, or the double octave below the middle C of our harpſichords, or the note of an open pipe eight feet long. Now there is a ſimilar (we may call it the very ſame) reinforcement of ſound in every concord. Where the pulſe of one ſound of the concord biſects the pulſe of the other, the two ſounds are more uniformly ſpread: but where they coincide, or almoſt coincide, the condenſation of one undulation combines with that of the other, and there comes on the ear a ſtronger condenſation, and a louder ſound. This may be called a *noiſe*; and the equable and frequent recurrence of this noiſe ſhould produce a muſical note. If, for inſtance, *c* and *a* are ſounded together: There is this noiſe at every third pulſe of *c*, and every fifth pulſe of *a*; that is, 80 times in a ſecond. This ſhould produce a note which is a 12th below *c*, and a 17th major below *a*; that is, the double octave below *f*, which makes 320 vibrations in a ſecond. That is to ſay, along with the two notes *c* and *a* of the concord, and the compound ſound, which we call the *concord of the VIth*, we ſhould hear a third note FF in the baſs. Now this is known to be a fact, and it is the grave harmonic obſerved by Romieu and Tartini about the year 1754, and verified by all muſicians ſince that time. Tartini prized this obſervation as a moſt important diſcovery, and conſidered it as affording a foundation for the whole ſcience of muſic. We ſee that it is all included in the theory of beats publiſhed five years before, namely, in 1749; and every one of theſe grave harmonics, or Tartinian ſounds, as they have been called, are immediate conſequences of this theory. The ſyſtem of harmonious compoſition which Tartini has, with wonderful labour and addreſs, founded on it, has therefore no ſolidity. It is, however, preferable to Rameau's, becauſe it proceeds on a fact founded on the nature of muſical ſounds; whereas Rameau's is a mere whim, proceeding on a falſe aſſumption; namely, "that a muſical ſound is eſſentially accompanied by its octave, 12th, and 17th *in alto*."—This is not true, though ſuch accompaniment be very frequent, and it be very difficult to prevent it. Mr Rameau ought to have ſeen this. Are theſe acute harmonics muſical ſounds or not? He ſurely will not deny this. Therefore they, too, are eſſentially accompanied by *their* harmonics, and this abſolutely and neceſſarily *ad infinitum*; which is certainly abſurd. We ſhall have a better occaſion for conſidering this point when we deſcribe the *TRUMPET Marigni* in a future article.

84 Dr Smi ſyſtem EQUAL HARMO We have taken notice of only two ſyſtems of temperament; both of them are ſyſtems of mean tones, and are in good repute as practicable methods. It would be almoſt an endleſs taſk to mention all the ſyſtems of temperament which have been propoſed. Dr Smith, after having, with great ingenuity, appreciated the changes of harmoniouſneſs that are induced on the different concords by the ſame temperament, and having aſſigned that proportion of temperament which renders them equally harmonious, each in its kind, gives a ſyſtem of temperament, which he calls EQUAL HARMONY. Each concord (excepting the octave) is tempered in the inverſe proportion of the product of the terms of its perfect ratio. It is very nearly equivalent to a diviſion of the octave into 50 equal parts. We do not give any farther account of it here, although we think its

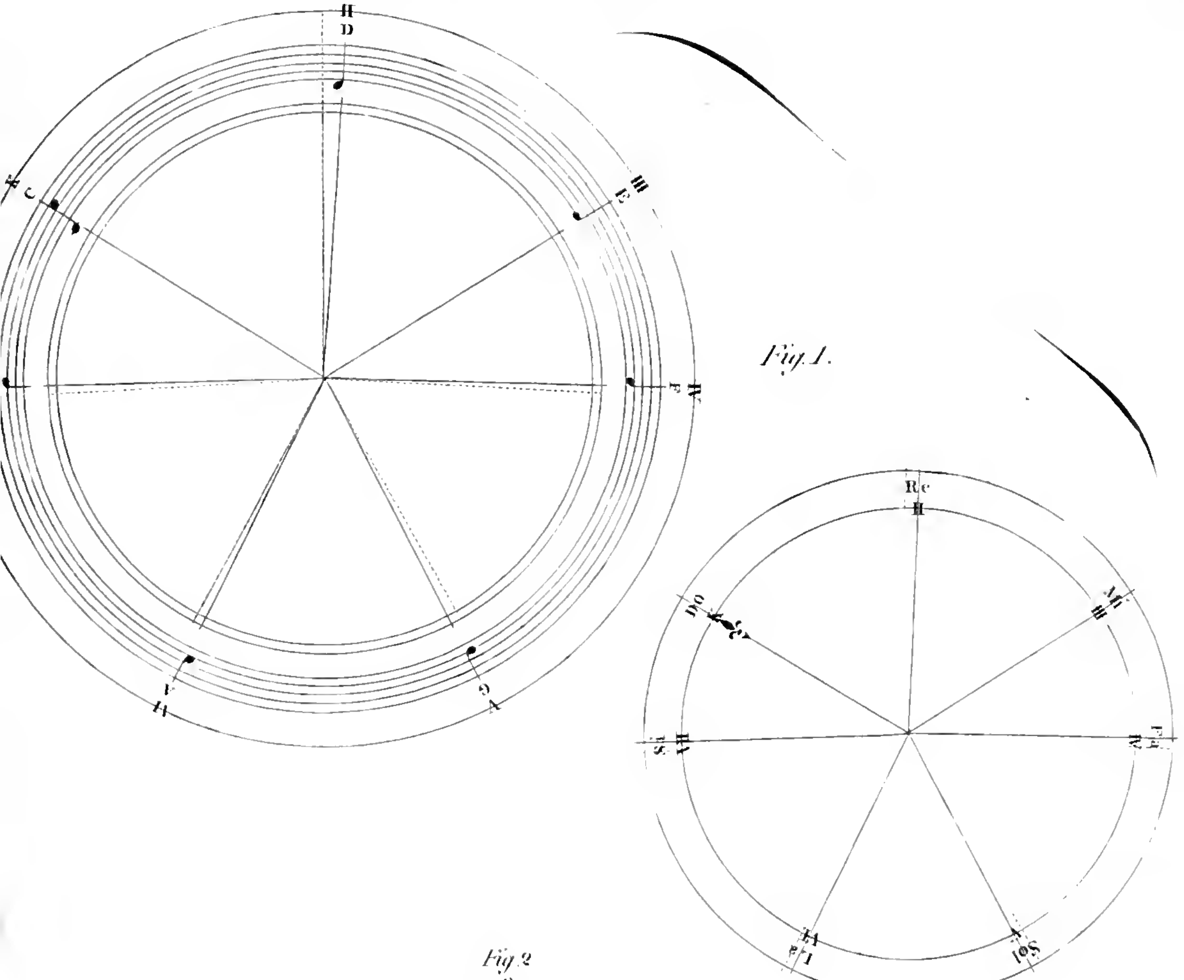
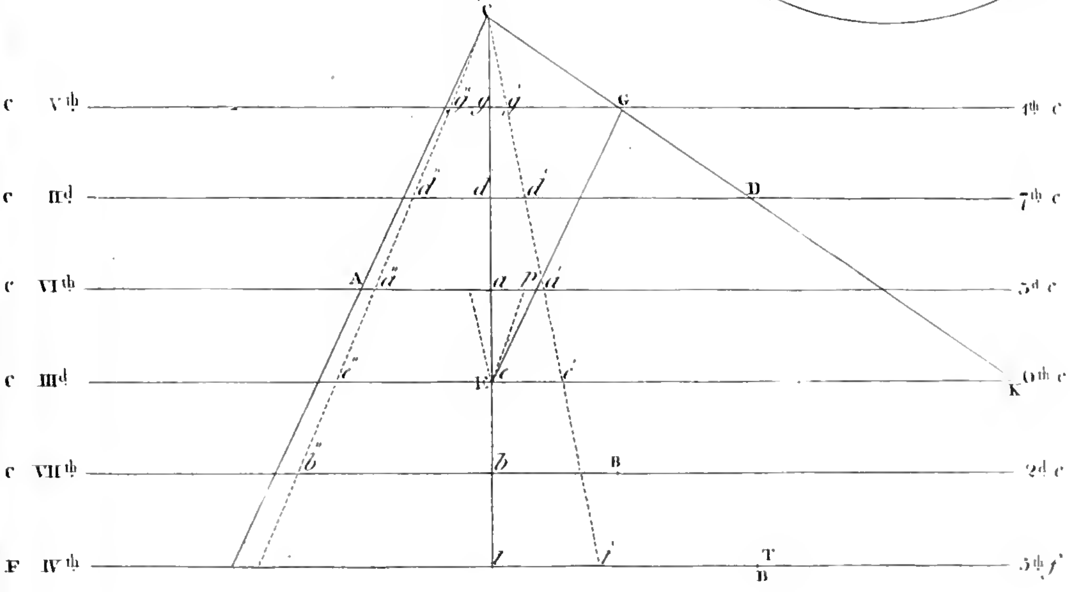

H
D
III
E
IV
F
V
G
C
K
Re
II
Mi
III
Fa
IV
Sol
V
La
VI
Si
VII

Fig. 1.

Fig. 2


C
c V th
4th c
g g g G
c II d
7th c
d d d D
c VI th
3d c
A a a P a
c III d
6th c
e E e e K
c VII th
2d c
b b B
F IV th
5th f
1 1 T B

harmony preferable to any thing that we have ever heard. We heard it, as executed for him, and under his inſpection, by the celebrated harpſichord-maker Kirkmann, both when the inſtrument was yet in the hands of the maker, and afterwards by the ingenious author. We have alſo heard ſome excellent muſicians declare, that the organ of Trinity college chapel at Cambridge was greatly improved in its harmony by the change made on its temperament under the inſpection of Dr Smith. When we name Stanley, we preſume that the authority will not be diſputed. We mention this, becauſe the writer in the Philoſophical Tranſactions ſpeaks of this ſyſtem, with flattened major thirds, as of no value. But we do not give any farther account of it, becauſe it is not ſuited to our inſtruments, which have but twelve ſounds in the octave.

85

The reader will pleaſe to recollect, that the great object of temperament is twofold. Firſt, to enable us to tranſpoſe muſic from one pitch to another, ſo that we may make any note of the organ the fundamental of the piece. This undoubtedly requires a ſyſtem approaching to one of mean tones, becauſe the harmony muſt be the ſame in every key. This requires temperament, becauſe a ſound muſt be occaſionally conſidered, either as the ſharp of the note below it, or the flat of the one above. This cannot produce perfect harmony, becauſe the limma of the perfect diatonic ſcale is greater than a half tone. Thus a temperament is neceſſary merely for the ſake of the melody. But, *ſecondly*, the nature of modern muſic requires every note to be accompanied, or conſidered as accompanied, with full harmony. This is, in fact, the ſame thing with modulating on every different note as a fundamental; but it requires a much cloſer attention to the perfection of the intervals, becauſe a defect or exceſs in an interval that would ſcarcely offend the ear, if the notes were heard in ſucceſſion, is quite intolerable when they are ſounded together. Here the difference between the major and minor tone is of almoſt as great moment as the difference of the limma from a ſemitone. The ſecond object, therefore, is to obtain, in the compaſs of three octaves, as many good concords of full harmony; that is, conſiſting of a fundamental with its major third and its fifth, erect or inverted, as poſſible. There is no other harmony, although our notes have frequently a different ſituation and appearance.

86
xims of npera- nt very tuitous.

It is no wonder that, in a ſubject where we are yet to ſeek for a principle, the attempts to attain this object have been very various, and very gratuitous. The mathematicians, even in modern times, have allowed themſelves to be led away by fancies about the ſimplicity and conſequent perfection of ratios; and having no clear principle, it is no wonder that ſome of their deductions are contrary to experience. According to Euler, thoſe ratios which are moſt perfect, that is, moſt ſimple, admit of leaſt temperament. The octave is therefore infinitely perfect; for it is allowed by all, that it muſt not have the ſmalleſt temperament. A Vth muſt be leſs tempered than a IIId. Even the practical muſician thinks that he has tempered theſe two concords equally, when the offenſive quality of each is made equally ſo; but in this caſe it is demonſtrable, that the Vth has been much more tempered than the IIId. But this could not be diſcovered till we got the theory of beats.

Moſt of the mathematical muſicians adhered to ſyſtems of mean tones; or, which are equivalent to ſuch ſyſtems, giving ſimilar harmonies on every key of the harpſichord. This is ſurely the moſt natural, and is peculiarly ſuggeſted by the tranſpoſing of muſic from one pitch to another: but they differ exceedingly, and without giving any convincing arguments, in their eſtimation of the effects of the ſame temperament on different concords. Much of this, we apprehend, ariſes from diſpoſition. Perſons of a gay diſpoſition reliſh the harmony of the IIId, and prefer a ſharp to a flat temperament of this concord. Perſons of a more penſive diſpoſition, prefer ſuch temperaments as allow the minor thirds to be more perfect.

87
Equal harmony rejected

But there are many, eminent both as performers and as theoriſts, who reject any ſyſtem which gives the ſame harmonies on every note of the octave. They obſerve, that in the progreſs of the cultivation of muſic in Europe, the melodies of all nations have gradually approached to a certain uniformity. Certain cadences, cloſes, ſtrains, and phraſes, are becoming every day more common; and even in the conduct of a conſiderable piece of muſic, and the gradual but ſlow paſſage of the modulation from one key into another, there is a certain regularity. Nay, they add, that this cannot be greatly deviated from without becoming very offenſive. We may remain ignorant of the cauſe of this uniformity; but its exiſtence ſeems to prove that it ariſes from ſome natural principle; and therefore it ought to be complied with, and our temperaments ſhould be accommodated to it. The reſult of this uniformity in the muſic of our times is, that the modulation on ſome keys is much leſs frequent than on others, and this frequency decreaſes in a certain order. Suppoſing that we begin on C. A piece of plain muſic ſeldom goes farther than G and F. A little more fancy and refinement leads the compoſer into D, or into B^b, &c. &c. It would therefore be deſirable to adjuſt our temperaments ſo, that the harmonies in C ſhall be the beſt poſſible, and gradually leſs perfect in the order of modulation. Thus we ſhall, in our general practice, have finer harmony than if it were made equal throughout the octave; becauſe the unavoidable imperfections are thrown into the leaſt frequented places of the ſcale. The practical muſicians add to this, that by ſuch a temperament the different keys acquire characters, which fit each of them more particularly for the expreſſion of different ſentiments, and for exciting different emotions. This is very perceptible in our harpſichords as they are generally tuned. The major key of A is remarkably brilliant; that of F is as remarkably ſimple, &c.

We cannot ſay that we are altogether convinced by theſe arguments. The violin is unqueſtionably the inſtrument of the greateſt powers. A concert of inſtruments of this kind, unembarraſſed by the harpſichord, or any inſtruments incapable of occaſional temperament, is the fineſt muſic we have. The performers make no ſuch degradations of harmony, but keep it as perfect as poſſible throughout; and a violin performer is ſenſible of violence and conſtraint when he accompanies a keyed inſtrument into theſe unfrequented paths. Let him play the ſame muſic alone, and he will play it quite differently, and much more to his own ſatiſfaction. We imagine, too, that much of the uniformity ſpoken of is the reſult of imitation and faſhion, and even of the temperaments that we have preferred. There is an evident diſtinction in the native muſic of different nations. An experienced muſician will know, from a few bars, whether an air is Iriſh, Scotch, or Poliſh. This diſtinction is in the modulation; which, in thoſe nations, follows different courſes, and ſhould therefore, on the ſame principle, lead to different temperaments.

With reſpect to the variety of characters given to the different keys, we muſt acknowledge the fact. We have tuned a piano forte in the uſual manner; but inſtead of beginning the proceſs with C, we began it with D. An excellent performer of voluntaries ſat down to the inſtrument, and began to indulge his rich fancy; but he was confounded at every ſtep; he thought the inſtrument quite out of tune. But when he was informed how it had been tuned, and then tried a known plain air on it, he declared it to be perfectly in tune. It is ſtill very doubtful, however, whether we ſhould not have much finer muſic, by equaliſing the harmony in the different keys, and truſting for the different expreſſion ſo much ſpoken of to a judicious mixture of other notes called *diſcords*.

88 Cauſe of this uncertainty now removed by Dr Smith's theory.

After all, the great uncertainty about the moſt proper temperament has remained ſo long undetermined, becauſe we had no method of executing with certainty any temperament that was offered to the public. What ſignifies it on what principle it may be proper to flatten a Vth one-fifth of a comma, and ſharpen a VIth one-ſeventh of a comma, unleſs we are able to do both the one and the other? Till Dr Smith publiſhed the theory of beats, the monochord was the only aſſiſtance we had: but however nicely it may be divided, it is ſcarcely poſſible to make the moveable bridge ſo ſteady and ſo accurate in its motion, that it will not ſenſibly derange the tenſion of the ſtring. We have ſeen ſome very nice and coſtly monochords; but not one of them could be depended on to one-eighth of a comma. Even if perfect, they give but momentary ſounds by pinching. The bow cannot be truſted, becauſe its preſſure changes the tenſion. Mr Watt's experiments with his monochord of continued ſound ſhewed this evidently. A pitch-pipe with a ſliding piſton promiſes the greateſt accuracy; but we are ſadly diſappointed, becauſe the gradation of the piſton cannot be performed by any mathematical rule. It muſt be puſhed more than half way down to produce, the octave more than one-third to produce the Vth, &c. and this without any rule yet diſcovered. Thanks to Dr Smith we can now produce an inſtrument tuned exactly, according to any propoſed ſyſtem, and then ſubmit it to the fair examination of muſicians. Even the ſpeculatiſt may now form a pretty juſt opinion of the merits of a ſyſtem, by calculating, or meaſuring by ſuch ſcales as we have propoſed, the beats produced by the tempered concords in all parts of the octave. No one who has liſtened with attention to the rattling beats of a full organ, with its twelfth and ſeſquialter ſtops all ſounding, will deny that they are hoſtile to all harmony or good muſic. We cannot be much miſtaken in preferring any temperament in proportion as it diminiſhes the number of thoſe beats. We ſhould therefore examine them on this principle alone; attending more particularly to the beats of the third major, becauſe theſe are in fact the loudeſt and moſt diſagreeable; and we muſt not content ourſelves with the beats of each concord with the fundamental of the full harmony, whether K—III—V, or K—4—VI, or K—3—V, or K—4—6, which ſometimes occurs. We muſt attend equally to the beats of the two notes of accompaniment with each other: theſe are generally the moſt faulty.

89.

This examination is neither difficult nor tedious. 1. Write down, in one column, the lengths of the ſtrings or diviſions of the monochord; in another write their logarithms; in a third the remainders, after ſubtracting each from the logarithm of the fundamental. 3. Have at hand a ſimilar table for the perfect diatonic ſcale. 4. Compare theſe, one by one, and note the difference, + or —, in a 4th column. Theſe are the temperaments of each note of the ſcale. 5. Compare every couple of notes which will compoſe a major or minor third, or a fifth, by ſubtracting the logarithm of the one note from that of the other. The differences are the intervals tempered. 6. Compare theſe with the perfect intervals of the diatonic ſcale, and note the differences, + or —, and ſet them down in a fifth column. Theſe are all the temperaments in the ſyſtem. 7. If we have uſed logarithms conſiſting of five decimal places, which is even more than ſufficient, conſider theſe numeral temperaments as the q of the formula given in n° 65. for calculating the beats, and then p is always $= 540$. Or we may make another column, in which the temperaments are reduced to ſome eaſy fraction of a comma.

90 Syſtem of Dr Young.

We ſhall content ourſelves with giving one example; the temperament propoſed by Mr Young in the Philoſophical Tranſactions for 1800. It is contained in the following table.

1.	2.	3.	4.	5.		
				IIIds upward on		
C	100000	5.00000		C	135	Sharp.
C♯	94723	4.97645	2355	G. F.	190	
D	89304	4.95087	4913	D. B♭	245	
E♭	83810	4.92330	7670	A. E♭	346	
E	79752	4.90174	9826	E. A♭	448	
F	74921	4.87461	12539	B. C♯	494	
F♯	71041	4.85151	14849	F♯	540	
G	66822	4.82492	17508	3ds upward on		
G♯	63148	4.80036	19964	A. E.	236	Flat.
A	59676	4.77580	22420	D. B.	291	
B♭	56131	4.74921	25079	G. F♯	346	
B	53224	4.72610	27390	C. C♯	448	
C	50000	4.69897	30103	F. G♯	494	
				B♭. E♭	540	

Vths upward on

E♭. G♯. C♯. F♯	perfect	Flat.
F. B♭ E. B	46	
C. G. D. A	116	

Interval of a comma - -	540
minor third - -	7918
major third - -	9691
fifth - - -	17609

The firſt column of the above table contains the ordinary deſignations of the notes. The ſecond contains the correſponding lengths of the monochord. The third contains the logarithms of column ſecond. The fourth contains the difference of each logarithm from the firſt. The next column contains, firſt, the temperaments of all the mpera- t of the ale of Iuſic, || mplars.

the major thirds, having for their loweſt note the ſound correſponding to the letter. Thus 494, or $\frac{494}{540}$ of a comma, is the temperament of the IIId, B — D♯, and C♯ — F. Secondly, it contains all the minor thirds formed on the notes repreſented by the letters. The column below contains the temperaments of the Vths. *N. B.* Theſe temperaments are calculated by the author. We have found ſome of them a little different. Thus we make the temperament of C — G only 108. Below this we have ſet down the meaſures of the perfect intervals, which are to be compared with the differences of the logarithms in column third.

91 em of iber- .

We preſume not to decide on the merits of this temperament: Only we think that the temperaments of ſeveral thirds, which occur very frequently, are much too great; and many inſtances of the 6th, which is frequent in the flat key, are ſtill more ſtrongly tempered. A temperament, however, which very nearly coincides with Dr Young's, has great reputation on the continent. This is the temperament by Mr Kirnbergher, publiſhed at Berlin in 1771, in his book called *Die Kunſt des reinen Satzes in der Muſik*. The eminent mathematician Major Templehoff has made ſome important obſervations on this temperament, and on the ſubject in general, in an eſſay publiſhed in 1775, Berlin. Dr Young's is certainly preferable.

The monochord is thus divided by Kirnbergher:

C =	1,0000	F =	7500	B♭ =	5625
C♯	9492	F♯	7111	B	5313
D	8889	G	6667	c	5000
E♭	8437	G♯	6328		
E	8000	A	5963		

We conclude this article (perhaps too long) by earneſtly recommending to perſons who are not mathematically diſpoſed, the ſliding ſcales, either circular or rectilineal, containing the octave divided into 301 parts; and a drawing of fig. 2. on card paper, of proper ſize, having the quarter comma about two inches, and a ſeries of ſcales correſponding to it. This will ſave almoſt the whole of the calculation that is required for calculating the beats, and for examining temperaments by this teſt. To readers of more information, we earneſtly recommend a careful peruſal of Smith's Harmonics, ſecond edition. We acknowledge a great partiality for this work, having got more information from it than from all our patient ſtudy of the moſt celebrated writings of Ptolemy, Huyghens, Euler, &c. It is our duty alſo to ſay, that we have got more information concerning the muſic of the Greeks from Dr Wallis's appendix to his edition of Porphyrius's Commentary on Ptolemy's Harmonics, than from any other work.

TEMPIE, a place in New Galicia, 200 leagues N. W. of the city of Mexico.—*Morſe.*

Templars.

TEMPLARS. In the account of this order, which is publiſhed in the *Encyclopædia*, we have, with many others, ſuppoſed that the guilt of which they were accuſed at the ſuppreſſion of the order was leſs enormous than their enemies alleged. For the honour of human nature, we are ſtill unwilling to believe that this was not the caſe. Juſtice, however, compels us to admit, that the Abbé Barruel has brought together ſuch a cloud of witneſſes againſt the Templars, that we know not how to reſiſt their evidence; and that he has completely proved, that *Philip le Bel* was not influenced by avarice when he ſuppreſſed that order in France. "It has been ſaid, that he and Clement V. had concerted between them the diſſolution of the Templars. The falſity of ſuch an aſſertion is evident on the inſpection of their letters. Clement V. at firſt will give no credit to the accuſations againſt the Templars; and even when he receives inconteſtable proofs from Philip le Bel, he had ſtill ſo little concerted the plan with that Prince, that every ſtep taken by the one or the other occaſions diſputes on the rights of the church or of the throne.

"It was alſo ſaid, that the king wiſhed to ſeize on the great riches of theſe knights: but at the very commencement of his proceedings againſt the order, he ſolemnly renounced all ſhare in their riches; and perhaps no Prince in Chriſtendom was truer to his engagement. Not a ſingle eſtate was annexed to his domain; and all hiſtory bears teſtimony to the fact.

"We next hear of a ſpirit of revenge which actuated this Prince; and during the whole courſe of this long trial, we do not hear of a ſingle perſonal offence that he had to revenge on the Templars. In their defence, not the moſt diſtant hint, either at the revengeful ſpirit, or at any perſonal offence againſt the king, is given; ſo far from it, until the period of this great cataſtrophe, the grand maſter of the order had been a particular friend of the king's, who had made him godfather to one of his children.

"In fine, the rack and torture is ſuppoſed to have forced confeſſions from them which otherwiſe they never would have made; and in the minutes, we find the avowal of at leaſt 200 knights all made with the greateſt freedom, and without any coercion. Compulſion is mentioned but in the caſe of one perſon, and he makes exactly the ſame avowal as 12 other knights, his companions, freely made (A). Many of theſe avowals were made in councils where the biſhops begin by declaring, that all who had confeſſed through fear of the torture ſhould be looked upon as innocent, and that no Knight Templar ſhould be ſubjected to it (B). The Pope Clement V. was ſo far from favouring the king's proſecutions, that he began by declaring them all to be void and null. He ſuſpended the archbiſhops, biſhops, and prelates, who had acted as inquiſitors in France. The king accuſes the Pope in vain of favouring the Templars; and Clement is only convinced after having been preſent at the interrogatories of 72 knights at Poictiers, in preſence of many biſhops, cardinals, and legates. He interrogated them, not like a judge who ſought for criminals, but like one who wiſhed to find innocent men, and thus exculpate himſelf from the charge of having favoured them. He hears them repeat the ſame avowals, and they are freely confirmed. He deſired that theſe avowals ſhould be read to them after an interval of ſome days, to ſee if they would ſtill freely perſevere in their depoſitions. He hears them all confirmed. *Qui perſeverantes in illis, eas expreſſe et ſponte prout recitatæ fuerant approbârunt.* He wiſhed ſtill further to interrogate

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(A) *Layette*, N° 20. *Interrog. made at Caen.*

(B) See the *Council of Ravenna. Rubeus Hiſt. Raven.* lib. vi.

gate the grand maſter and the principal ſuperiors, *præceptores majores*, of the divers provinces of France, Normandy, Poitou, and of the Tranſmarine countries. He ſent the moſt venerable perſons to interrogate thoſe of the ſuperiors, whoſe age or infirmities hindered them from appearing before him. He ordered the depoſitions of their brethren to be read to them, to know if they acknowledged the truth of them. He required no other oath from them than to anſwer freely and without compulſion; and both the grand maſter and the ſuperiors of theſe divers provinces depoſe and confeſs the ſame things, confirm them ſome days after, and approve of the minutes of their depoſitions taken down by public notaries. Nothing leſs than ſuch precautions could convince him of his error: it was then only that he revoked his menaces and his ſuſpenſion of the French biſhops, and that he allows the king to proceed in the trials of the Templars.

"Let ſuch pretexts be forgotten, and let us only dwell on the avowals which truth alone forced from theſe criminal knights.

"Their depoſitions declare, that the Knights Templars, on their reception, denied Chriſt, trampled on the croſs, and ſpit upon it; that Good Friday was a day which was particularly conſecrated to ſuch outrages; that they promiſed to proſtitute themſelves to each other for the moſt unnatural crimes; that every child begotten by a Templar was caſt into the fire; that they bound themſelves by oath to obey, without exception, every order coming from the grand maſter; to ſpare neither ſacred nor prophane; to look upon every thing as lawful when the good of the order was in queſtion; and, above all, never to violate the horrible ſecrets of their nocturnal myſteries, under pain of the moſt terrible chaſtiſements (c).

"In making their depoſitions, many of them declared they had only been forced into theſe horrors by impriſonment and the moſt cruel uſage; that they wiſhed, after the example of many of their brethren, to paſs into other orders, but that they did not dare, fearing the power and vengeance of their order; that they had ſecretly confeſſed their crimes, and had craved abſolution. In this public declaration, they teſtified, by their tears, the moſt ardent deſire of being reconciled to the church.

"All repeat the ſame depoſition, except three, who declare they have no knowledge of the crimes imputed to their order. The Pope, not content with this information taken by men of religious orders and by French noblemen, requires that a new trial ſhould take place in Poitou before cardinals and others whom he himſelf nominates: Again, with the ſame freedom, and for the third time, the grand maſter and other chiefs, in preſence of Clement V. repeat their depoſitions. Molay even requeſted, that one of the lay brothers, who was about his perſon, ſhould be heard, and this brother confirms the declaration. During many years theſe informations were continued and renewed at Paris, in Champagne, in Normandy, in Quercy, in Languedoc, in Provence. In France alone, above 200 avowals of the ſame nature are to be found: nor did they vary in England, where, at the ſynod of London held in 1311, 78 Engliſh knights were heard, and two whole months were ſpent in taking informations and in verifying their declarations. Fifty-four Iriſh were alſo heard, and many Scotch, in their reſpective countries. It was in conſequence of theſe declarations that the order of the Templars was aboliſhed in thoſe kingdoms, and that the parliament diſpoſed of their goods (d). The ſame declarations were taken and proved in Italy, at Ravenna, at Bologna, at Piſa, and at Florence, though in all theſe councils the prelates were very ready to abſolve all thoſe knights who could ſucceed in their juſtifications.

"I would willingly aſſert (continues the Abbé), that it was the ſmaller part of the Templars who ſuffered themſelves to be carried away by ſuch abominations. Some even at Paris were declared innocent. In Italy a ſtill greater number were abſolved; of all thoſe who were judged at the councils of Mayence and Salamanca none were condemned: and hence we may conclude, that of the 9000 houſes belonging to the order, many had not been tainted, and that whole provinces were to be excepted from the general ſtain of infamy. But the condemnations, the juridical depoſitions, the method of initiating the knights, almoſt became general; the ſecrecy of their receptions, where neither prince, nor king, nor any perſon whatever, could be preſent during the laſt half century, are ſo many teſtimonies which corroborate the divers accuſations contained in the articles ſent to the judges; that is to ſay, that at leaſt two thirds of the order knew of the abominations practiſed without taking any ſteps to extirpate them. *Quod omnes, vel quaſi duæ partes ordinis ſcientes dictos errores corrigere neglexerint*.

"This certainly cannot mean that two thirds of the knights had equally partaken of theſe abominations. It is evident, on the contrary, that many deteſted them as ſoon as they were acquainted with them; and that others only ſubmitted to them, though initiated, after the harſheſt treatment and moſt terrible threats. Nevertheleſs, this proves, that the greateſt part of theſe knights were criminal, ſome through corruption, others through weakneſs or connivance; and hence the diſſolution of the order became neceſſary."

TEMPLE, a townſhip of New-Hampſhire, Hillſborough county, N. of New-Ipſwich, and 70 miles weſterly of Portſmouth. It was incorporated in 1768, and contains 520 inhabitants.—*Morſe*.

Temple *Bay*, on the Labrador coaſt, oppoſite Belle Iſle. A Britiſh ſettlement of this name was deſtroyed by the French, in October, 1796.—*ib.*

Biog. Dict

TEMPLEMAN (Peter), M. D. the ſon of an eminent attorney at Dorcheſter in the county of Dorſet, by Mary daughter of Robert Haynes, was born March 17, 1711, and was educated at the Charter-houſe (not on the foundation), whence he proceeded to Trinity-college, Cambridge, and there took his degree of B. A. with diſtinguiſhed reputation. During his reſidence at Cambridge, by his own inclination, in conformity with that of his parents, he applied himſelf to the ſtudy of divinity, with a deſign to enter into holy orders; but after ſome time, from what cauſe we know not, he altered

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(c) See the *Vouchers brought by Dupuy*, and *Extract of the Regiſters*.

(d) Vide *Valſinger in Edvardum II. et Ypodigma Neuſtriæ apud Dupuy.—Eſſai de Fred. Nicolai.*

mple-
man.

tered his plan, and applied himſelf to the ſtudy of phyſic. In the year 1736, he went to Leyden, where he attended the lectures of Boerhaave, and the profeſſors of the other branches of medicine in that celebrated univerſity, for the ſpace of two years or more. About the beginning of 1739, he returned to London, with a view to enter on the practice of his profeſſion, ſupported by a handſome allowance from his father. Why he did not ſucceed in that line was eaſy to be accounted for by thoſe who knew him. He was a man of a very liberal turn of mind, of general erudition, with a large acquaintance among the learned of different profeſſions, but of an indolent, inactive diſpoſition; he could not enter into juntos with people that were not to his liking; nor cultivate the acquaintance to be met with at tea-tables; but rather choſe to employ his time at home in the peruſal of an ingenious author, or to ſpend an attic evening in a ſelect company of men of ſenſe and learning. In this he reſembled Dr Armſtrong, whoſe limited practice in his profeſſion was owing to the ſame cauſe. In the latter end of the year 1750 he was introduced to Dr Fothergill by Dr Cumming, with a view of inſtituting a Medical Society, in order to procure the earlieſt intelligence of every improvement in phyſic from every part of Europe. At the ſame period he tells his friend, "Dr Mead has very generouſly offered to aſſiſt me with all his intereſt for ſucceeding Dr Hall at the Charter houſe, whoſe death has been for ſome time expected. Inſpired with gratitude, I have ventured out of my element (as you will plainly perceive), and ſent him an ode." Dr Templeman's epitaph on Lady Lucy Meyrick (the only Engliſh copy of verſes of his writing that we know of), is printed in the eighth volume of the "Select Collection of Miſcellany Poems, 1781." In 1753 he publiſhed the firſt volume of "Curious Remarks and Obſervations in Phyſic Anatomy, Chirurgery, Chemiſtry, Botany, and Medicine; extracted from the Hiſtory and Memoirs of the Royal Academy of Sciences at Paris;" and the ſecond volume in the ſucceeding year. A third was promiſed, but we believe never printed. It appears, indeed, that if he had met with proper encouragement from the public, it was his intention to have extended the work to twelve volumes, with an additional one of index, and that he was prepared to publiſh two ſuch volumes every year. His tranſlation of "Norden's Travels" appeared in the beginning of the year 1757; and in that year he was editor of "Select Caſes and Conſultations in Phyſic, by Dr Woodward," 8vo. On the eſtabliſhment of the Britiſh Muſeum, in 1753, he was appointed to the office of keeper of the reading room, which he reſigned on being choſen, in 1760, ſecretary to the then newly inſtituted Society of Arts, Manufactures, and Commerce. In 1762, he was elected a correſponding member of the Royal Academy of Science of Paris, and alſo of the Œconomical Society at Berne. Very early in life Dr Templeman was afflicted with ſevere paroxyſms of an aſthma, which eluded the force of all that either his own ſkill, or that of the moſt eminent phyſicians then living, could ſuggeſt to him; and it continued to haraſs him till his death, which happened September 23, 1769. He was eſteemed a man of great learning, particularly with reſpect to languages; ſpoke French with great fluency, and left the character of a humane, generous, and polite member of ſociety.

Templeton
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Tenneſſee.

TEMPLETON, a townſhip in the N. W. part of Worceſter county Maſſachuſetts, containing 950 inhabitants. It was granted as a bounty to the ſoldiers in king Philip's war, and was called Narraganſet Nº 6, until its incorporation in 1762. It is 63 miles W. by N. W. of Boſton, and 28 N. by W. of Worceſter.—*Morse.*

TENCH'S *Iſland*, in the South Pacific Ocean, was diſcovered in 1790, by Lieut. Ball, and lies in lat. 1 39 S. and long. 151 31 W. It is low, and only about 2 miles in circuit, but is entirely covered with trees, including many of the cocoa-nut kind. It abounds with inhabitants, and the men appear to be remarkably ſtout and healthy.—*ib.*

TENERIFFE, a town of Santa Martha and Terra Firma, in S. America, ſituated on the eaſtern bank of the great river Santa Martha, below its confluence with Madalena, about 135 miles from the city of Santa Martha, towards the ſouth, the road from which capital to Teneriffe is very difficult by land, but one may go very eaſily and agreeably from one to the other partly by ſea, and partly by the above mentioned river.—*ib.*

TENNANT'S *Harbour*, on the coaſt of the Diſtrict of Maine, lies about three leagues from George's Iſlands.—*ib.*

TENNESSEE, a large, beautiful, and navigable river of the State of Tenneſſee, called by the French *Cherokee*, and abſurdly by others, Hogohegee river, is the largeſt branch of the Ohio. It riſes in the mountains of S. Carolina, in about lat. 37, and purſues a courſe of about 1000 miles, ſouth and ſouth-weſt nearly to lat. 34, receiving from both ſides a number of large tributary ſtreams. It then wheels about to the north in a circuitous courſe, and mingles with the Ohio, nearly 60 miles from its mouth. It is navigable for veſſels of great burden to the *Muſcle Shoals*, 250 miles from its mouth. It is there about three miles broad, full of ſmall iſles, and only paſſable in ſmall boats or batteaux. From theſe ſhoals to the *Whirl*, or *Suck*, the place where the river is contracted to the breadth of 70 yards, and breaks through the Great Ridge, or Cumberland Mountain, is 250 miles, and the navigation for large boats all the way excellent. The higheſt point of navigation upon this river is Tellico Block-Houſe, 900 miles from its mouth according to its meanders. It receives Holſton river 22 miles below Knoxville, and then running weſt 15 miles receives the Clinch. The other waters which empty into Tenneſſee, are Duck and Elk rivers, and Cow Creek on the one ſide; and the Occachappo, Chickamanga and Hiwaſſee rivers on the ſouth and ſouth-eaſtern ſides. In the Tenneſſee and its upper branches are great numbers of fiſh, ſome of which are very large and of an excellent flavour. The river to which the name Tenneſſee was formerly confined, is that part of it which runs northerly, and receives Holſton river 20 miles below Knoxville. The Coyeta, Chota, and Chilhawee Indian towns are on the weſt ſide of the river; and the Talaſſee town on the eaſt ſide.—*ib.*

Tennessee, one of the United States of America, and, until 1796, called the *Tenneſſee Government*, or *Territory of the United States South of the Ohio.* It is in length 400 miles, and in breadth 104; between lat. 35 and 36 30 N. and long. 81 28 and 91 38 W. It is bounded N. by Kentucky and parts of Virginia; E. by North-Carolina; S. by Georgia; W. by the Miſſiſippi. It is

divided

divided into 3 diſtricts, viz. Waſhington, Hamilton, and Mero, which are ſubdivided into 13 counties, viz. Waſhington, Sullivan, Greene, Carter, Hawkins, Knox, Jefferſon, Sevier, Blount, Grainger, Davidſon, Sumner, Robertſon, and Montgomery. The firſt four belonging to Waſhington diſtrict, the next five to that of Hamilton, and the four latter to Mero diſtrict. The two former diſtricts are divided from the latter, by an uninhabited country of 91 miles in extent; that is from the block-houſes, at the point formed by the junction of the river Clinch with the Tenneſſee, called South-Weſt Point, to Fort Blount upon Cumberland river, through which there is a waggon road, opened in the ſummer of 1795. There are few countries ſo well watered with rivers and creeks. The principal rivers are the Miſſiſſippi, Tenneſſee, Cumberland, Holſton, and Clinch. The tract called the Broken Ground, ſends immediately into the Miſſiſſippi, the Wolf, Hatchee, Forked-Deer, Obian or Obean, and Reelfoot; which are from 30 to 80 yards wide at their mouths; moſt of the rivers have exceedingly rich low grounds, at the extremity of which is a ſecond bank, as on moſt of the lands of the Miſſiſſippi. Beſides theſe rivers, there are ſeveral ſmaller ones, and innumerable creeks, ſome of which are navigable. In ſhort, there is hardly a ſpot in this country, which is upwards of 20 miles diſtant from a navigable ſtream. The chief mountains are Stone, Yellow, Iron, Bald, and Unaka, adjoining to one another, from the eaſtern boundary of the State, and ſeparate it from N. Carolina; their direction is nearly from N. E. to S. W. The other mountains are Clinch and Cumberland. It would require a volume to deſcribe the mountains of this ſtate, above half of which is covered with thoſe that are uninhabitable. Some of theſe mountains, particularly the Cumberland or Great Laurel Ridge, are the moſt ſtupendous piles in the United States. They abound with ginſeng and coal. The caverns and caſcades in theſe mountains are innumerable. The *Enchanted Mountain*, about two miles ſouth of Braſs-Town, is famed for the curioſities on its rocks. There are on ſeveral rocks a number of impreſſions reſembling the tracks of turkies, bears, horſes, and human beings, as viſible and perfect as they could be made on ſnow or ſand. The latter were remarkable for having uniformly ſix toes each; one only excepted, which appeared to be the print of a negro's foot. By this we muſt ſuppoſe the originals to have been the progeny of Titan or Anak. One of theſe tracks was very large, the length of the foot 16 inches, the diſtance of the extremes of the outer toes 13 inches, the proximate breadth behind the toes 7 inches, the diameter of the heel-ball 5. One of the horſe tracks was likewiſe of an uncommon ſize, the tranſverſe and conjugate diameters, were 8 by 10 inches; perhaps the horſe which the Great Warrior rode. What appears the moſt in favour of their being the real tracks of the animals they repreſent, is the circumſtance of a horſe's foot having apparently ſlipped ſeveral inches, and recovered again, and the figures having all the ſame direction, like the trail of a company on a journey. If it be a *luſus naturæ*, the old dame never ſported more ſeriouſly. If the operation of chance, perhaps there was never more apparent deſign. If it were done by art, it might be to perpetuate the remembrance of ſome remarkable event of war, or engagement fought on the ground. The vaſt heaps of ſtones near the place, ſaid to be tombs of warriors ſlain in battle, ſeem to favour the ſuppoſition. The texture of the rocks is ſoft. The part on which the ſun had the greateſt influence, and which was the moſt indurated, could eaſily be cut with a knife, and appeared to be of the nature of the pipe ſtone. Some of the Cherokees entertain an opinion that it always rains when any perſon viſits the place, as if ſympathetic nature wept at the recollection of the dreadful cataſtrophe which thoſe figures were intended to commemorate. The principal towns are Knoxville, the ſeat of government, Naſhville, and Jonesborough, beſides 8 other towns, which are as yet of little importance. In 1791, the number of inhabitants was eſtimated at 35,691. In November, 1795, the number had increaſed to 77,262 perſons. The ſoil is luxuriant, and will afford every production, the growth of any of the United States. The uſual crop of cotton is 800lbs. to the acre, of a long and fine ſtaple; and of corn, from 60 to 80 buſhels. It is aſſerted, however, that the lands on the ſmall rivers, that empty into the Miſſiſſippi, have a decided preference to thoſe on Cumberland river, for the production of cotton, rice, and indigo. Of trees, the general growth is poplar, hickory, black and white walnut, all kind of oaks, buck-eye, beech, ſycamore, black and honey locuſt, aſh, horn-beam, elm, mulberry, cherry, dogwood, ſaſſafras, poppaw, cucumber-tree, and the ſugar-tree. The undergrowth, eſpecially on low lands, is cane; ſome of which are upwards of 20 feet high, and ſo thick as to prevent any other plant from growing. Of herbs, roots, and ſhrubs, there are Virginia and Seneca ſnakeroot, ginſeng, and angelica, ſpice-wood, wild plum, crab-apple, ſweet anniſe, red-bud, ginger, ſpikenard, wild hop and grape vines. The glades are covered with wild rye, wild oats, clover, buffaloe graſs, ſtrawberries and pea-vines. On the hills, at the head of rivers, and in ſome high cliffs of Cumberland, are found majeſtic red cedars; many of theſe are four feet in diameter, and 40 feet clear of limbs. The animals are ſuch as are found in the neighbouring States. The rivers are well ſtocked with all kinds of freſh water fiſh; among which are trout, perch, cat-fiſh, buffaloe-fiſh, red-horſe, eels, &c. Some cat-fiſh have been caught which weighed upwards of 100 pounds: the weſtern waters being more clear and pure than the eaſtern rivers, the fiſh are in the ſame degree more firm and ſavory to the taſte. The climate is temperate and healthful; the ſummers are very cool and pleaſant in that part which is contiguous to the mountains that divide this ſtate from N. Carolina; but on the weſtern ſide of the Cumberland Mountain the heat is more intenſe, which renders that part better calculated for the production of tobacco, cotton and indigo. Lime-ſtone is common on both ſides of the Cumberland Mountain. There are no ſtagnant waters; and this is certainly one of the reaſons why the inhabitants are not afflicted with thoſe bilious and intermitting fevers, which are ſo frequent, and often fatal, near the ſame latitude on the coaſt of the ſouthern States. Whatever may be the cauſes, the inhabitants have been remarkable healthy ſince they ſettled on the waters of Cumberland river. The country abounds with mineral ſprings. Salt licks are found in many parts of the country. Iron ore abounds in the diſtricts of Waſhington and Hamilton, and fine ſtreams to put iron-works in operation. Iron ore was lately diſcovered upon the ſouth of Cumberland

berland river, about 30 miles below Naſhville, and a furnace is now erecting. Several lead mines have been diſcovered, and one on French Broad has been worked; the ore produced 75 per cent. in pure lead. The Indians ſay that there are rich ſilver mines in Cumberland Mountain, but cannot be tempted to diſcover any of them to the white people. It is ſaid that gold has been found here; but the mine from which that metal was extracted is now unknown to the white people. Ores and ſprings ſtrongly impregnated with ſulphur are found in various parts. Saltpetre caves are numerous; and in the courſe of the year 1796, ſeveral tons of ſaltpetre were ſent to the Atlantic markets. This country furniſhes all the valuable articles of the ſouthern States. Fine waggon and ſaddle horſes, beef cattle, ginſeng, deer-ſkins, and furs, cotton, hemp, and flax, may be tranſported by land; alſo iron, lumber, pork and flour may be exported in great quantities, now that the navigation of the Miſſiſſippi is opened to the citizens of the United States. But few of the inhabitants underſtand commerce, or are poſſeſſed of proper capitals; of courſe it is as yet but badly managed. However, being now an independent State, it is to be hoped that the eyes of the people will ſoon be opened to their true intereſt, and agriculture, commerce, and manufactures will each receive proper attention. The Preſbyterians are the prevailing denomination of Chriſtians; in 1788, they had 23 large congregations, who were then ſupplied by only 6 miniſters. There are alſo ſome Baptiſts and Methodiſts. The inhabitants have paid great attention to the intereſts of ſcience; beſides private ſchools, there are 3 colleges eſtabliſhed by law; Greenville in Green's county, Blount at Knoxville, and Waſhington in the county of that name. Here is likewiſe a "Society for promoting Uſeful Knowledge." A taſte for literature is daily increaſing. The inhabitants chiefly emigrated from Pennſylvania, and that part of Virginia that lies weſt of the Blue Ridge. The anceſtors of theſe people were generally of the Scotch nation; ſome of whom emigrated firſt to Ireland, and from thence to America. A few Germans and Engliſh are intermixed. In 1788, it was thought there were 20 white perſons to one negro; and the diſproportion is thought to be far greater now. This country was included in the 2d charter of king Charles II. to the proprietors of Carolina. In a ſubſequent diviſion, it made a part of N. Carolina. It was explored about the year 1745, and ſettled by about 50 families in 1754; who were ſoon after driven off or deſtroyed by the Indians. Its ſettlement re-commenced in 1765. The firſt permanent ſettlement took place near Long-Iſland of Holſton, and upon Watauga, about 1774; and the firſt appearance of any perſons from it, in the public councils of N. Carolina, was in the convention of that State in 1776. In the year 1780, a party of about 40 families, under the guidance and direction of James Robertſon, (ſince Brig. Gen. Robertſon of Mero diſtrict) paſſed through a wilderneſs of at leaſt 300 miles to the French Lick, and there founded Naſhville. Their neareſt neighbours were the ſettlers of the infant State of Kentucky, between whom and them, was a wilderneſs of 200 miles. From the year 1784, to 1788, the government of N. Carolina over this country was interrupted by the aſſumed State of Frankland; but in the year 1789, the people returned to their allegiance. In 1789, N. Carolina ceded this territory to the United States, on certain conditions, and Congreſs provided for its government. A convention was held at Knoxville, in 1796, and on the 6th of February the conſtitution of the State of Tenneſſee was ſigned by every member of it. Its principles promiſe to enſure the happineſs and proſperity of the people. The following are the diſtances on the new road from Naſhville in Davidſon county, to Fort Campbell, near the junction of Holſton with the Tenneſſee.

	Miles.
From Naſhville to Stoney river	9
Big Spring	6
Cedar Lick	4
Little Spring	6
Barton's Creek	4
Spring Creek	5
Martin's Spring	5
Blair's Spring	5
Buck Spring	12
Fountaines	8
Smith's Creek	6
Coney River	11
Mine Lick	9
Falling Creek	9
War Path	7
Bear Creek	18
Camp Creek	8
King's Spring	16
Grovet's Creek	7
The foot of Cumberland Mountain	2
Through the mountain to Emmery's river, a branch of the Peleſon	11
To the Pappa Ford of the Peleſon or Clinch river	12
To Campbell's Station, near Holſtein	10
To the Great Iſland	100
To Abingdon in Waſhington county	35
To Richmond in Virginia	310
Total	635

By this new road, a pleaſant paſſage may be had to the weſtern country with carriages, as there will be only the Cumberland mountain to paſs, and that is eaſy of aſcent; and beyond it, the road is generally level and firm, abounding with fine ſprings of water. The Indian tribes within and in the vicinity of this State are the Cherokees and Chickaſaws.—*ib.*

TENSAW, a ſettlement near Mobile Bay, inhabited by 90 American families, that have been Spaniſh ſubjects ſince 1783.—*ib.*

TEOWENISTA *Creek*, runs ſoutherly about 28 miles, then weſterly 6 miles, and empties into Alegany river about 18 miles from its mouth, and nearly 5 below the Hickory town.—*ib.*

TEQUAJO, or *Tiquas*, a province of Mexico; according to ſome Spaniſh travellers, being about lat. 37, where they found 16 villages.—*ib.*

TEQUEPA, a part of the coaſt of New Mexico, about 18 leagues N. W. of Acapulco.—*ib.*

TEQUERY *Bay*, on the ſouth-eaſt part of the coaſt of the iſland of Cuba, between Cape Cruiz, and Cape Maizi, at the eaſt end. It affords good anchorage and ſhelter for ſhips, but is not much frequented.—*ib.*

TERANE', a town in Egypt, ſituated on what Mr

Browne calls the *left* of the moſt weſtern mouth of the Nile, at a very ſmall diſtance from the river. Its latitude is 30° 24′. The buildings are chiefly unburned brick, though there are alſo ſome of ſtone. The town and diſtrict containing ſeveral villages, belonged, before the French invaſion, to Murad Bey, who uſually entruſted its government, and the collection of its revenue, to one of his Caſheſs. That revenue ariſes principally from natrôn (See NATRUM, *Encycl.*), found in great quantities in certain lakes about thirty-five miles from Terané; and it is on account of theſe lakes only that the town is worthy of notice in this work; for though there are many columns in its neighbourhood, which indicate the ſcite of ancient ſtructures, none of them have inſcriptions aſcertaining their antiquity.

The eaſtern extremity of the moſt weſtern lake Mr Browne found to be 30° 31′ North. No vegetation appears, except reeds, on the margin of the lake, which is very irregular in its form; ſo that it is not eaſy to ſay what may be the quantity of ground covered with water. It is higher in winter than in ſummer; and when it was viſited by our author, its breadth did not exceed a mile, though its length was nearly four. Towards the end of the ſummer, it is ſaid, theſe lakes are almoſt dry; and the ſpace that the water has retired from is then occupied by a thick depoſition of ſalt. Not far removed from the eaſtern extremity, a ſpring riſes with ſome force, which much agitates the reſt of the water. Cloſe to that ſpring the depth was far greater than Mr Browne's height; in other parts it was obſervable that it did not generally exceed three feet. The thermometer near this ſpring ſtood at 76, while in the open air it was 87. The more weſtern lake differs not materially from the eaſtern in ſize, form, or productions. The colour of the water in both is an imperfect red; and where the bottom is viſible, it appears almoſt as if covered with blood. Salt, to the thickneſs of five or ſix inches, lies conſtantly in the more ſhallow parts. The ſurface of the earth, near the lake, partakes more or leſs generally of the character of natrôn, and, in the parts fartheſt removed, offers to the foot the ſlight reſiſtance of ploughed ground after a ſlight froſt. The ſoil is coarſe ſand. The water of the lake, on the ſlighteſt evaporation, immediately depoſits ſalt. There is a mountain not far from the lakes, where natrôn is found in inſulated bodies, near the ſurface, of a much lighter colour than that produced in the lake, and containing a greater portion of alkali. How thick the ſubſtance of natrôn commonly is in the lake, our author did not accurately determine; but thoſe employed to collect it report, that it never exceeds a cubit, or common pike; but it appears to be regenerated as it is carried away. If ever it ſhould be brought to ſuperſede the uſe of barilla, the quantity obtainable ſeems likely to anſwer every poſſible demand.

TEREBRATULÆ (ANOMIÆ, *Lin.* ſee that article *Encycl.*) have been ſuppoſed not to exiſt now but as petrified ſhells. This, however is a miſtake. The anomia is an inhabitant of every region, and has exiſted in every age. As many terebratulæ were caught by Perouſe's people during his voyage of diſcovery, and as Lamanon the naturaliſt thought they ſhould be conſidered as a genus by themſelves, he has given us the following deſcription of the *anomia*, or, as he calls it, *terebratula*, on the coaſt of Tartary:

The length of the ſhell varies from ſix to twenty lines, and its breadth from five to eighteen; there are, however, conſiderable varieties of proportion between different individuals, beſides thoſe ariſing from the different ages of the animal. It would be improper, therefore, to diſtinguiſh the various ſpecies of anomiæ by the proportion of their ſhells. The waving lines on the edges of the ſhell are equally defective, as diſtinctive characters; for our author obſerved in the ſame ſpecies the ſhell approaching or receding indifferently from the circular form, and in ſome the edges of the valves are on the ſame plane; whereas in others, one of the valves forms a ſalient angle in the middle of its curve, and the other a re entering angle.

The ſhell is of a moderate thickneſs, about that of a common muſcle; it is ſomewhat tranſparent, convex like the cockle: neither of the ſhells is more ſenſibly arched than the other; that, however, which has the ſpur, is rather the moſt ſo, eſpecially in the ſuperior part.

On the ſurface of the ſhell are ſeen a number of ſlight tranſverſe depreſſions, of a ſemicircular waved form, which reach the part where the ſhell ceaſes to be circular, in order to form the angle which ſupports the ſummit.

Theſe ſtriæ are covered with a very thin and ſlightly-adhering perioſteum; in ſome ſpecimens there are from one to three ſhallow broad depreſſions, radiating inſenſibly from the centre of the ſhell, and becoming more marked as they approach the edges, where they form, with the correſponding parts of the other ſhell, thoſe ſalient and re-entering angles which have been mentioned. The perioſteum is rather more firmly fixed on the latter angles than on the former.

The ſhells are equal in the rounded part of their edge, and cloſe very exactly; however, towards the ſummit, the ſpur of one of the ſhells reaches conſiderably beyond the other ſhell, conſequently they are unequal, as in oyſters.

The ſpur, or ſummit, is formed by the folding from within of the edge of the ſhell, and the elongation of its upper part. The folded edges form an oval aperture of a moderate ſize, through which the animal extends the muſcle, by means of which it attaches itſelf to other ſubſtances. This ſhell is not, therefore, perforated, as its name of terebratula would ſeem to imply, the opening not being worked in one of the ſhells, but formed by the elongation of one ſhell, the folding in of its edges, and the approach of the other ſhell. The ſummit is not pointed, but round.

The ligament, as in the oyſter, is placed between the ſummits, and does not appear on the outſide; it adapts itſelf to the pedicle of the animal. As the ſummit takes up a conſiderable part of the ſhell, the valves are only capable of opening a very little without running the riſk of being broken. It is very firm, though ſlender, and not eaſily to be diſcovered, being fixed in a ſmall groove, which is filled up when the ſhell is ſhut by the correſponding part of the oppoſite ſhell. This ligament preſerves its texture, even for a conſiderable time after the ſhell is emptied and become dry.

Oyſters are without a hinge, the teeth which form it in many other ſhells not exiſting in them. The anomia has been conſidered as an oyſter, becauſe its hinge or teeth have not been examined: they are not viſible indeed in the foſſile ſpecimens; but in opening them when alive, the teeth compoſing the hinge are ſufficiently viſible, being even much larger than in the greater part of bivalve ſhells. The foſſil terebratulæ are almoſt always found with their ſhells cloſed; whereas the other bivalves have uſually theirs either open or ſeparated: the reaſon of this ſeems to ariſe from the nature of the hinge, that of the anomia not allowing it to ſeparate, and the ligament, which is very tight, contributing to keep the two ſhells united. The teeth which form the hinge of the anomia approach very near to thoſe of the *ſpondyle*, deſcribed by M. Adanſon. In this laſt they are formed by two rounded projections, and in the anomia by the ſame a little elongated. It is above theſe teeth that the ligament is placed in the larger ſhell: there are between it and the teeth two cavities, one on each ſide which ſerve to receive the teeth of the other valve. The teeth of the larger ſhell have, beſides, a ſlight projection, which fits into a longitudinal furrow in the other ſhell in front of the teeth.

The ſubſtance which covers the inſide of the ſhell holds, as in oyſters, a middle place between *nacre* and the interior ſubſtance of ſhells, which are deſtitute of it. The degree of its luſtre, poliſh and thickneſs, varies with the age and circumſtances of individuals.

The colour of the teeth is always white; that of the outer ſurface of the ſhell verges more or leſs to the ochry red, eſpecially on the border. The inſide has alſo a very ſlight tint of this colour, on a varying greyiſh-white ground.

There is viſible on each ſide of the ſhell the impreſſion of two very diſtinct tendons; a circumſtance which forms a very eſſential difference between this genus and that of the oyſter: this latter having only one tendon ariſing from the middle of the body. The impreſſions of the tendon in the largeſt ſhell are oblong, ſituate near the ſummit, and hollowed; each of them has curved tranſverſe ridges, divided into two parts by a longitudinal furrow, repreſenting the wings of certain inſects. In the other valve the inſertions have a different form; their ſituation is the ſame, but they are very irregularly rounded and encompaſſed by two ſulcations, which are ſeparated from each other by an intervening ridge, and then are continued in a right line towards the opening of the ſhell as far as about two thirds of its length. That part of the ſummit of the ſhell along which the pedicle of the animal paſſes, is longitudinally ſtriated in the larger ſhell, of which the middle ſtria is the deepeſt: the longitudinal ſtriæ are divided into equal parts by a tranſverſe depreſſion. There are no ſimilar marks on the other ſhell.

Our author diſſected the animal itſelf, and found what he calls the *manteau* of the anomia, formed of a very fine membrane, lining the inſide of both ſhells, and containing the body of the animal. Its origin is of the ſame breadth as the hinge of the ſhell, whence it divides into two lobes, lining both the ſhells: it forms, therefore, only a ſingle aperture, terminating at each end of the hinge, and of the ſame breadth with the interior ſurface of the ſhell: it appears to have only one trachea, which is formed by the two lobes of the manteau.

Our naturaliſt having opened the ſhell, divided the ligament as delicately as poſſible, unfixed the hinge, and detaching from the larger ſhell the lobe of the manteau, turned over the body of the animal. This operation expoſed to view the large muſcles which adhered to the ſhell; they are ſoft, membranous, and, as it were, fleſhy on the inſide, being covered with ſmall ſanguiferous glands. From the lower part of each muſcle there proceeds a pretty ſtrong tendon, which reaches to the extremity of the manteau; they run parallel to the edge of the ſhell, and at a conſiderable diſtance from each other; and are each encloſed in a ſort of flatted ſac, of the ſhape of a ribbon, which is filled with a red viſcid matter. It appears that the place of inſertion of the muſcles, as well as the muſcles themſelves, which extend along the lobe of the manteau, furniſh real blood, which is contained in three ſmall fleſhy red glandular bodies of unequal ſize, which are viſible after having taken off the muſcles; perhaps theſe conſtitute the heart of the animal.

The muſcles which are inſerted into the other ſhell are alſo divided into ſeveral parts: ſome are ſeen extending along the correſponding lobe of the manteau; many others riſe up in a kind of tuft, which is fixed into the ſhell above: ſome again ſubdivide into ſuch minute ramifications as not to allow of tracing their courſe, even with the aſſiſtance of a microſcope; but others, more apparent, contribute to the formation of the pedicle which paſſes through the opening left between the two ſhells, is connected to each of them by ſeveral fibres, and fixes itſelf to ſome external body, principally to other bivalves. The muſcles of the anomia have therefore three attachments, namely, to the inner ſurface of each ſhell, and to ſome external body.

The form of the pedicle is cylindrical, being encloſed in a muſcular ſubſtance, which contain ſeveral fibres; it is from a line to a line and a half long, and two thirds in diameter. It adheres ſo forcibly to different ſubſtances, as that the animal, and all the muſcles which contribute to the formation of the pedicle, may more eaſily be torn through than the pedicle detached from the place of its adheſion. The glutinous ſubſtance which connects them to each other, reſiſts even the heat of boiling water. It is by means of this pedicle that the animal raiſes its ſhell ſo as to be, while in the water, in a poſition inclined to the horizon. The ſmalleſt valve is always the loweſt, being that upon which the animal reſts; the ſuperior one being the larger, and ſerving as a covering. Our author thinks the animal has the power of loco-motion.

After raiſing the lobe of the manteau he obſerved the ears. They are large, compoſed of two membranaceous laminæ on each ſide, of which the ſuperior is the narrower. Theſe laminæ are connected to each other by a thin membrane, ſo as to form only a ſingle pouch. They have on their edges long fringes, which hang looſe upon the manteau; but a very remarkable circumſtance is, that their ears are ſupported by little bones like thoſe of fiſh. The form of the ears is that of an arch; they are ſeparated from each other on their lower part, where the fringes are the longeſt; ſo that the two ears on one ſide are perfectly diſtinct from thoſe on the other ſide. The commencement of the ears is at the teeth of the hinge.

Between the ears are ſituate the ſtomach, œſophagus, and mouth; the whole forming a triangle, of which the mouth is the baſe. It is placed at the ſide of the hinge, and conſiſts of a large tranſverſe opening without lips or jaw-bone. The œſophagus is very ſhort, but is capable of elongation when the animal opens its mouth. The ſtomach, which is of the ſhape of a pointed ſac, is connected by a membrane to the bones of the ear. On opening the ſtomach, he found a ſmall ſhrimp half digeſted.

At the bottom of the ſtomach is ſeen the inteſtine, of which it is, as it were, a continuation. It is extremely ſhort, not exceeding half a line in a ſhell fifteen lines acroſs, and is compoſed of a very ſlender membrane. The excrements are diſcharged upon the lobes of the manteau, but they are eaſily thrown out by the motions of the two lobes.

The little bones of the ears, already mentioned, had not formerly been obſerved in any of the teſtaceous animals; whence the terebratulæ approach nearer to fiſh than the inhabitants of any other ſhell. In the anomiæ which are preſerved in cabinets, there is found only a very ſmall portion of theſe bones, whence they have obtained the improper appellation of *tongue* or *fork*, which indicate only the form of the fragments, and not their uſe.

The ſmall bones of the ears are compoſed of ſeveral pieces, the principal of which is of an oval form; it ſprings from the ſide of the hinge, of which it appears to be a continuation; thence it extends about two-thirds of the breadth of the ſhell, where it is reflected, and reſts againſt the upper part of the fork, to the branches of which it is united by a ſimple ſuperpoſition; a kind of articulation very common among the numerous ſmall bones that compoſe the heads of fiſh. The fork extends from the the ſummit a little more than one-third of the breadth of the ſhell: it is formed by a pivot which divides into two long and pointed branches; theſe are remarkably brittle, and ſupport the extremities of the bones of the larger ears. The lamina, which compoſes a ſecond ſet of ears, reſts upon a curved bone, which on one ſide is attached to the inferior internal part of the bone of the larger ears, and on the other reaches to the ſide of the mouth of the animal, where it is united to another flat little bone, which is applied to a ſimilar bone on the other ſide. Theſe laſt little bones are exactly below the membrane which forms the mouth. All theſe bones are flat, very brittle, and ſurrounded with fibres and membranes. By their articulations the ears are enabled to move; they alſo ſupport the body of the animal, which touches neither of the ſhells, but remains between them as upon treſſels. The ſpace between the branches of the bones of the ears is filled up with a tranſparent firm membrane: at the baſe of the fork is a ſimilar one, and a perpendicular partition dividing the ſpace occupied by the body of the animal from the reſt of the ſhell. There are two orifices in this membrane communicating with the ſpace between the two lobes of the manteau, and which ſerves as a trachea; for we have remarked, in the deſcription of the manteau, that the two lobes are entirely ſeparated from each other, and therefore do not form a real trachea.

From this deſcription, it follows that the anomia ought to be ſeparated from the genus oyſter, ſince it has a toothed hinge, ſeveral ligaments, and an interior organization wholly different; neither ought it to be confounded with the cockle, the ſhells of which are both equal, and are deſtitute of any ſenſible perioſteum, without reckoning other differences. It has ſtill leſs analogy with the other bivalves, and therefore ought to conſtitute a peculiar genus; the ſpecies of which, both foſſil and living, are very numerous.

See Plate XLIII. where fig 1. is a front view of a terebratula of middle ſize. Fig. 2. is a view of the internal ſtructure.—A A, laminæ of the ſuperior ears—B B, laminæ of the inferior—C, the ſtomach—D, the anus—E E, the manteau—F, the œſophagus.

TERMINA, *Laguna*, or *Lake of Tides*, lies at the bottom of the Gulf of Campeachy, in the ſouth-weſt part of the Gulf of Mexico. It is within Trieſte and Beef Iſland, and Port Royal Iſland. The tide runs very hard in, at moſt of the channels between the iſlands; hence the name.—*Morse.*

TERNAI, the name given by Perouſe to a very fine bay which he diſcovered on the coaſt of Tartary, in Lat. 45° 13′ North, and in Long. 135° 9′ Eaſt from Paris. The bottom is ſandy, and diminiſhes gradually to ſix fathoms within a cable's length of the ſhore. The tide riſes five feet; it is high water at 8^h 15^m at full and change; and the flux and reflux do not alter the direction of the current at half a league from the ſhore.

"Five ſmall creeks (ſays La Perouſe,) ſimilar to the ſides of a regular polygon, from the outline of this roadſtead; theſe are ſeparated from each other by hills, which are covered to the ſummit with trees. Never did France, in the freſheſt ſpring, offer gradations of colour of ſo varied and ſtrong a green; and though we had not ſeen, ſince we began to run along the coaſt, either a ſingle fire or canoe, we could not imagine that a country ſo near to China, and which appeared ſo fertile, ſhould be entirely uninhabited. Before our boats had landed, our glaſſes were turned towards the ſhore, but we ſaw only bears and ſtags, which paſſed very quietly along the ſea ſide. The ſame plants which grow in our climates carpeted the whole ſoil, but they were ſtronger, and of a deeper green; the greater part were in flower. Roſes, red and yellow lilies, lilies of the valley, and all our meadow flowers in general, were met with at every ſtep. Pine trees covered the tops of the mountains; oaks began only half way down, and diminiſhed in ſtrength and ſize in proportion as they came nearer the ſea; the banks of the rivers and rivulets were bordered with willow, birch, and maple trees, and on the ſkirts of the foreſts we ſaw apple and medlar trees in flower, with clumps of hazle nut trees, the fruit of which already made its appearance. Our ſurpriſe was redoubled, when we reflected on the population which overburdens the extenſive empire of China, ſo that the laws do not puniſh fathers barbarous enough to drown and deſtroy their children, and that this people, whoſe polity is ſo highly boaſted of, dares not extend itſelf beyond its wall, to draw its ſubſiſtence from a land, the vegetation of which it would be neceſſary rather to check than to encourage. At every ſtep after we had landed, we perceived traces of men by the deſtruction they had made; ſeveral trees, cut with ſharp edged inſtruments; the remains of ravages by fire were to be ſeen in ſeveral places, and we obſerved ſome ſheds, which had been erected by hunters in a corner of the woods. We alſo found ſome ſmall baſkets, made of the bark of birch trees, ſewed with thread, and ſimilar to thoſe of the Canadian Indians;

rackets for walking on the ſnow; in a word, every thing induced us to think that the Tartars approach the borders of the ſea in the ſeaſon for hunting and fiſhing; that they aſſemble in colonies at that period along the rivers; and that the bulk of the nation live in the interior of the country on a ſoil perhaps better calculated for the multiplication of their immenſe flocks and herds."

Our navigators caught in the bay vaſt quantities of fine fiſh, ſuch as cod, harp-fiſh, trout, ſalmon, herrings, and plaice; but though game was plenty on ſhore, they had no ſucceſs in hunting. The meadows, ſo delightful to the ſight, could ſcarce be croſſed; the thick graſs was three or four feet high, ſo that they found themſelves in a manner buried in it, and they were under the perpetual dread of being bitten by ſerpents, of which they ſaw a great number on the banks of the rivulets. They found, however, immenſe quantities of ſmall onions, ſorrel, and celery; which, together with the freſh fiſh, ſerved as antidotes againſt the ſcurvy.

TERRA *de Latraton*, that is, the *Ploughman* or *Labourer's Land*, the name given by the Spaniards to Labrador or New-Britain, inhabited by the Eſquimaux.—*Morſe.*

TERRA *del Fuego Iſland*, or *Land of Fire*, at the ſouth extremity of S. America, is ſeparated from the main on the N. by the Straits of Magellan, and contains about 42,000 ſquare miles. This is the largeſt of the iſlands ſouth of the Straits, and they receive this name on account of the vaſt fires and ſmoke which the firſt diſcoverers of them perceived. The iſland of Staten Land lies on the eaſt. They are all barren and mountainous; but there have been found ſeveral ſorts of trees and plants, and a variety of birds on the lower grounds and iſlands that are ſheltered by the hills. Here are found Winter's bark, and a ſpecies of arbutus which has a very well taſted red fruit of the ſize of ſmall cherries. Plenty of celery is found in ſome places, and the rocks are covered with very fine muſcles. A ſpecies of duck as large as a gooſe, and called the loggerhead duck at the Falkland Iſlands, is here met with, which beats the water with its wings and feet, and runs along the ſea with inconceivable velocity; and there are alſo geeſe and falcons.—*ib.*

TERRA FIRMA, or *Caſtile del Oro*, the moſt northern province of S. America, 1,400 miles in length, and 700 in breadth; ſituated between the equator and 12 N. lat. and between 60 and 82 W. long. bounded N. by the N. Atlantic Ocean, here called the North Sea, E. by the ſame ocean and Surinam, S. by Amazonia and Peru, and W. by the N. Pacific Ocean. It is called Terra Firma from being the firſt part of the continent diſcovered by the Spaniards, and is divided into Terra Firma Proper, or Darien, Carthagena, St Martha, Venezuela, Cumana, Paria, New Granada, and Popayan. The chief towns are Porto Bello, Panama, Carthagena, and Popayan. The principal bays of this province in the Pacific Ocean, are thoſe of Panama and St Michael, in the North Sea, Porto Bello, Sino, Guiara, &c. The chief rivers are the Darien, Chagre, Santa Maria, Conception, and Oronoko. The climate here, eſpecially in the northern parts, is extremely hot and ſultry during the whole year. From the month of May, to the end of November, the ſeaſon called winter by the inhabitants, is almoſt a continual ſucceſſion of thunder, rain and tempeſts, the clouds precipitating the rain with ſuch impetuoſity, that the low lands exhibit the appearance of an ocean. Great part of the country is conſequently flooded; and this, together with the exceſſive heat, ſo impregnates the earth with vapours, that in many provinces, particularly about Popayan and Porto Bello, the air is extremely unwholeſome. The ſoil of this country is very different, the inland parts being very rich and fertile, and the coaſts ſandy and barren. It is impoſſible to view without admiration, the perpetual verdure of the woods, the luxuriancy of the plains, and the towering height of the mountains. This country produces corn, ſugar, tobacco, &c. and fruits of all kinds. This part of S. America was diſcovered by Columbus in his third voyage to America. It was ſubdued and ſettled by the Spaniards about the year 1514, after deſtroying, with great inhumanity, ſeveral millions of the natives. —*ib.*

TERRA FIRMA *Proper*, or *Darien*, a ſubdiviſion of Terra Firma. Chief towns, Porto Bello, and Panama.—*ib.*

TERRA *Nueva*, near Hudſon's Straits, is in lat. 62 4 N. and long. 67 W. high water, at full and change, a little before 10 o'clock.—*ib.*

TERRE PLEIN, or TERRE-PLAIN, in fortification, the top, platform, or horizontal ſurface of the rampart, upon which the cannon are placed, and where the defenders perform their office. It is ſo called becauſe it lies level, having only a little ſlope outwardly to counteract the recoil of the cannon. Its breadth is from 24 to 30 feet; being terminated by the parapet on the outer ſide, and inwardly by the inner talus.

TERRELLA, or little earth, is a magnet turned of a ſpherical figure, and placed ſo as that its poles, equator, &c. do exactly correſpond with thoſe of the world. It was ſo firſt called by Gilbert, as being a juſt repreſentation of the great magnetic globe we inhabit. Such a terrella, it was ſuppoſed, if nicely poiſed, and hung in a meridian like a globe, would be turned round like the earth in 24 hours by the magnetic particles pervading it; but experience has ſhewn that this is a miſtake.

TERRITORY *North-Weſt of the Ohio*, or *North-Weſtern Territory*, a large part of the United States, is ſituated between 37 and 50 N. lat. and between 81 8 and 98 8 W. long. Its greateſt length is about 900 miles, and its breadth 700. This extenſive tract of country is bounded north by part of the northern boundary line of the United States; eaſt by the lakes and Pennſylvania; ſouth by the Ohio river; weſt by the Miſſiſſippi. Mr Hutchins, the late geographer of the United States, eſtimates that this tract contains 263,040,000 acres, of which 43,040,000 are water; this deducted, there will remain 220,000,000 of acres, belonging to the Federal Government, to be ſold for the diſcharge of the national debt; except a narrow ſtrip of land bordering on the ſouth of Lake Erie, and ſtretching 120 miles weſt of the weſtern limit of Pennſylvania, which belongs to Connecticut. But a ſmall portion of theſe lands is yet purchaſed of the natives, and to be diſpoſed of by Congreſs. Beginning on the meridian line, which forms the weſtern boundary of Pennſylvania, ſeven ranges of townſhips have been ſurveyed and laid off by order of Congreſs. As a north and ſouth line ſtrikes the Ohio in an oblique direction, the termination of the 7th range falls upon that river, 9 miles above the Muſkingum, which is the firſt large river that falls into the Ohio. It forms this junction 172 miles below Fort Pitt, including the windings of the Ohio, though, in a direct line, it is but 90 miles. That part of this territory in which the Indian title is extinguiſhed, and which is ſettling under the government of the United States, is divided into five counties as follows:

Counties.	When created.
Waſhington, - -	1788 July 26th.
Hamilton, - - - -	1790 Jan. 2d.
St Clair, - - - -	1790 April 27th.
Knox, - - - -	1790 June 20th.
Wayne, - - - -	1796.

Theſe counties have been organized with the proper civil and military officers. The county of St Clair is divided into three diſtricts, viz. the diſtrict of Cahokia, the diſtrict of Prairie-du-rochers, and the diſtrict of Kaſkaſkias. Courts of general quarter ſeſſions of the peace, county courts of common pleas, and courts of probate, to be held in each of theſe diſtricts, as if each was a diſtinct county; the officers of the county to act by deputy, except in the diſtrict where they reſide. The principal rivers in this territory are Muſkingum, Hockhocking, Sciota, Great and Little Miami, Blue and Wabaſh, which empty into the Ohio; Au Vaſe, Illinois, Ouiſconſing, and Chippeway, which pay tribute to the Miſſiſſippi, beſides a number of ſmaller ones. St Lewis, Kennomic, St Joſeph's, Barbue, Grand, Miami of the Lakes, Sanduſky, Cayahoga, and many others which paſs to the lakes. Between the Kaſkaſkias and Illinois rivers, which are 84 miles apart, is an extenſive tract of level, rich land, which terminates in a high ridge, about 15 miles before you reach the Illinois river. In this delightful vale are a number of French villages, which, together with thoſe of St Genevieve, and St Louis, on the weſtern ſide of the Miſſiſſippi, contained, in 1771, 1273 fencible men. The number of ſouls in this large tract of country, has not been aſcertained. From the beſt data the author has received, the population may be eſtimated, five years ago, as follows:

Indians, (ſuppoſe) - -	65,000	1792.
Ohio Company purchaſe, -	2,500	do.
Col. Symmes' ſettlements, -	2,000	do.
Galliopolis, (French ſettlements) oppoſite the Kanhaway river,	1,000	do.
Vincennes and its vicinity, on the Wabaſh,	1,500	do.
Kaſkaſkias and Cahokia, -	680	1790.
At Grand Ruiſſeau, village of St Philip, and Prairie-du-rochers,	240	do.
Total	72,820	

In 1790, there were in the town of Vincennes, about 40 American families and 31 ſlaves, and on the Miſſiſſippi, 40 American families and 73 ſlaves, all included in the above eſtimate. On the Spaniſh or weſtern ſide of the Miſſiſſippi, there were, in 1790, about 1800 ſouls, principally at Genevieve, and St Louis. The lands on the various rivers which water this territory, are interſperſed with all the variety of ſoil which conduces to pleaſantneſs of ſituation, and lays the foundation for the wealth of an agricultural and manufacturing people. Large level bottoms, or natural meadows, from 20 to 50 miles in circuit, are found bordering the rivers, and variegating the country in the interior parts. Theſe afford as rich a ſoil as can be imagined, and may be reduced to proper cultivation with very little labour. The prevailing growth of timber, and the more uſeful trees, are maple or ſugar-tree, ſycamore, black and white mulberry, black and white walnut, butternut, cheſnut; white, black, Spaniſh, and cheſnut oaks, hickory, cherry, buckwood or horſe cheſnut, honey-locuſt, elm, cucumber tree, lynn tree, gum tree, iron wood, aſh, aſpin, ſaſſafras, crab-apple tree, paupaw or cuſtard apple, a variety of plum trees, nine bark ſpice, and leather wood buſhes. White and black oak, and cheſnut, with moſt of the above-mentioned timbers, grow large and plenty upon the high grounds. Both the high and low lands produce great quantities of natural grapes of various kinds, of which the ſettlers univerſally make a ſufficiency for their own conſumption, of rich red wine. It is aſſerted in the old ſettlement of St Vincent, where they have had opportunity to try it, that age will render this wine preferable to moſt of the European wines. Cotton is ſaid to be the natural production of this country, and to grow in great perfection. The ſugar maple is the moſt valuable tree, for an inland country. Any number of inhabitants may be forever ſupplied with a ſufficiency of ſugar, by preſerving a few trees for the uſe of each family. A tree will yield about ten pounds of ſugar a year, and the labour is very trifling. Springs of excellent water abound in this territory; and ſmall and large ſtreams, for mills and other purpoſes, are actually interſperſed, as if by art, that there be no deficiency in any of the conveniencies of life. Very little waſte land is to be found in any part of this tract of country. There are no ſwamps but ſuch as may be readily drained, and made into arable and meadow land; and though the hills are frequent, they are gentle, and ſwelling no where high or incapable of tillage. They are of a deep rich ſoil, covered with a heavy growth of timber, and well adapted to the production of wheat, rye, indigo, tobacco, &c. The communication between this country and the ſea, will be principally in the 4 following directions: 1. The route through the Scioto and Muſkingum to Lake Erie, and ſo to the river Hudſon. 2. The paſſage up the Ohio and Monongahela to the portage above mentioned, which leads to the navigable waters of the Patowmack. This portage is 30 miles, and will probably be rendered much leſs by the execution of the plans now on foot for opening the navigation of thoſe waters. 3. The Great Kanhaway, which falls into the Ohio from the Virginia ſhore, between the Hockhocking and the Scioto, opens an extenſive navigation from the ſouth-eaſt, and leaves but 18 miles portage from the navigable waters of James' river, in Virginia. This communication, for the country between Muſkingum and Scioto, will probably be more uſed than any other for the exportation of manufactures, and other light and valuable articles, and eſpecially, for the importation of foreign commodities, which may be brought from the Cheſapeak to the Ohio much cheaper than they are now carried from Philadelphia to Carliſle, and the other thick ſettled back counties of

Pennſyl-

Pennſylvania (A). 4. But the current down the Ohio and Miſſiſſippi, for heavy articles that ſuit the Florida and Weſt-India markets, ſuch as corn, flour, beef, lumber, &c. will be more frequently loaded than any ſtreams on earth. The diſtance from the Scioto to the Miſſiſſippi, is 800 miles; from thence to the ſea, is 900. This whole courſe is eaſily run in 15 days; and the paſſage up thoſe rivers is not ſo difficult as has uſually been repreſented. It is found, by late experiments, that ſails are uſed to great advantage againſt the current of the Ohio; and it is worthy of obſervation, that in all probability ſteam boats will be found to do infinite ſervice in all our extenſive river navigation. No country is better ſtocked with wild game of every kind. The rivers are well ſtored with fiſh of various kinds, and many of them are of an excellent quality. They are generally large, though of different ſizes; the cat-fiſh, which is the largeſt, and of a delicious flavour, weighs from 6 to 80 pounds. The number of old forts, found in this weſtern country, are the admiration of the curious, and a matter of much ſpeculation. They are moſtly of an oblong form, ſituated on ſtrong, well choſen ground, and contiguous to water. When, by whom, and for what purpoſe, theſe were thrown up, is uncertain. They are undoubtedly very ancient, as there is not the leaſt viſible difference in the age or ſize of the timber growing on or within theſe forts, and that which grows without; and the oldeſt natives have loſt all tradition reſpecting them. The poſts eſtabliſhed for the protection of the frontiers, and their ſituation, may be ſeen on the map. By an ordinance of Congreſs, paſſed on the 13th of July, 1787, this country, for the purpoſes of temporary government, was erected into one diſtrict, ſubject, however, to a diviſion, when circumſtances ſhall make it expedient. The ordinance of Congreſs, of July 13th, 1787, article 5th, provides that there ſhall be formed in this territory, not leſs than three, nor more than five States; and the boundaries of the States ſhall become fixed and eſtabliſhed as follows, viz. the weſtern State in the ſaid territory ſhall be bounded on the Miſſiſſippi, the Ohio and Wabaſh rivers; a direct line drawn from the Wabaſh and Poſt Vincents due north to the territorial line between the United States and Canada, and by the ſaid territorial line to the Lake of the Woods and Miſſiſſippi. The middle State ſhall be bounded by the ſaid direct line, the Wabaſh from Poſt Vincents to the Ohio; by the Ohio by a direct line drawn due north from the mouth of the Great Miami to the ſaid territorial line, and by the ſaid territorial line. The eaſtern State ſhall be bounded by the laſt mentioned direct line, the Ohio, Pennſylvania, and the ſaid territorial line: Provided however, and it is further underſtood and declared, that the boundaries of theſe 3 States ſhall be ſubject ſo far to be altered, that if Congreſs hereafter ſhall find it expedient, they ſhall have authority to form 1 or 2 States, in that part of the ſaid territory which lies N. of an E. and W. line drawn through the ſoutherly bend or extreme of Lake Michigan; and when any of the ſaid States ſhall have 60,000 free inhabitants therein, ſuch State ſhall be admitted by its delegates into the Congreſs of the United States, on an equal footing with the original States in all reſpects whatever; and ſhall be at liberty to form a permanent conſtitution and State government; provided the conſtitution and government ſo to be formed ſhall be republican, and in conformity to the principles contained in theſe articles, and ſo far as it can be conſiſtent with the general intereſt of the confederacy, ſuch admiſſion ſhall be allowed at an earlier period, and when there may be a leſs number of free inhabitants in the State, than 60,000. The ſettlement of this country has been checked, for ſeveral years paſt, by the unhappy Indian war, an amicable termination of which took place on the 3d of Auguſt, 1795, when a treaty was formed at Grenville, between Major Gen. Anthony Wayne, on the part of the United States, and the Chiefs of the following tribes of Indians, viz. Wyandots, Delawares, Shawanoes, Ottawas, Chippewas, Putawatimes, Miamis, Eel river, Weeas, Kickapoos, Pian-Kaſhaws and Kaſkaſkias. By the third article of this treaty, the Indians cede to the United States, for a valuable conſideration, all lands lying eaſtward and ſouthward of a line "beginning at the mouth of Cayahoga river, and running thence up the ſame to the portage between that and the Tuſcarawas branch of the Muſkingum; thence down that branch to the croſſing place above Fort Lawrence; thence weſterly to a fork of that branch of the Great Miami river, running into the Ohio, where commences the portage between the Miami of the Ohio, and St Mary's river, which is a branch of the Miami of the lake; thence a weſterly courſe to Fort Recovery, which ſtands on a branch of the Wabaſh, then ſouth-weſterly in a direct line to the Ohio, ſo as to interſect that river oppoſite the mouth of Kentucky or Catawa river." Sixteen tracts of land of 6 and 12 miles ſquare, interſperſed at convenient diſtances in the Indian country, were, by the ſame treaty, ceded to the United States, for the convenience of keeping up a friendly and beneficial intercourſe between the parties. The United States, on their part, "relinquiſh their claims to all other Indians lands northward of the river Ohio, eaſtward of the Miſſiſſippi, and weſtward and ſouthward of the Great Lakes and the waters uniting them, according to the boundary line agreed on by the United States and the king of Great Britain, in the treaty of peace made between them in the year 1783. But from this relinquiſhment, by the United States, the following tracts of land are explicitly excepted. 1ſt. The tract of 150,000 acres near the rapids of the Ohio river, which has been aſſigned to Gen. Clark, for the uſe of himſelf and his warriors. 2d. The poſt of St Vincents on the river Wabaſh, and the lands adjacent; of which the Indian title has been extinguiſhed. 3d. The land at all other places in poſſeſſion of the French people and other white ſettlers among them, of which the Indian title has been extinguiſhed, as mentioned in the third article; and 4th. The poſt of Fort Maſſac, towards the mouth of the Ohio. To which ſeveral parcels of land ſo excepted, the ſaid tribes relinquiſh all the title and claim which they or any of them may have." Goods to the value of 20,000 dolls. were delivered

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(A) A gentleman of much obſervation, and a great traveller in this country, is of opinion that this communication, or route, is chimerical.

delivered the Indians at the time this treaty was made; and goods to the amount of 9,500 dollars, at firſt coſt in the United States, are to be delivered annually to the Indians at ſome convenient place northward of the Ohio. A trade has been opened, ſince this treaty, by a law of Congreſs, with the forementioned tribes of Indians, on a liberal footing, which promiſes to give permanency to this treaty, and ſecurity to the frontier inhabitants.—*Morse.*

TESTIGOS, iſlands near the coaſt of New Andaluſia, in Terra Firma, on the ſouth coaſt of the Caribbean Sea, in the Weſt-Indies. Several ſmall iſlands at the eaſt end of the iſland of Margarita lie between that iſland, and thoſe called Teſtigos. N. lat. 11 6, W. long. 61 48.—*ib.*

TETEROA *Harbour*, on the W. ſide of the iſland of Ulietea, one of the Society Iſlands. S. lat. 16 51, W. long. 151 27.—*ib.*

TETHUROA, an iſland in the S. Pacific Ocean, about 24 miles from Point Venus in the iſland of Otaheite. S. lat. 17 4, W. long. 149 30.—*ib.*

TETRAEDRON, or TETRAHEDRON, in geometry, is one of the five Platonic or regular bodies or ſolids, comprehended under four equilateral and equal triangles. Or it is a triangular pyramid of four equal and equilateral faces.

TETRAGON, in geometry, a quadrangle, or a figure having four angles. Such as a ſquare, a parallelogram, a rhombus, and a trapezium. It ſometimes alſo means peculiarly a ſquare.

TETRAGON, in aſtrology, denotes an aſpect of two planets with regard to the earth, when they are diſtant from each other a fourth part of a circle, or 90 degrees. The tetragon is expreſſed by the character □, and is otherwiſe called a ſquare or quartile aſpect.

TETZEUCO, a brackiſh lake in Mexico.—*Morse.*

TEUSHANUSHSONG-GOGHTA, an Indian village on the northern bank of Alleghany river, in Pennſylvania, 5 miles north of the ſouth line of the ſtate, and 14 E. S. E. of Chatoughque Lake.—*ib.*

TEWKSBURY, called by the Indians, *Wamſit* or *Pawtukett*, a townſhip of Maſſachuſetts, Middleſex county, on Concord river, near its junction with Merrimack river, 24 miles northerly of Boſton. It was incorporated in 1734, and contains 958 inhabitants.—*ib.*

TEWKSBURY, a townſhip of New Jerſey, Hunterdon county. The townſhip of Lebanon, Readington, and Tewkſbury contain 4,370 inhabitants, including 268 ſlaves.—*ib.*

THAMES *River*, in Connecticut, is formed by the union of Shetucket and Little, or Norwich rivers, at Norwich Landing, to which place it is navigable for veſſels of conſiderable burden; and thus far the tide flows. From this place the Thames purſues a ſoutherly courſe 14 miles, paſſing by New-London on its weſt bank, and empties into Long-Iſland Sound; forming the fine harbour of New-London.—*ib.*

THATCHER's *Iſland*, lies about a mile eaſt of the ſouth eaſt point of Cape Ann, on the coaſt of Maſſachuſetts, and forms the northern limit of Maſſachuſetts Bay; and has two light-houſes. Cape Ann lighthouſe lies in lat. 43 36 north, and long. 70 47 weſt.—*ib.*

THEAKIKI, the eaſtern head water of Illinois river, riſes about 8 miles S. of Fort St Joſeph. After running through rich and level lands, about 112 miles, it receives Plein river in lat. 41 48 N. and from thence the confluent ſtream aſſumes the name of Illinois. In ſome maps it is called *Huakiki*.—*ib.*

THEBES, in Egypt. Having in the *Encyclopædia* given Mr Bruce's account of this ancient city, which repreſents it as having been a paltry place, ſo contrary to the deſcription of Homer, juſtice to the father of poetry requires that we here notice what has been ſaid of it by a ſubſequent traveller, who remained three days among its ruins. According to Mr Browne, "the maſſy and magnificent forms of the ruins that remain of ancient Thebes, the capital of Egypt, the city of Jove, the city with 100 gates, muſt inſpire every intelligent ſpectator with awe and admiration. Diffuſed on both ſides of the Nile, their extent confirms the claſſical obſervations, and Homer's animated deſcription ruſhes into the memory:

'Egyptian Thebes, in whoſe palaces vaſt wealth is ſtored; from each of whoſe hundred gates iſſue two hundred warriors, with their horſes and chariots.'

"These venerable ruins, probably the moſt ancient in the world, extend for about three leagues in length along the Nile. Eaſt and weſt they reach to the mountains, a breadth of about two leagues and a half. The river is here about three hundred yards broad. The circumference of the ancient city muſt therefore have been about twenty-ſeven miles.

"In ſailing up the Nile, the firſt village you come to within the precincts is Kourna, on the weſt, where there are few houſes, the people living moſtly in the caverns. Next is Abuhadjadj, a village, and Karnac, a ſmall diſtrict, both on the eaſt. Far the largeſt portion of the city ſtood on the eaſtern ſide of the river. On the ſouth-weſt Medinet-Abu marks the extremity of the ruins; for Arment, which is about two leagues to the ſouth, cannot be conſidered as a part.

"In deſcribing the ruins, we ſhall begin with the moſt conſiderable, which are on the eaſt of the Nile. The chief is the Great Temple, an oblong ſquare building of vaſt extent, with a double colonnade, one at each extremity. The maſſy columns and walls are covered with hieroglyphics; a labour truly ſtupendous. 1. The Great Temple ſtands in the diſtrict called *Karnac*. 2. Next in importance is the temple at *Abuhadjadj*. 3. Numerous ruins, avenues marked with remains of ſphinxes, &c. On the weſt ſide of the Nile appear, 1. Two coloſſal figures, apparently of a man and woman, formed of a calcareous ſtone like the reſt of the ruins. 2. Remains of a large temple, with caverns excavated in the rock. 3. The magnificent edifice ſtyled the *palace of Memnon*. Some of the columns are about forty feet high, and about nine and a half in diameter. The columns and walls are covered with hieroglyphics. This ſtands at *Kourna*. 4. Behind the palace is the paſſage ſtyled *Bibân-el-Meluk*, leading up the mountain. At the extremity of this paſſage, in the ſides of the rock, are the celebrated caverns known as the ſepulchres of the ancient kings."

Though Mr Browne agrees with Pococke and Bruce, that the paſſage in Homer refers not to the gates of the city, he is yet of opinion, contrary to them, that Thebes had been a walled town. He ſays, indeed, that ſome faint remains of its ſurrounding wall are viſible at this day; and he thinks that he diſcovered the ruins of three

three of its gates, though he does not affirm this with abſolute confidence.

THEODOSIUS, a celebrated mathematician, flouriſhed in the times of Cicero and Pompey; but the time and place of his death are unknown. This Theodoſius, the Tripolite, as mentioned by Suidas, is probably the ſame with Theodoſius the philoſopher of Bythinia, who, Strabo ſays, excelled in the mathematical ſciences, as alſo his ſons; for the ſame perſon might have travelled from the one of thoſe places to the other, and ſpent part of his life in each of them; like as Hipparchus was called by Strabo the Bythinian, but by Ptolemy and others the Rhodian. *Dict.*

Theodoſius chiefly cultivated that part of geometry which relates to the doctrine of the ſphere, concerning which he publiſhed three books. The firſt of theſe contains 22 propoſitions; the ſecond, 23; and the third, 14; all demonſtrated in the pure geometrical manner of the ancients. Ptolemy made great uſe of theſe propoſitions, as well as all ſucceeding writers. Theſe books were tranſlated by the Arabians, out of the original Greek, into their own language. From the Arabic the work was again tranſlated into Latin, and printed at Venice. But the Arabic verſion being very defective, a more complete edition was publiſhed, in Greek and Latin, at Paris 1558, by John Pena, Regius Profeſſor of aſtronomy. And Vitello acquired reputation by tranſlating Theodoſius into Latin. This author's works were alſo commented on and illuſtrated by Clavius, Heleganius, and Guarinus, and laſtly by De Chales, in his Curſus Mathematicus. But that edition of Theodoſius's Spherics, which is now moſt in uſe, was tranſlated and publiſhed by our countryman the learned Dr Barrow, in the year 1675, illuſtrated and demonſtrated in a new and conciſe method. By this author's account, Theodoſius appears, not only to be a great maſter in this more difficult part of geometry, but the firſt conſiderable author of antiquity who has written on that ſubject.

Theodoſius, too, wrote concerning the Celeſtial Houſes; alſo of Days and Nights; copies of which, in Greek, were in the King's library at Paris. Of which there was a Latin edition, publiſhed by Peter Daſypody, in the year 1572.

THEON, of Alexandria, a celebrated Greek philoſopher and mathematician, who flouriſhed in the 4th century, about the year 380, in the time of Theodoſius the Great; but the time and manner of his death are unknown. His genius and diſpoſition for the ſtudy of philoſophy were very early improved by cloſe application to all its branches; ſo that he acquired ſuch a proficiency in the ſciences as to render his name venerable in hiſtory, and to procure him the honour of being preſident of the famous Alexandrian ſchool. One of his pupils was the admirable Hypatia, his daughter, who ſucceeded him in the preſidency of the ſchool; a truſt which, like himſelf, ſhe diſcharged with the greateſt honour and uſefulneſs. See her life, *Encycl.*

The ſtudy of Nature led Theon to many juſt conceptions concerning God, and to many uſeful reflections in the ſcience of moral philoſophy. Hence, it is ſaid, he wrote with great accuracy on Divine Providence. And he ſeems to have made it his ſtanding rule, to judge the truth of certain principles, or ſentiments, from their natural or neceſſary tendency. Thus, he ſays, that a full perſuaſion that the Deity ſees every thing we do, is the ſtrongeſt incentive to virtue; for he inſiſts, that the moſt profligate have power to refrain their hands, and hold their tongues, when they think they are obſerved, or overheard, by ſome perſon whom they fear or reſpect. With how much more reaſon then, ſays he, ſhould the apprehenſion and belief, that God ſees all things, reſtrain men from ſin, and conſtantly excite them to their duty? He alſo repreſents this belief concerning the Deity as productive of the greateſt pleaſure imaginable, eſpecially to the virtuous, who might depend with greater confidence on the favour and protection of Providence. For this reaſon, he recommends nothing ſo much as meditation on the preſence of God: and he recommended it to the civil magiſtrate as a reſtraint on ſuch as were profane and wicked, to have the following inſcription written, in large characters, at the corner of every ſtreet—GOD SEES THEE, O SINNER.

Theon wrote notes and commentaries on ſome of the ancient mathematicians. He compoſed alſo a book, intitled *Progymnoſmata*, a rhetorical work, written with great judgment and elegance; in which he criticiſed on the writings of ſome illuſtrious orators and hiſtorians; pointing out, with great propriety and judgment, their beauties and imperfections; and laying down proper rules for propriety of ſtyle. He recommends conciſeneſs of expreſſion, and perſpicuity, as the principal ornaments. This book was printed at Baſle in the year 1541; but the beſt edition is that of Leyden, in 1626, in 8vo.

THEOPHILANTHROPISTS, a ſect of deiſts, who, in September 1796, publiſhed at Paris a ſort of catechiſm or directory for ſocial worſhip, under the title of *Manuel des Theanthrophiles*. This religious breviary found favour: the congregation became numerous; and in the ſecond edition of their manual they aſſumed the leſs harſh denomination of *Theophilanthropes*, *i. e.* lovers of God and man. A book of hymns, a liturgy for every decade of the French year, and an homiletical ſelection of moral leſſons, are announced, or publiſhed, by their unknown ſynod. Thus they poſſeſs a ſyſtem of pinus ſervices adapted to all occaſions, which ſome one of the individuals who attend reads aloud; for they object to the employment of a regular lecturer, in conſequence of their hoſtility to prieſts.—This novel ſect was countenanced by Lareveillere Lepaux, one of the Directory, and, ſoon after its formation, opened temples of its own in Dijon, and in other provincial towns. They had declamations, in the ſpirit of ſermons, which abounded with ſuch phraſes as *l'eternal geometre*, and the like, and which have long ſince been familiar to thoſe who frequent the lodges of free maſonry. Whether the ſect now exiſts, or fell at the laſt revolution which annihilated the directory, we have not learned; but a tranſlation of its *Manuel* into Engliſh, for the uſe, we ſuppoſe, of our Jacobins, was made ſo early as the year 1797. From this contemptible performance, we learn that the creed of the Theophilanthropiſts is compriſed in the four following propoſitions:

The Theophilanthropiſts believe in the exiſtence of God, and the immortality of the ſoul.

The ſpectacle of the univerſe atteſts the exiſtence of the Firſt Being.

The faculty which we poſſeſs of thinking, aſſures us, that we have, within ourſelves, a principle which is ſuperior to matter, and which ſurvives the diſſolution of the body.

The exiſtence of God, and the immortality of the ſoul, do not need long demonſtrations; they are ſentimental truths, which every one may find written in his heart, if he conſult it with ſincerity.

Thus a ſort of religious inſtinct is ſet up as the ſole foundation of piety, which every one has as much right to diſavow as another to aſſert; and the obligations of which, therefore, can in no way be ſhewn to be incumbent on thoſe to whom this novel illumination is not vouchſafed. Society, under ſuch a ſyſtem, gains no means of influencing the conduct of refractory members.

The morality of the Theophilanthropiſts is founded on one ſingle precept: *Worſhip God, cheriſh your kind, render yourſelves uſeful to your country!*

Among the duties comprehended under the denomination of cheriſhing our kind, we find that of *not lending for uſury:* the others are chiefly extracted from the goſpels, and do not interfere with the province of the civil magiſtrate. The queſtion of monogamy is not diſcuſſed.

Among the duties to our country are placed thoſe of fighting in its defence, and of paying the taxes. It was certainly prudent in the ſtateſman to ſlide theſe duties into the catalogue of his eſtabliſhed maxims of morality; and he ran thereby little riſk of provoking heretical animadverſions on his creed in France.

The following inſcriptions are ordered to be placed above the altars in the ſeveral temples or ſynagogues of the Theophilanthropiſts; but for what reaſon altars are admitted into ſuch ſynagogues we are not informed:

Firſt inſcription, "We believe in the Exiſtence of God, in the immortality of the ſoul."

Second inſcription, "Worſhip God, cheriſh your kind, render yourſelves uſeful to the country."

Third inſcription, "Good is every thing which tends to the preſervation or the perfection of man.—Evil is every thing which tends to deſtroy or to deteriorate him."

Fourth inſcription, "Children, honour your fathers and mothers. Obey them with affection. Comfort their old age.—Fathers and mothers, inſtruct your children.

Fifth inſcription, "Wives, regard in your huſbands the chiefs of your houſes.—Huſbands, love your wives, and render yourſelves reciprocally happy."

This pentalogue is chiefly objectionable on account of the vague drift of the fifth commandment: the whole has too general a turn for obvious practical application. The introduction of ceremonies of ſculpture, of painting, and of engraving, is forbidden. If poetry and muſic may concur to render the worſhip impreſſive, why not the other fine arts? The fine arts have never illuſtrated a country which excluded them from the public temples. Are they to be extinguiſhed in France by Theophilanthropic iconoclaſts?

At p. 28. of the Manuel, this ſurpriſing maxim occurs: *Avoid innovations!* A ſect fifteen months old grown as teſty as the church of Rome! They acknowledge, that perhaps better inſcriptions may be found: yet they forbid the exchange? They prefer *mumpſimus* to the *ſumpſimus* of genuine Chriſtianity!

THEOPHILUS, a writer and biſhop of the primitive church, was educated a Heathen, and afterwards converted to Chriſtianity. Some have imagined that he is the perſon to whom St Luke dedicates the Acts of the Apoſtles; but they are groſsly miſtaken; for this Theophilus was ſo far from being contemporary with St Luke and the apoſtles, that he was not ordained biſhop of Antioch till *anno* 170; and he governed this church twelve or thirteen years. He was a vigorous oppoſer of certain heretics of his time, and compoſed a great number of works; all of which are loſt, *Biog.* except three books to Autolycus, a learned Heathen of his acquaintance, who had undertaken to vindicate his own religion againſt that of the Chriſtians. The firſt book is properly a diſcourſe between him and Autolycus, in anſwer to what this Heathen had ſaid againſt Chriſtianity. The ſecond is to convince him of the falſehood of his own, and the truth of the Chriſtian religion. In the third, after having proved that the writings of the Heathens are full of abſurdities and contradictions, he vindicates the doctrine and the lives of the Chriſtians from thoſe falſe and ſcandalous imputations which were then brought againſt them. Laſtly, at the end of his work, he adds an hiſtorical chronology from the beginning of the world to his own time, to prove that the hiſtory of Moſes is at once the moſt ancient and the trueſt; and it appears from this little epitome, how well this author was acquainted with profane hiſtory. Theſe three books are filled with a great variety of curious diſquiſitions concerning the opinions of the poets and philoſophers, and there are but few things in them relating immediately to the doctrines of the Chriſtian religion. Not that Theophilus was ignorant of theſe doctrines, but, having compoſed his works for the converſion of a Pagan, he inſiſted rather on the external evidence or proofs from without, as better adapted, in his opinion, to the purpoſe. His ſtyle is elegant, and the turn of his thoughts very agreeable; and this little ſpecimen is ſufficient to ſhew that he was indeed a very eloquent man.

The piece is entitled, in the Greek manuſcripts, "The books of Theophilus to Autolycus, concerning the Faith of the Chriſtians, againſt the malicious detractors of their religion." They were publiſhed, with a Latin verſion, by Conradus Geſner, at Zurich, in 1546. They were afterwards ſubjoined to Juſtin Martyr's works, printed at Paris in 1615 and 1636; then publiſhed at Oxford, 1684, in 12mo. under the inſpection of Dr Fell; and, laſtly, by Jo. Chriſt. Wolfius, at Hamburgh, 1723, in 8vo.

It is remarkable, that this patriarch of Antioch was the firſt who applied the term *Trinity* to expreſs the Three Perſons in the Godhead.

THERAPEUTÆ, ſo called from the extraordinary purity of their religious worſhip, were a Jewiſh ſect, who, with a kind of religious phrenzy, placed their whole felicity in the contemplation of the Divine nature. Detaching themſelves wholly from ſecular affairs, they transferred their property to their relations or friends, and withdrew into ſolitary places, where they devoted themſelves to a holy life. The principal ſociety of this kind was formed near Alexandria, where they lived, not far from each other, in ſeparate cottages, each of which had its own ſacred apartment, to which the inhabitant retired for the purpoſes of devotion. After their morning prayers, they ſpent the day

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in ſtudying the law and the prophets, endeavouring by the help of the commentaries of their anceſtors, to diſcover ſome allegorical meaning in every part. Beſides this, they entertained themſelves with compoſing ſacred hymns in various kinds of metre. Six days of the week were, in this manner, paſſed in ſolitude. On the ſeventh day they met, clothed in a decent habit, in a public aſſembly; where, taking their places according to their age, they ſat, with the right hand between the breaſt and the chin, and the left at the ſide. Then ſome one of the elders, ſtepping forth into the middle of the aſſembly, diſcourſed, with a grave countenance and a calm tone of voice, on the doctrines of the ſect; the audience in the mean time, remaining in perfect ſilence, and occaſionally expreſſing their attention and approbation by a nod. The chapel where they met was divided into two apartments; one for the men, the other for the women. So ſtrict a regard was paid to ſilence in theſe aſſemblies, that no one was permitted to whiſper, or even to breathe aloud; but when the diſcourſe was finiſhed, if the queſtion which had been propoſed for ſolution had been treated to the ſatisfaction of the audience, they expreſſed their approbation by a murmur of applauſe. Then the ſpeaker, riſing, ſung a hymn of praiſe to God, in the laſt verſe of which the whole aſſembly joined. On great feſtivals, the meeting was cloſed with a vigil, in which ſacred muſic was performed, accompanied with ſolemn dancing; and theſe vigils were continued till morning, when the aſſembly, after a morning prayer, in which their faces were directed towards the riſing ſun, was broken up. So abſtemious were theſe aſcetics, that they commonly ate nothing before the ſetting ſun, and often faſted two or three days. They abſtained from wine, and their ordinary food was bread and herbs.

Much diſpute has ariſen among the learned concerning this ſect. Some have imagined them to have been Judaizing Gentiles, but Philo ſuppoſes them to be Jews, by ſpeaking of them as a branch of the ſect of Eſſenes, and expreſsly claſſes them among the followers of Moſes. Others have maintained, that the Therapeutæ were an Alexandrian ſect of Jewiſh converts to the Chriſtian faith, who devoted themſelves to a monaſtic life. But this is impoſſible; for Philo, who wrote before Chriſtianity appeared in Egypt, ſpeaks of this as an eſtabliſhed ſect. From comparing Philo's account of this ſect with the ſtate of philoſophy in the country where it flouriſhed, we conclude, that the Therapeutæ were a body of Jewiſh fanatics, who ſuffered themſelves to be drawn aſide from the ſimplicity of their ancient religion by the example of the Egyptians and Pythagoreans. How long this ſect continued is uncertain: But it is not improbable that, after the appearance of Chriſtianity in Egypt, it ſoon became extinct.

THERMOMETRIC SPECTRUM, is a name given to the ſpace in which a thermometer may be placed, ſo that it ſhall be affected by the ſun's rays refracted by a priſm. It is, in part, the ſame with the PRISMATIC SPECTRUM, which exhibits the different colours produced by the ſolar light.

The philoſophical inſtrument now called a *thermometer*, was firſt named THERMOSCOPE; and was prized by the naturaliſt, becauſe it gave him indications of the preſence and agency of fire in many caſes where our ſenſation of warmth or heat was unable to diſcover it. It was not long before it was obſerved that it alſo affords us meaſures of the changes which take place either in the quantity or the activity of the cauſe of heat, and of many other important phenomena uſually accompanied by heat. They were then called *thermometers*. But in both of theſe offices, it is ſtill a doubt whether it indicates and meaſures any real ſubſtance, a being *ſui generis*, to which we may give the name *fire*, *phlogiſton*, *caloric*, *heat*, or any other; or only indicates and meaſures certain ſtates or conditions, in which all bodies may be found, without the addition or abſtraction of any material ſubſtance.

We think that this queſtion has a greater chance now of being decided than in any former time, in conſequence of a recent and very important diſcovery made by that unwearied obſerver of the works of God, the celebrated Dr Herſchel. Being greatly incommoded when looking at the ſun, by the great heats produced in the eye-pieces of his teleſcopes, he thought that the laws of refraction enabled him to diminiſh them by a proper conſtruction of his eye-pieces. He began his attempts like a philoſopher, by examining the heat produced in the various parts of the priſmatic ſpectrum. Comparing the gradations of heat with that of illumination, he found that they did not, by any means, follow the ſame law. The illumination increaſed gradually from the violet end of the ſpectrum, where it was exceedingly faint, to the boundary of the green and yellow, where it was the moſt remarkable; and after this, it decreaſed as the illuminated object approached the red extremity of the ſpectrum. But the calorific power of the refracted light increaſed all the way from the extreme violet to the extreme red; and its laſt augmentations were conſiderable, and therefore unlike the uſual approaches of a quantity to its maximum ſtate. This made him think of placing the thermometer a little way beyond the extremity of the viſible ſpectrum. To his great aſtoniſhment, he found that the thermometer was more affected there than in the hotteſt part of the *illuminated* ſpectrum. Expoſing the thermometer at various diſtances beyond the extreme red, but in the plane of refraction, he found that it was moſt ſtrongly affected when placed beyond that extremity, about one-fifth of the whole length of the ſpectrum; from thence the calorific influence of the ſun gradually diminiſhed, but was ſtill very conſiderable at a diſtance from the extreme red equal to three-fifths of the length of the luminous ſpectrum. Theſe firſt ſuggeſted modes of trial appeared to Dr Herſchel to be too rude to intitle him to ſay that the warming influence did not extend ſtill farther. Indeed the inſtrument ſcarcely performed the part of a thermometer, but merely that of an indicator of heat, or a thermoſcope.

Here is a very new, and wonderful, and important, piece of information. We apprehend that all the philoſophers of Europe, as well as the unlearned of all nations, believe that the *warming* influence of the ſun, and of other luminous bodies, is conjoined with their power of *illumination*. Moſt of the philoſophers admitted the emiſſion of a matter called *light*, projected from the ſhining body, and moving with aſtoniſhing velocity, in thoſe lines which the mathematicians called *rays*, becauſe they diverged from the ſhining point, as the *radii* or ſpokes of a wheel diverge from the nave. This notion ſeems to be the ſimple ſuggeſtion of Nature; and it alſo ſeems to be the opinion entertained by Sir Iſaac Newton. His demonſtration of the laws of reflection and refraction proceeds on this ſuppoſition alone, and the particles of light are held by him to be affected by accelerating and deflecting forces, in the ſame way as a ſtone thrown from the hand is affected by gravity. Huyghens, indeed, Dr Hooke, and Euler, imagined that viſion and illumination were effected in the ſame way that hearing, and reſonance, and echo, are effected—that there is no matter projected from the ſhining body; but that we are ſurrounded by an elaſtic fluid, which is thrown into vibrations by certain tremors of the viſible object—and that thoſe vibrations of this fluid affect our eye in the ſame way as the undulation of elaſtic air, produced by the tremors of a ſtring or a bell, affect our ear. According to theſe philoſophers, a ray of viſion is merely the line which paſſes through all theſe undulations at right angles.

Theſe two opinions ſtill divide the mathematical philoſophers of Europe; but the majority, and particularly the moſt eminent for mathematical and mechanical ſcience, are (with the exception of Huyghens and Euler) on the ſide of the vulgar. This opinion has been greatly ſtrengthened of late years by the diſcoveries in chemiſtry. The influence of light on the growth of plants, the total want of aromatic oils in ſuch as grow in the dark, and their formation and appearance in the very ſame plant, along with the green colour, as ſoon as the plant is placed in the light (even that of open day without ſunſhine, or in the light of a candle,) is a ſtrong indication of ſome ſubſtance being obtained from the light, abſorbed by the plant, and combined with its other ingredients. The ſame concluſion is drawn from the effects of the ſun's light on vegetable colours, on the nitric and nitrous acids, on manganeſe, on the calces or oxyds of metals, and numberleſs other inſtances, which all concur in rendering it almoſt unqueſtionable that the ſun's rays, and thoſe of other ſhining bodies, may be, and daily are, combined with the other ſubſtances of which bodies are compoſed, and may be again ſeparated from them. And, ſhould any doubts remain, it would ſeem that the theory of combuſtion, firſt conceived and imperfectly publiſhed by Dr Hooke in his *Micrography*, p. 103. and in his *Lampas*, p. 1. &c. adopted by Mayow (ſee HOOKE and MAYOW in this *Suppl.*), forgotten, and lately revived and confirmed by Mr Lavoiſier, remove them entirely. In the beautiful and well-contrived experiments of the laſt gentleman, the light, accompanied by its heat, which had been abſorbed in the proceſs of growth or other natural operations, re-appeared in their primitive form, and might again be abſorbed and made to undergo the ſame round of changes.

Scheele, not inferior to Newton in caution, patience, and accuracy, and attentive to every thing that occurred in his experiments, diſcovered the ſeparability of the illuminating and the warming influences of ſhining bodies. He remarked, that a plate of glaſs, the moſt colourleſs and pellucid that can be procured, when ſuddenly interpoſed between a glowing fire and the face, inſtantly cuts off the warming power of the fire, without cauſing any ſenſible diminution of its brilliancy. He followed this diſcovery into many obvious conſequences, and found them all fully confirmed by obſervation and experiment. The writer of this article, immediately on hearing of Scheele's experiments, repeated them with complete ſucceſs: but he found, that when the glaſs plate had acquired the higheſt temperature which it could acquire in that ſituation, it did not any longer intercept the heat, or at leaſt in a very ſmall and almoſt inſenſible degree. It ſeemed to abſorb the heat, till ſaturated, without abſorbing any conſiderable portion of the light.

This ſeparability of heat from light does not ſeem to have met with the attention it deſerved. Dr Scheele's untenable theories on theſe ſubjects turned away the attention of the chemiſts from this diſcovery, and the mathematical philoſophers ſeem not to have heard of it at all. The late Dr Hutton of Edinburgh was more ſenſible of its importance; and in his laſt endeavours to ſupport the falling cauſe of phlogiſton, makes frequent alluſions to it. But in his attempts to explain the curious obſervations of Meſſrs Sauſſure and Pictet, in which there are unqueſtionable appearances of radiated heat, he reaſons ſo unconſequentially, that few readers proceed farther, ſo as to notice ſeveral obſervations of facts where the illuminating and warming influences are plainly ſeparated. In all theſe inſtances, however, Dr Hutton conſiders the inviſible rays as light, but not as heat; maintaining that they are inviſible, or do not render bodies viſible, only becauſe our eyes are inſenſible to their feeble action.

It was reſerved for Dr Herſchel to put this matter beyond diſpute by theſe valuable experiments. For did the inviſibility of any of the light beyond the extreme red of the priſmatic ſpectrum ariſe from the inſenſibility of our organs, the ſpectrum would gradually fade away beyond the red; but it ceaſes abruptly. Theſe thoughts could not eſcape this attentive obſerver. He therefore examined more particularly thoſe inviſible rays, cauſing them to be reflected by mirrors, and refracted through lenſes; and, in ſhort, he ſubjected them to all the ſubſequent treatments which Newton applied to the colouring rays. He found them retain their ſpecific refrangibilities and reflexibilities with as much uniformity and obſtinacy as Newton had obſerved in the colour-making rays. They were made to paſs through lenſes while the illuminating rays were intercepted by an opaque body, and the inviſible rays were then collected into a focus. They were reflected, both by the anterior and poſterior ſurfaces of tranſparent bodies. In all theſe trials they retained their power of expanding the liquor of a thermometer, and exciting the ſenſation of heat.

Theſe trials were not confined to the ſolar light or the ſolar rays: They were alſo made on the emanations from a candle, from an open fire, and from red hot iron; then they were made with bodies not hot enough to ſhine; with the heat of a common ſtove, and the heat from iron which was not viſible in the dark. The event was the ſame in all; and it was clearly proved that heat, or the cauſe of heat, is as ſuſceptible of radiation as light is; and that this radiation is performed in both according to the ſame laws.

We look with impatience for the ſubſequent experiments of this celebrated philoſopher on this ſubject; for we conſider them as of the greateſt and moſt extenſive importance for explaining the operations of Nature. We ſee, with indiſputable evidence, that there are rays from the ſun, and other bodies, which do not illuminate. It does not follow, however, that there are rays which do not warm; for the thermometer was affected in every part of the coloured ſpectrum. Dr Herſchel ſeems to think that the power of affecting the organ of ſight depends on the particular degrees of mechanical momentum which are indicated by the different degrees of refrangibility. We confeſs that we think it unlikely that ſuch a power ſhould terminate abruptly. We do not obſerve this in analogous phenomena: the evaneſcence of our ſenſations of ſound, of muſical pitch, of heat, &c. are all gradual. We think it more likely that illuminating and warming are ſpecific effects of different things. We ſhould have entertained this opinion independent of all other experience; and we think it ſtrongly confirmed by the experiments of Dr Scheele already mentioned. We are diſpoſed therefore to believe that there are rays which illuminate, but which do not warm; and rays which warm without illuminating. We have experiments in proſpect, by which we hope to put this to the teſt.

Theſe experiments of Dr Herſchel afford another good argument for the common opinion concerning light, namely, that *it is a matter emitted from the ſhining body*, and not merely the undulations of an elaſtic medium; for if it were undulation, then, ſince there is heat in the yellow light, it would follow that a certain frequency of undulation produces, both the ſenſation of heat and the ſenſation of a yellow colour. In this caſe they ſhould be inſeparable.

This follows, in the ſtricteſt manner, from the principles or aſſumptions adopted by Euler in his mechanical theory of undulations. The chromatic differences in the rays of light are affirmed to ariſe entirely from the different frequencies of the aethereal undulations; and he endeavours to ſhew that theſe differences in frequency produces a difference in refrangibility. It is evident that this reaſoning is equally concluſive with reſpect to the calorific or heating power of the rays. The light and the heat are both undulations: theſe differ only in frequency; and this frequency is indicated (according to Euler) by the refrangibility. There is a certain frequency therefore which excites the ſenſation of yellow. The ſame frequency, indicated by the ſame refrangibility, produces heat; therefore the frequency which produces this degree of heat alſo produces the ſenſation of yellow. We muſt not ſay that the momentum of the undulation may produce heat, but is inſufficient for the production of light, as a ſtring may vibrate too feebly for being heard; for we ſee, by Dr Herſchel's experiments, that, with a momentum ſufficient for making the moſt brilliant ſpectrum, there are rays (and thoſe which have the greateſt momentum) which produce heat, and yet are inviſible.

It does not follow, from any of Dr Herſchel's experiments, that the rays emitted by iron, which is not hot enough to ſhine in a dark room, have *all* the different degrees of refrangibility obſerved by him. Perhaps none of them would fall on the chromatic ſpectrum. We think, however, that this is not probable. It may be tried by collecting them to a focus by a lenſe, intercepting, however, all thoſe which are leſs refrangible than the red-making rays. We truſt that the thermometer in the focus will ſtill be affected.

This is but a very imperfect account of this important diſcovery; but we thought that it would be highly intereſting to our readers. The preſs was employed on this very ſheet when we received the information from a friend, who had ſeen Dr Herſchel's Diſſertation, which will appear in the firſt volume publiſhed by the Royal Society. We truſt that the ingenious author will ſoon follow it up with the inveſtigation of the ſubject in all its conſequences.

We hope that he will examine what will reſult from mixing ſome of the inviſible rays with ſome of the coloured ones. We know that the yellow and the blue, when mixed, produce the ſenſation of green. Perhaps the inviſible rays may alſo change the appearance. We do not, however, expect this.

We alſo hope that Dr Herſchel will examine whether the inviſible rays of the ſun produce any effect on vegetable colours; whether they blacken the calces of ſilver and biſmuth, luna cornea, and decompoſe the nitrous and the oxygenated muriatic acid, &c. &c. We ſhould thus get more inſight into the nature of caloric and of combuſtion. Combuſtion may perhaps be reſtored to its rank in the phenomena of Nature, and no longer be ſunk in the general gulph of oxygenation, and thus obliterated from the memory of chemiſts. It is perhaps the moſt remarkable phenomenon of material Nature; and *fire* and burning will never go out of the language of plain men. Fire, and all its concomitants, have, in all times, been conſidered as even the *chief* objects of chemical attention; and an unlearned perſon will ſtare, when a chemiſt tells him that there is no ſuch thing, and that what he calls the burning of a piece of coal is only the making it ſour. He will perhaps ſmile; but it will not be a ſmile of aſſent.

It was one darling object of the Revolutionary Committee of Chemiſts, aſſembled at Paris in 1787, to baniſh from our minds, *by means of a new language*, all remembrance of any thing which we did not derive from the philoſophers of France. We think ourſelves in a condition to prove this by letters to this country from the ſcene of action; in which the expected victory is ſpoken of in terms of exultation, and with ſo little reſtraint, that the writer forgets that it is Dr Black whom he is informing that *l'air fixe* and *le pauvre phlogiſtique* will ſoon be forgotten; and yet the writer was a gentleman of uncommon modeſty and worth, and ſincerely attached to Dr Black. We give this as a remarkable inſtance of the *eſprit de corps*, and of the nature and towering ambition of that nation. From this they have not ſwerved; and they hope to gain this ſummit of ſcientific dominion in the ſame way as *the ſame philoſophers* hope to baniſh Chriſtianity by means of their new kalendar. It may, however, turn out that both Dr Hooke and Mr Lavoiſier are miſtaken, when they make the oxygen gas the ſole ſource of both the light and the heat which accompany combuſtion. One of them may perhaps be furniſhed by the body which all, except the new philoſophers, call combuſtible.

The objections which may be made to the theory of Huyghens and Euler, on the acknowledged principles of mechanics, appear to us unanſwerable. Euler has never attempted to anſwer thoſe taken from the different diſperſing powers of different ſubſtances. The objections made to the Newtonian, or vulgar theory of emiſſion, are not ſuch as imply abſurdity; they are only difficulties. The chief of them, *viz.* the ſameneſs of velocity in all lights whatever, is of this kind. It is merely an improbability. But the objections to the theory of undulation, deduced from the chemical effects of light, are not leſs ſtrong than thoſe deduced from mechanical principles. It is quite inconceivable that the undulation of a medium, which pervades all bodies, ſhall produce aromatic oils in ſome, a green fæcula in others, ſhall change ſulphuric acid into ſulphur, &c. &c. No effects are produced by the undulations of air, or the tremors of elaſtic bodies, which have the moſt diſtant analogy or reſemblance to theſe.

That the ſun and other ſhining bodies emit the matter of light and heat, ſeems therefore to merit the general reception which it meets with from the philoſophers. But even of this claſs there are differences in opinion. Some imagine that light only is emitted, and that the heat which we feel is occaſioned by the action of the luminous rays on our atmoſphere, or on the ground. Were the ſun's calorific rays as denſe at the ſurface of the ſun as his luminous rays are, the heat there muſt exceed (ſay they) all that we can form any conception of. Yet we ſee, that when the nucleus of the ſun is laid bare by ſome natural operation, which, like a volcanic exploſion, throws aſide the luminous ocean which covers it to a prodigious depth, the naked parts of this nucleus are black. Therefore the intenſe heat in that place is not able to make it ſhining hot, as it does in all our experiments with intenſe heats, giving a dazzling glare. This is thought highly improbable; and it is therefore ſuppoſed that there is, primitively, no heat in the ſun's rays, but that they act on our air, or other terreſtrial matter, combining with it, and diſengaging heat from it, or producing that particular ſtate and condition which we call *heat*.

We think that Dr Herſchel's diſcovery militates ſtrongly and irreſiſtibly againſt this opinion; and ſhews, that whatever reaſon we have for ſaying that the ſun's rays bring light from the ſun we have the ſame authority for ſaying, that they bring heat, fire, caloric, phlogiſton, or by whatever other name we chooſe to diſtinguiſh the cauſe of warmth, expanſion, liquefaction, ebullition, &c.

We muſt either ſay that light and heat are not ſubſtances of a peculiar kind, ſuſceptible of union with the other ingredients of bodies, but merely a ſtate of undulation of an elaſtic medium, as ſound is the undulation of air; or we muſt ſay that the ſun's rays contain light and heat, in a detached ſtate, fit for appearing in their ſimpleſt form, producing illumination and expanſion, and for uniting chemically with other matter. Whichever of theſe opinions we adopt, it is pretty clear that all attempts to diſcover a difference in the weight of hot and cold bodies may be given over. In the firſt caſe, it is ſelf-evident; in the ſecond, we have abundant evidence, that if light and heat, being gravitating matter like all other bodies, were added to, or abſtracted from bodies, in ſufficient quantity to be ſenſibly heavy, the rays of the ſun, or even the light of a candle, would occaſion inſtant deſtruction by its mere momentum; ſince every particle of radiated light and heat moves at the rate of 200,000 miles in a ſecond.

This diſcovery of Dr Herſchel's adds greatly to the probability of the opinion which we expreſſed on another occaſion, that the forces of powers of natural ſubſtances, which are the immediate cauſes of the chemical phenomena, are no way different from the mechanical forces which render bodies heavy, coherent, elaſtic, expanſive, &c.; in ſhort, that they are what we call *accelerating forces*. We deduced this from the fact, that mechanical force can be oppoſed to them, ſo as to prevent their action in circumſtances where it would otherwiſe certainly take place. Thus, by external preſſure, we can prevent that union of water and caloric which would convert it into elaſtic ſteam. We can even diſunite them again, when ſteam is already produced, by forcibly condenſing it into a ſmaller ſpace. Now, the refraction and reflection of heat are performed according to the ſame preciſe laws which we obſerve in the refraction and reflection of light; and Sir Iſaac Newton has demonſtrated that thoſe phenomena ariſe from the action of accelerating forces, whoſe direction is perpendicular to the acting ſurfaces. The matter of heat, therefore, is like other matter in its mechanical properties; and, in the motion of refraction, it is acted on and deflected, juſt as a projectile is acted on and deflected by gravity. It continues in motion till its velocity and direction are changed by deflecting forces, exerted by the particles of the tranſparent medium or the reflecting ſurface. It would take up too much room, but it is a very eaſy proceſs, to demonſtrate that this regular refraction of heat is altogether incompatible with the uſually ſuppoſed notion of caloric; namely, that it is an expanſive fluid like air, but incomparably more elaſtic; from which property very plauſible explanations have been given of the elaſticity of gaſes, ſteams, and ſuch like fluids. Every intelligent mechanician will be ſenſible that all this ſort of chemical ſcience falls to the ground, when it is proved, by exhibition of the fact, that radiated heat is refracted in the ſame way with radiated light. We muſt look for the explanation of the immenſe exploſive force of fulminating ſilver, gold, &c. in ſome very different principles from thoſe which are now in vogue. We apprehend, too, that the very phenomenon of this refraction gives indication of forces which are ſufficiently powerful for this explanation: For when we reflect on the aſtoniſhing velocity of the ray of heat; on the minute ſpace along which it is deflected, and conſequently the time of this action, minute beyond all imagination; and when we compare thoſe circumſtances with a deflection produced by gravity in the motion of a projectile—it is evident that the deflecting force of refraction muſt exceed the greateſt force that we have any knowledge of, in a greater proportion than the weight of Mount Ætna exceeds that of a particle of ſand. We would deſire Mr de la Place to ſuſpend his hopes of eſtabliſhing univerſal fataliſm, till he can reconcile theſe phenomena with his fundamental principle, "*that all forces which are diffuſed from a ſingle point, neceſſarily and eſſentially diminiſh in the inverſe duplicate ratio of the diſtances*." Till he can do this, he had better ſtill allow, with Newton, that the ſelection of the duplicate ratio for the action of gravity (by which alone the ſolar ſyſtem can be rendered permanent and orderly) is a mark of wiſdom and benevolence. We would adviſe him to reconcile his mind to this; and perhaps, like the modeſt and admiring Newton, he may, in good time, find comfort in the thought.

It is alſo highly worthy of remark, that this refracting force, almoſt immenſe, which is ſo plainly exerted between the particles of bodies and light, when conſidered as of the ſame kind with thoſe that produce chemical union, appears abundantly ſufficient for explaining ſome of the moſt wonderful phenomena of chemiſtry; ſuch as the prodigious elaſticity of ſteam, of gunpowder, and the ſtill more aſtoniſhing exploſion of fulminating gold and ſilver. Some of the phenomena of deflected light are produced by theſe optical forces acting at diſtances ſufficiently great to admit of meaſurement; as in the Newtonian obſervations on the paſſage of light near the edges of opaque bodies. Theſe deflections enable us to compare the deflecting forces with gravity. The *refracting* force, however, is vaſtly greater than even this, as may be ſeen by the greater deflection which is produced by it; and, being exerted along a ſpace incomparably ſmaller, it muſt be greater ſtill. Here, then, are forces fully adequate to the phenomena of fulmination. And we would again deſire Mr de la Place to remark that, although theſe exploding forces are irreſiſtible, their action ſeems to vaniſh entirely beyond the limits of mathematical contact. This is plain from the fact, that thoſe exploſions do not project the fragments to great diſtances. This is remarkably the caſe in all the moſt eminent of them. Common or nitric gunpowder is perhaps the only great exception. This particular circumſtance will ſurely ſuggeſt to this eminent analyſt the *inverſe triplicate* ratio of the diſtance as more likely to explain the phenomena than his favourite law.

We truſt that our readers will not be diſpleaſed with this ſhort ſketch of Dr Herſchel's diſcovery, and the few reflections which it naturally ſuggeſted to our minds. We ſhall not be greatly ſurpriſed, although it ſhould produce a ſort of counter-revolution in chemical ſcience, in conſequence of new conceptions which it may give us of the union of bodies with light and heat. The phenomena of the vegetable and animal economy ſhew that they are ſuſceptible of combination with other ſubſtances beſides the baſis of vital air. Whatever changes this may produce in the great revolution which has already taken place in chemical ſcience, they will (in our opinion) be favourable to true philoſophy; becauſe Dr Herſchel's diſcovery co-operates with other arguments of ſound mathematical reaſoning, to overturn that principle on which De la Place hopes to found his atheiſtical doctrine of fate and neceſſity. It contributes therefore to reſtore to the face of Nature that ſmiling feature of providential WISDOM which Newton had the honour of exhibiting to the view of rational men. The ſun is the ſource of light and genial warmth to a vaſt ſyſtem, which is held together, in almoſt eternal order and beauty, by a law of attraction ſelected by Infinite Wiſdom, as the only one adequate to this magnificent purpoſe.

THEVENOT (Melchiſedec), librarian to the king of France, and a celebrated writer of travels, was born at Paris in 1621, and had ſcarcely gone through his academical ſtudies, when he diſcovered a ſtrong paſſion for viſiting foreign countries. At firſt he ſaw only part of Europe; but then he took great care to procure very particular informations and memoirs from thoſe who had travelled over other parts of the globe, and out of thoſe compoſed his "Voyages and Travels."—He laid down among other things, ſome rules, together with the invention of an inſtrument, for the better finding out of the longitude, and the declination of the needle; and ſome have thought that theſe are the beſt things in his works, ſince travels, related at ſecond hand, can never be thought of any great authority or moment; not but Thevenot travelled enough to relate ſome things upon his own knowledge. Another paſſion in him, equally ſtrong with that for travelling, was to collect ſcarce books in all ſciences, eſpecially in philoſophy, mathematics, and hiſtory; and in this he may be ſaid to have ſpent his whole life. When he had the care of the King's library, though it was one of the beſt furniſhed in Europe, he found 2000 volumes wanting in it which he had in his own. Beſides printed books, he bought a great many manuſcripts in French, Engliſh, Spaniſh, Italian, Latin, Greek, Hebrew, Syriac, Arabic, Turkiſh, and Perſic. The marbles preſented to him by Mr Nointel, at his return from his embaſſy to Conſtantinople, upon which there are baſs-reliefs and inſcriptions almoſt 2000 years old, may be reckoned among the curioſities of his library. He ſpent moſt of his time among his books, without aiming at any poſt of figure or profit: he had, however, two honourable employments; for he aſſiſted at a conclave held after the death of Pope Innocent X. and was the French king's envoy at Genoa. He was attacked with what is called a ſlow fever in 1692, and died October the ſame year, at the age of 71. According to the account given, he managed himſelf very improperly in this illneſs; for he diminiſhed his ſtrength by abſtinence, while he ſhould have increaſed it with hearty food and generous wines, which were yet the more neceſſary on account of his great age.—Thevenot's Travels into the Levant, &c. were publiſhed in Engliſh in the year 1687, folio; they had been publiſhed in French at Paris 1663, folio. He wrote alſo "L'Art de Nager," the Art of Swimming, 12mo, 1696.

THOMAS (Chriſtian) was born at Leipſic 1655, and was well educated, firſt under his father, and afterwards in the Leipſic univerſity. At firſt he acquieſced in the eſtabliſhed doctrines of the ſchools; but upon reading Puffendorf's "Apology for rejecting the Scholaſtic Principles of Morals and Law," light ſuddenly burſt upon his mind, and he determined to renounce all implicit deference to ancient dogmas. He read lectures upon the ſubject of Natural Law, firſt from the text of Grotius, and afterwards from that of Puffendorf, freely exerciſing his own judgment, and, where he ſaw reaſon, advancing new opinions. Whilſt his father was living, paternal prudence and moderation reſtrained the natural vehemence and acrimony of the young man's temper, which was too apt to break out, even in his public lectures. But when he was left to himſelf, the boldneſs with which he advanced unpopular tenets, and the ſeverity with which he dealt out his ſatirical cenſures, ſoon brought upon him the violent reſentment of theologians and profeſſors.

An "Introduction to Puffendorf," which Thomas publiſhed in the year 1687, wherein he deduced the obligation of morality from natural principles, occaſioned great offence. The following year he became ſtill more unpopular, by opening a monthly literary journal, which he intitled "Free Thoughts, or Monthly Dialogues on various Books, chiefly new;" in which he attacked many of his contemporaries with great ſeverity. The raillery of this ſatirical work was too provoking to be endured: complaints were lodged before the eccleſiaſtical court of Dreſden; the bookſeller was called upon to give up the author; and it was only through the in-

[illegible] of the Mareſchal that Thomas eſcaped puniſhment. The title of the work was now changed; but its ſpirit remained. A humours and ſatirical life of Ariſtotle, and ſeveral other ſarcaſtic papers, kept alive the flame of reſentment, till at length it again burſt forth, on a charge brought againſt him before the ſame court by the clergy of Leipſic, for contempt of religion; but he defended himſelf with ſuch ability, that none of his adverſaries choſe to reply, and the matter was dropped.

A ſatirical review, which he wrote, of a treatiſe "On the Divine Right of Kings," publiſhed by a Daniſh divine; "A Defence of the Sect of the Pietiſts," and other eccentric and ſatirical publications, at laſt inflamed the reſentment of the clergy againſt Thomas to ſuch a degree, that he was threatened with impriſonment. To eſcape the ſtorm which thickened about him, he entreated permiſſion from the Elector of Brandenburg, in whoſe court he had ſeveral friends, that he might read private lectures in the city of Hall. This indulgence being obtained, Thomas became a voluntary exile from Leipſic. After a ſhort interval, he was appointed public profeſſor of juriſprudence, firſt in Berlin, and afterwards at Hall. In theſe ſituations, he found himſelf at full liberty to indulge his ſatirical humour, and to engage in the controverſies of the times: and as long as he lived, he continued to make uſe of this liberty in a manner which ſubjected him to much odium. At the ſame time, he perſevered in his endeavours to correct and ſubdue the prejudices of mankind, and to improve the ſtate of philoſophy. He died at Hall in the year 1728.

Beſides the ſatirical journal already mentioned, Thomas wrote ſeveral treatiſes on logic, morals, and juriſprudence; in which he advanced many dogmas contrary to received opinions. In his writings on phyſics, he leaves the ground of experiment and rational inveſtigation, and appears among the myſtics. His later pieces are in many particulars inconſiſtent with the former.—His principal philoſophical works are, "An Introduction to Aulic Philoſophy, or Outlines of the Art of Thinking and Reaſoning;" "Introduction to Rational Philoſophy;" "A Logical Praxis;" "Introduction to Moral Philoſophy;" "A Cure for Irregular Paſſions, and the Doctrine of Self-Knowledge;" "The new Art of diſcovering the ſecret Thoughts of Men;" "Divine Juriſprudence;" "Foundations of the Law of Nature and Nations;" "Diſſertation on the Crime of Magic;" "Eſſay on the Nature and Eſſence of Spirit, or Principles of Natural and Moral Science;" "Hiſtory of Wiſdom and Folly."

From the ſpecimen given by Dr Enfield of his more peculiar tenets (for we have read none of his books), Thomas appears to have been a man of wonderful inconſiſtency in his opinions; teaching on one ſubject rational piety and true ſcience, and on another abſurdity and atheiſm. "No other rule (he ſays) is neceſſary in reaſoning, than that of following the natural order of inveſtigation; beginning with thoſe things which are beſt known, and proceeding, by eaſy ſteps, to thoſe which are more difficult." This is perfectly conſiſtent with the foundation of the Baconian logic; and is indeed the only foundation upon which a ſyſtem of ſcience can poſſibly be built. Yet could the man, who profeſſes to proceed from a principle ſo well eſtabliſhed, gravely advance, as concluſions of ſcience, the following abſurdities: "Perception is a paſſive affection, produced by ſome external object, either in the intellectual ſenſe, or the inclination of the will. God is not perceived by the intellectual ſenſe, but by the inclination of the will: for creatures affect the brain; but God, the heart. All creatures are in God: nothing is exterior to him. Creation is extenſion produced from nothing by the divine power. Creatures are of two kinds, paſſive and active; the former is matter, the latter ſpirit. Matter is dark and cold, and capable of being acted upon by ſpirit, which is light, warm, and active. Spirit may ſubſiſt without matter, but deſires a union with it. All bodies conſiſt of matter and ſpirit, and have therefore ſome kind of life. Spirit attracts ſpirit, and thus ſenſibly operates upon matter united to ſpirit. This attraction in man is called *love;* in other bodies *ſympathy*. A finite ſpirit may be conſidered as a limited ſphere, in which rays, luminous, warm, and active flow from a centre. Spirit is the region of the body to which it is united. The region of finite ſpirits is God. The human ſoul is a ray from the divine nature; whence it deſires union with God, who is love. Since the eſſence of ſpirit conſiſts in action, and of body in paſſion, ſpirit may exiſt without thought; of this kind are light, ether, and other active principles in nature." Fortunately, this jargon is as unintelligible as the categories of Kant, and the blaſphemies of Spinoza; for an account of which the reader is referred to *Critical* PHILOSOPHY in this *Suppl.* and to SPINOZA in the *Encycl.*

Biograph Dictionar

THORNTON (Bonnel), a modern poet, the intimate friend of Lloyd and Colman, and juſtly claſſed with them in point of talents, was born in Maiden-lane, London, in the year 1724. He was the ſon of an apothecary; and being educated at Weſtminſter ſchool, was elected to Chriſt-Church, Oxford, in the year 1743. He was thus eight years ſenior to Colman, who was elected off in 1751. The firſt publication in which he was concerned was, "The Student, or Oxford and Cambridge Miſcellany," which appeared in monthly numbers; and was collected in two volumes 8vo, in 1748. Smart was the chief conductor of the work; but Thornton, and other wits of both univerſities, aſſiſted in it. He took his degree of maſter of arts in 1750; and as his father wiſhed him to make phyſic his profeſſion, he took the degree of bachelor of that faculty in 1754. In the ſame year he undertook the periodical paper called *The Connoiſſeur*, in conjunction with Colman, which they continued weekly to the 30th of September 1756. In the concluding paper, the different ages and purſuits of the two authors are thus jocularly pointed out, in the deſcription of the double author, Mr Town. "Mr Town is a fair, black, middle ſized, very ſhort man. He wears his own hair and a periwig. He is about thirty years of age (literally thirty-two), and not more than four-and-twenty. He is a ſtudent of the law and a bachelor of phyſic. He was bred at the univerſity of Oxford, where, having taken no leſs than three degrees, he looks down on many learned profeſſors as his inferiors; yet having been there but little longer than to take the firſt degree of bachelor of arts, it has more than once happened that the cenſor-general of all England has been reprimanded by the cenſor of his college, for neglecting to furniſh the uſual eſſay, or, in the collegiate phraſe, the theme of the week." Engaged in purſuits of this kind, Bonnel Thornton did not very cloſely follow the profeſſion to which his father deſtined him, but lived rather a literary life, employing his pen on various ſubjects. To the daily paper called the *Public Advertiſer*, then in high reputation, he was a frequent contributor; and he once had it in contemplation to treat with Mr Ritch for the patent of Covent Garden theatre. In 1764, Mr Thornton married Miſs Sylvia Brathwaite, youngeſt daughter of Colonel Brathwaite, who had been governor of a fort in Africa. In 1766, encouraged, as he ſays himſelf, by the ſucceſs of his friend Colman's Terence, he publiſhed two volumes of a tranſlation of Plautus in blank verſe; propoſing to complete the whole if that ſpecimen ſhould be approved. Theſe volumes contained ſeven plays, of which the *Captive* was tranſlated by Mr Warner, who afterwards completed all that Thornton had left unfiniſhed; and the *Mercator* by Mr Colman. The remaining five are, the *Amphitryon*, *Miles Glorioſus*, *Trinummus*, *Aulularia*, *Rudens*. Some parts of the remaining plays which Thornton had tranſlated are preſerved by his continuator. There can be no doubt that this is the beſt way of tranſlating the old comedies, and that Thornton was well qualified for the taſk; but the work has never been in high favour with the public. Yet Warburton ſaid of it, that "he never read ſo juſt a tranſlation, in ſo pure and elegant a ſtyle." Thornton publiſhed in 1767, *The Battle of the Wigs*, as an additional canto to Garth's Diſpenſary; the ſubject of which was the diſputes then ſubſiſting between the fellows and licentiates.

The life of Thornton was not deſtined to attain any great extenſion: in the prime of his days, while he was ſurrounded by domeſtic felicity, the comforts of fortune, and the reſpect of ſociety, ill health came upon him; and medical aid proving inefficient, he died, of the gout in his ſtomach, May 9, 1768, at only 44 years of age. His wife, a daughter, and two ſons, ſurvived him. Beſides the productions already mentioned, he wrote the papers in the Adventurer marked A; "An Ode to St Cecilia's day, adapted to the ancient Britiſh Muſic," a burleſque performance; "The Oxford Barber;" with many detached eſſays in the public papers. A few letters addreſſed to his Sylvia before they were married, diſplay great tenderneſs, expreſſed with frankneſs and eaſe. A ſmall edition of his works might, with much propriety, be preſented to the public, before it ſhall be too late to aſcertain them all. His character may be taken from his epitaph, written in Latin by his friend Dr Warton, and placed on his monument in Weſtminſter Abbey. It is to this effect: "His genius, cultivated moſt happily by every kind of polite literature, was accompanied and recommended by manners open, ſincere, and candid. In his writings and converſation he had a wonderful livelineſs, with a vein of pleaſantry peculiarly his own. In ridiculing the failings of men, without bitterneſs, and with much humour, he was ſingularly happy; as a companion, he was delightful."

THETFORD, a townſhip in the ſouth-eaſt corner of Orange county, Vermont, on the weſtern bank of Connecticut river, about 10 miles north of Dartmouth College, and contains 862 inhabitants.—*Morſe*.

THOMAS's *Bay*, on the W. coaſt of the iſland of Antigua. It affords ſome ſhelter from the S. and S. E. winds.—*ib*.

Thomas *Iſland, St*, or the *Dan's Iſland*, is the largeſt and moſt northerly of the Virgin Iſlands, in the Weſt-Indies, and is about 9 miles long and 3 broad. It has a ſandy ſoil and is badly watered, but enjoys a conſiderable trade, eſpecially in time of peace, in the contraband way; and privateers in time of war ſell their prizes here. A large battery has been erected for its defence, mounted with twenty pieces of cannon, N. lat. 18 22, W. long. 64 51. It has a ſafe and commodious harbour, and lies about 30 miles eaſt of the iſland of Porto Rico.—*ib*.

Thomas *Iſland, St*, on the weſt coaſt of New-Mexico. N. lat. 20 10, weſt long. 113 5.—*ib*.

Thomas, *St*, a town of Guiana in S. America, ſituated on the banks of the Oroonoko. N. lat. 75, weſt long. 62 36.—*ib*.

Thomas, *Port St*, a harbour in the bay of Honduras, on the Spaniſh Main; from which goods are ſhipped to Europe.—*ib*.

Thomas, *St*, the chief town of New-Andaluſia, or Paria, in the northern diviſion of Terra Firma.—*ib*.

Thomas, *St*, a pariſh of Charleſton diſtrict, in S. Carolina. It contains 3,836 inhabitants; of whom 397 are whites, and 3,405 ſlaves.—*ib*.

THOMASTOWN, a poſt-town of the Diſtrict of Maine, Lincoln county, on the weſt ſide of Penobſcot Bay, and about 4 leagues from Franklin Iſland, at the mouth of the river St George, which divides this town from Warren and Cuſhing, to the weſtward. A conſiderable river in the ſouth-eaſt part of the townſhip is called Weſſoweſſgeeg. From the hill of Madambettocks may be ſeen iſlands and lands to a great diſtance; and near it there is thought to be plenty of iron ore; but no attempts have been made to aſcertain its quality. The grand ſtaples of Thomaſtown are lime and lumber. Lime-ſtone is very common, and ſpots of land, or rather rock, of ſix rods ſquare, are frequently ſold for 100 dollars. There are now about 35 kilns erected, each of which, on an average, will produce 200 fifty gallon caſks. Theſe kilns, if burned only three times a year, (though many are 5 or 6 times) will furniſh about 21,000 caſks; which neat, after all expenſes, about ſix ſhillings a caſk. Too much attention being paid to this buſineſs, prevents a due cultivation of the lands. There are now owned on the river 12 brigs, ſchooners, and ſloops, equal to about 1,100 tons, employed in foreign and coaſting voyages. On the river, and its ſeveral ſtreams, are a number of tide and other griſt and ſaw mills, which afford great profit to their owners. A fort with a number of cannon, and a regular garriſon of provincials, was formerly ſtationed about five miles below the head of the tide. Few veſtiges of the fort now remain; but in place of it an elegant building was erected in 1794, by the Hon. Henry Knox, Eſq. The ſettlement of Thomaſtown began about 1720, in 1777 it was incorporated, in 1790 it contained 801 inhabitants; and it was computed to contain in 1796 above 1,200. There are here no public ſchools conſtantly kept, though there are ſeveral private ones throughout the year. There are two churches, the one for Baptiſts, who are the moſt numerous, and the other for Congregationaliſts. Here is alſo a ſocial library. The compact part of the town is 7 miles ſoutherly of Camden, 7 eaſt of Warren, 39 N. E. by E. of Wiſcaſſet, 215 N. E. of Boſton, and 564 N. E. of Philadelphia.—*ib.*

THOME, *St*, or *St Thomas*, a plain in the centre of the iſland of St Domingo, in the Weſt Indies, on the ſouth ſide of the firſt chain of the mountains of Cibao, near which Artibonite river takes its riſe. It is contiguous to the north of that of St John of Maguana. The fort of St Thomas was erected here, near the head of the Artibonite, by Chriſtopher Columbus to protect the mines againſt the Indians. There is now no veſtige of the fort remaining.—*ib.*

THOMPSON, a townſhip of Windham county, in the north eaſt corner of Connecticut; having the town of Killingly on the ſouth, the ſtate of Rhode-Iſland eaſt, and that of Maſſachuſetts on the north; from which laſt it receives Quinabaug and Five-mile rivers.—*ib.*

THOPICANOS, a ſmall river of the N. W. Territory, which runs ſouthward to Wabaſh river, into which it enters a few miles eaſtward of Ouixtanon.—*ib.*

THORNTON, a townſhip of New-Hampſhire, in Grafton county, at the head of Merrimack river, which contains 385 inhabitants. It was incorporated in 1781.—*ib.*

THOULOUSE, *Port*, on the ſouth coaſt of the iſland of Cape Breton, near the entrance of the Strait of Fronſac or Canſo, lies between the gulf called Little St Peter and the iſlands of St Peter. It was formerly called Port St Peter, and is 60 miles weſt of Gabaron Bay.—*ib.*

THOUSAND *Iſles* are ſituated in St Lawrence, or Iroquois river, a little north of Lake Ontario.—*ib.*

THOUSAND *Lakes*, a name given to a great number of ſmall lakes near the Miſſiſſippi, a little to the N. E. of St Francis river, which is about 60 miles above St Anthony's Falls. The country about theſe lakes, though but little frequented, is the beſt within many miles for hunting; as the hunter ſeldom fails returning loaded beyond his expectation. Here the river Miſſiſſippi is not above 90 yards wide.—*ib.*

THREE *Brothers*, 3 iſlands within the river Eſſequibo on the eaſt coaſt of S. America.—*ib.*

THREE *Iſlands Bay*, or *Harbour*, on the eaſt coaſt of the Iſland of St Lucia, in the Weſt Indies.—*ib.*

THREE *Points*, *Cape*, on the coaſt of Guiana, in S. America. N. lat. 10 38, W. long. 61 57.—*ib.*

THREE *Siſters*, three ſmall iſles on the weſt ſhore of Cheſapeak Bay, which lie between Weſt river and Parker's Iſland.—*ib.*

THRUM *Cap*, in the S. Pacific Ocean, a ſmall circular iſle, not more than a mile in circumference, ſeven leagues N. 62° W. from Lagoon Iſland. High water, at full and change, between 11 and 12 o'clock. S. lat. 18 35, W. long. 139 48.—*ib.*

THULE, *Southern*, an iſland in the S. Atlantic Ocean, the moſt ſoutherly land ever diſcovered; hence the name. S. lat. 59 34, W. long. 27 45.—*ib.*

THUNDER. There is not one of the appearances of nature which has ſo much engaged the attention of mankind as thunder. The ſavage, the citizen, and the philoſopher, have obſerved it with dread, with anxiety, and with curioſity; and the philoſopher of our times treats the others with a ſmile of condeſcenſion, while he here enjoys the fulleſt triumph of his ſuperiority:

Felix qui potuit rerum cognoſcere cauſas,
Atque metus omnes et inevitabile fulmen
Subjecit pedibus.

But though this grand phenomenon has long engaged the curious attention of philoſophers, it is but very lately that they have been able to explain it; that is, to point out the more general law of nature of which it is a particular inſtance. Inflammable vapours had long furniſhed them with a ſort of explanation. The diſcovery of gunpowder, and ſtill more that of inflammable air, gave ſome probability to the exiſtence of extenſive ſtrata of inflammable vapours in the upper regions of the atmoſphere, which, being ſet on fire at one end, might burn away in rapid ſucceſſion, like a train of gunpowder. But the ſmalleſt inveſtigation would ſhew ſuch a diſſimilarity in the phenomena, and in the general effects, that this explanation can have no value in the eyes of a true naturaliſt. Horrid exploſion, and a blaſt which would ſweep every thing from the ſurface of the earth, muſt be the effects of ſuch inflammation. The very limited and capricious nature of the ravages made by thunder, render them altogether unlike exploſions of elaſtic fluids.

2
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No ſooner were the wonderful effects of the charged electrical phial obſerved, than naturaliſts began to think of this as exhibiting ſome reſemblance to a thunder-ſtroke (ſee ELECTRICITY, *Encycl.* n° 12.); but it was not till toward the year 1750 that this reſemblance was viewed in a proper light by the celebrated Franklin. In a diſſertation written that year, he delivers his opinion at large, and notices particularly the following circumſtances of ſimilarity.

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remark
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1. The colour and crooked form of lightning, perfectly ſimilar to that of a vivid electrical ſpark between diſtant bodies, and unlike every other appearance of light. This angular, deſultory, capricious form of an electrical ſpark, and of forked lightning, is very ſingular. No two ſucceſſive ſparks have the ſame form. Their ſharp angles are unlike every appearance of motion through unreſiſting air. Such motions are always curvilineal. The ſpark is like the ſimultaneous exiſtence of the light in all its parts; and the fact is, that no perſon can poſitively ſay in which direction it moves.

2. Lightning, like electricity, always ſtrikes the moſt advanced objects—hills, trees, ſteeples.

3. Lightning affects to take the beſt conductors of electricity. Bell wires are very frequently deſtroyed by it. At Leven houſe in Fifeſhire, in 1733, it ran along a gilded moulding from one end of the houſe to the other, exploding it all the way, as alſo the tinfoil on the backs of ſeveral mirrors, and the gilding of ſcreens and leather hangings.

4. It burns, explodes, and deſtroys theſe conductors preciſely as electricity does. It diſſolves metals; melts wires; it explodes and tears to pieces bodies which contain moiſture. When a perſon is killed by lightning, his ſhoes are commonly burſt. When it falls on a wet ſurface, it ſpreads along it. The Royal William, in Louiſburgh harbour, in 1758, received a thunder-ſtroke, which diſſipated the maintop-gallant maſt in duſt, and came down on the wet decks in one ſpark, which

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which ſpread over the whole deck as a ſpout of water would have done. This is quite according to electrical laws.

5. It has ſometimes ſtruck a perſon blind. Electricity has done the ſame to a chicken which it did not kill.

6. It affects the nervous ſyſtem in a way reſembling ſome of the known effects of electricity. The following is a moſt remarkable inſtance: —— Campbell, Eſq. of Succoth, in Dunbartonſhire, has been blind, for ſeveral years. The diſorder was a gutta ſerena. He was led one evening along the ſtreets of Glaſgow by his ſervant Alexander Dick, during a terrible thunder ſtorm. The lightning ſometimes fluttered along the ſtreets for a quarter of a minute without ceaſing. While this fluttering laſted, Mr Campbell ſaw the ſtreet diſtinctly, and the changes which had been made in that part by taking down one of the city gates. When the ſtorm was over, his entire blindneſs returned.—We have from a friend another inſtance, no leſs remarkable. One evening in autumn he was ſitting with a gentleman who had the ſame diſorder, and he obſerved ſeveral lambent flaſhes of lightning. Their faces were turned to the parlour window; and immediately after a flaſh, the gentleman ſaid to his wife "Go, my dear, make them ſhut the white gate; it is open, you ſee." The lady did ſo, and returned; and, after a little, ſaid, "But how did you know that the gate was open?" He exclaimed, "My God! I ſaw it open, and two men look in, and go away again," (which our friend alſo had obſerved). The gentleman on being cloſe queſtioned, could not recollect having had another glance, nor why it had not ſurpriſed him; but of the glimpſe itſelf he was certain, and deſcribed the appearance very exactly.

7. Lightning kills; and the appearances perfectly reſemble thoſe of a mortal ſtroke of electricity. The muſcles are all in a ſtate of perfect relaxation, even in thoſe ſituations where it is uſually otherwiſe.

8. Lightning is well known to deſtroy and to change the polarity of the mariner's needle.

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Dr Franklin was not contented with the bare obſervation of theſe important reſemblances. He availed himſelf of many curious diſcoveries which he had made of electrical laws. In particular, having obſerved that electricity was drawn off at a great diſtance, and without the leaſt violence of action, by a ſharp metallic point, he propoſed to philoſophers to erect a tall maſt or pole on the higheſt part of a building, and to furniſh the top of it with a fine metalline point, properly inſulated, with a wire leading to an inſulated apparatus for exhibiting the common electrical appearances. To the whole of this contrivance he gave the name of *thunder-rod*, which it ſtill retains. He had not a proper opportunity of doing this himſelf at the time of writing his diſſertation in a letter from Philadelphia to the Royal Society of London; but the contents were ſo ſcientific, and ſo intereſting, that in a few weeks time they were known over all Europe. His directions were followed in many places. In particular, the French academicians, encouraged by the preſence of their monarch, and the great ſatisfaction which he expreſſed at the repetition of Dr Franklin's moſt inſtructive experiments, which diſcovered and eſtabliſhed the theory of poſitive and negative electricity, as it is ſtill received, were eager to execute his orders, making his grand experiment, which promiſed ſo fairly to bring this tremendous operation of nature not only within the pale of ſcience, but within the management of human power.

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But, in the mean time, Dr Franklin, impatient of delay, and perhaps incited by the honourable deſire of well-deſerved fame, put his own ſcheme in practice. His inventive mind ſuggeſted to him a moſt ingenious method of preſenting a point to a thunder cloud at a very great diſtance from the ground. This was by fixing his point on the head of a paper kite, which the wind ſhould raiſe to the clouds, while the wet ſtring that held it ſhould ſerve for a conductor of the electricity. We preſume that it was with a palpitating heart that Dr Franklin, unknown to the neighbours, and accompanied only by his ſon, went into the fields, and ſent up his meſſenger that was to bring him ſuch news from the heavens. He told a perſon, who repeated it in the hearing of the preſent writer, that when he ſaw the fibres of the cord raiſe themſelves up like hogs briſtles, he uttered a deep ſigh, and would have wiſhed that moment of joy to have been his laſt. He obtained but a few faint ſparks from his apparatus that day; but returned to his houſe in a ſtate of perfect happineſs, now feeling that his name was never to die. Thus did the ſoap bubble, and the paper kite, from being the playthings of children, become, in the hands of Newton, and of Franklin, the means of acquiring immortal honour, and of doing the moſt important ſervice to ſociety.

We may juſtly conſider this as one of the greateſt of philoſophical diſcoveries, and as doing the higheſt honour to the inventor; for it was not a ſuggeſtion from an accidental obſervation, but aroſe from a ſcientific compariſon of facts, and a ſagacious application of the doctrine of poſitive and negative electricity: a doctrine wholly Dr Franklin's, and the reſult of the moſt acute and diſcriminating obſervation. It was this alone that ſuggeſted the whole; and by explaining to his ſatisfaction the curious property of ſharp points, gave him the courage to handle the thunderbolt of Jove.

It is then a point fully aſcertained, that thunder and lightning are the electric ſnap and ſpark, as much ſuperior to our puny imitations as we can conceive from the immenſe extent of the inſtruments in the hands of Nature. If, ſays Dr Franklin, a conductor one foot thick and five feet long will produce ſuch ſnaps as agitate the whole human frame, what may we not expect from a ſurface of 10,000 acres of electrified clouds? How loud muſt be the exploſion? how terrible the effects?

4
Electrical ſtates of the atmoſphere.

This diſcovery immediately directed the attention of philoſophers to the ſtate of the atmoſphere with reſpect to electricity; and in this alſo Dr Franklin led the way. He immediately erected his thunder rods; and they have been imitated all over the world, with many alterations or improvements, according to the different views and ſkill of their authors. It is needleſs to inſiſt here on their conſtruction. They have been deſcribed in the article Electricity (*Encycl.*); and any perſon well acquainted with its theory, as laid down in the *Supplementary* article Electricity, will be at no loſs to accommodate his own conſtruction to his ſituation and purpoſes.

Dr Franklin took the lead, as we have already obſerved,

ſerved, in this examination of the electrical ſtate of the atmoſphere. He ſeldom found it without giving ſigns of electricity, and this was generally negative. See *Phil. Tranſ.* Vol. XLVIII. p. 358. and 785.

Mr Canton repeated thoſe experiments, and found the ſame reſults; both, however, found that the electricity would frequently change from poſitive to negative, and from negative to poſitive, in very ſhort ſpaces of time, as different portions of clouds or air paſſed the thunder-rod.

5
Cautions to be obſerved in this examination by a thunder rod.

We muſt here remark, that our acquaintance with the laws of electricity ſufficiently informs us, that the electricity of our thunder-rod may frequently be of a different kind from that of the cloud which excites the appearances at our apparatus. We know that air, like glaſs, is a non-conductor; and that when it is brought into any ſtate of electricity, either by communication, or by mere induction, it will remain in that ſtate for ſome time, and that it always changes its electricity *per ſtratum*. A poſitive cloud, in the higher regions of the atmoſphere, will render the air immediately below it negative, and a ſtratum below that poſitive. If the thunder rod be in this poſitive ſtratum, it will exhibit poſitive electricity; but if the cloud be conſiderably nearer, the rod, by being in the adjoining negative ſtratum, may ſhow a negative electricity which will exceed the poſitive electricity which the diſtant poſitive cloud would have induced on its lower end by mere poſition, had the intervening air been away. This exceſs of negative electricity muſt depend on the degree in which the ſurrounding ſtratum of air has been rendered negative. If this has been the almoſt inſtantaneous effect of the preſence of the poſitive cloud, it cannot be rendered ſo negative as to produce negative electricity in the lower end of the thunder rod. But if the ſtratum of air has for ſome conſiderable time accompanied the poſitive cloud, its negative electricity has been increaſing, and ſome would remain, even if the cloud were removed. We muſt, at all times, conſider the thunder rod as affected by *all* the electricity in its neighbourhood. The diſtant poſitive cloud would at any rate render the lower end of the rod poſitive, without communication, by merely diſplacing the electricity in the rod itſelf, juſt as the north pole of a loadſtone would make the remote end of a ſoft iron rod a north pole. In like manner, the negative ſtratum of air immediately adjoining to the poſitive cloud would make the lower end of the rod negative, without communication. A poſitive ſtratum of air below this would have the contrary effect. The appearances, then, at the end of the rod, muſt be the reſult of the prevalence of one of theſe above the others; and many intervening circumſtances muſt be underſtood, before we can infer with certainty the ſtate of a cloud from the appearances at the lower end of the apparatus. It would, therefore, be a moſt inſtructive addition to a thunder rod to have an electroſcope at both ends. If they ſhew the ſame kind of electricity, we may be aſſured that it is by communication, and is the ſame with that of the ſurrounding ſtratum of air: But if they ſhew oppoſite electricities (which is generally the caſe), then we learn that it is by poſition or induction. We recommend this to the careful attention of the philoſopher.

In this way we perfectly explain an appearance which puzzled both of the above-mentioned obſervers. When a ſingle low cloud approached the rod, the electroſcope would ſhew poſitive electricity, but negative when the cloud was in the zenith, and poſitive again when it had paſſed by. We alſo learn from this the cauſe of Dr Franklin's diſappointment in his expectations of very remarkable phenomena by means of his kite. He imagined that it would be vaſtly ſuperior to the apparatus which he had recommended to the philoſophers of Europe. But the ſtring of the kite, traverſing ſeveral ſtrata in different ſtates of electricity, ſerved as a conductor between them, and he could only obtain the ſuperplus; which might be nothing, even when the clouds were ſtrongly electrified

The moſt copious and curious obſervations on the electrical ſtate of the atmoſphere are thoſe by Profeſſor Beccaria of Turin. He had connected the tops of ſeveral ſteeples of the city by inſulated wires. He did the ſame thing at a monaſtery on a high hill in the neighbourhood. Each of theſe collected the electricity of a ſeparate ſtratum of conſiderable extent. He frequently found theſe two ſtrata in oppoſite ſtates of ſtrong electricity.

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The following general obſervations are made out from a compariſon of a vaſt variety of more particular ones made in different places:

1. The air is almoſt always electrical, eſpecially in the day time and dry weather; and the electricity is generally poſitive. It does not become negative, unleſs by winds from places where it rains, ſnows, or is foggy.

2. The moiſture of the air is the conſtant conductor of its electricity in clear weather.

3. When dark or wet weather clears up, the electricity is always negative. If it has been very moiſt, and dries very faſt, the electricity is very intenſe, and diminiſhes when the air attains its greateſt dryneſs; and may continue long ſtationary, by a ſupply of air in a drying ſtate from diſtant places.

4. If, while the ſky overcaſts in the zenith, only a high cloud is formed, without any ſecondary clouds under it, and if this cloud is not the extenſion of another which rains in ſome remote place, the electricity (if any) is always poſitive.

5. If the clouds, while gathering, are ſhaped like locks of wool, and are in a ſtate of motion among each other; or if the general cloud is forming far aloft, and ſtretches down like deſcending ſmoke, a frequent poſitive electricity prevails, more intenſe as the changes in the atmoſphere are quicker; and its intenſity predicts the great quantity of ſnow or rain which is to follow.

6. When an extenſive, thin, level cloud forms, and darkens the ſky, we have ſtrong poſitive electricity.

7. Low thick fogs, riſing into dry air, carry up ſo much electricity as to produce ſparks at the apparatus. If the fog continues round the apparatus without riſing, the electricity fails.

8. When, in clear weather, a cloud paſſes over the apparatus, low and tardy in its progreſs, and far from any other, the poſitive electricity gradually diminiſhes, and returns when the cloud has gone over.

9. When many white clouds gather over head, continually uniting with and parting from each other, and thus form a body of great extent, the poſitive electricity increaſes.

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10. In the morning, when the hygrometer indicates dryneſs equal to that of the preceding day, poſitive electricity obtains, even before ſunriſe.

11. As the ſun gets up, this electricity increaſes; more remarkably if the dryneſs increaſes. It diminiſhes in the evening.

12. The mid-day electricity, of days equally dry, is proportional to the heat.

13. Winds always leſſen the electricity of a clear day, eſpecially if damp; therefore they do not electrify the air by friction on ſolid bodies.

14. In cold ſeaſons, with a clear ſky and little wind, a conſiderable electricity ariſes after ſunſet, at dew falling.

The ſame happens in temperate and warm weather.

If, in the ſame circumſtances, the general dryneſs of the air is leſs, the electricity is alſo leſs.

15. The electricity of dew, like that of rain, depends on its quantity. This electricity of dew may be imitated by electrifying the air of a cloſe room (not too dry), and filling a bottle with very cold water, and ſetting it in the upper part of the room. As the damp condenſes on its ſides, an electrometer will ſhew very vivid electricity.

Such a collection of obſervations, to be fit for inference, requires very nice diſcrimination. It is frequently difficult to diſcover electricity in damp air, though it is then generally ſtrongeſt; becauſe the inſulation of the apparatus is hurt by the dampneſs. To make the obſervation with accuracy, requires a portable apparatus, whoſe inſulation can be made good at all times. With ſuch apparatus we ſhall never miſs obſerving electricity in fogs, or during ſnow.

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There is a very curious phenomenon, which may be frequently obſerved in Edinburgh, and no doubt in other towns ſimilarly ſituated. In a clear day of the month of May, an eaſterly wind frequently brings a fog with it, which advances from the ſea in a denſe body; and when it comes up the High-ſtreet, it chills the body exceedingly, while it does not greatly affect the thermometer. Immediately before its gaining the ſtreet, one feels like a tickling on the face, as if a cobweb had fallen on it, and naturally puts up his hand, and rubs the face. We have never found this to fail, and have often been amuſed with ſeeing every perſon rubbing his face in his turn. The writer of this article has obſerved the ſame thing at St Peterſburgh, in a ſummer's evening, when a low fog came on about ten o'clock.

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The general appearances of a thunder ſtorm are nearly as follow:

For the moſt part the wind is gentle, or it is calm. A low denſe cloud begins in a place previouſly clear: this increaſes faſt in ſize; but this is only upwards, and in an arched form, like great bags of cotton. The lower ſurface of the cloud is commonly level, as if it reſted on a glaſs plane.

Soon after appear numberleſs ſmall ragged clouds, like flakes of cotton teazled out. Theſe are moving about in various uncertain directions, and continually changing their ragged ſhape. This change, however, is generally by augmentation. Whatever occaſions the precipitation of the diſſolved water ſeems to gain ground. As theſe clouds move about, they approach each other, and then ſtretch out their ragged arms towards each other. This is not by an augmentation, but by a real bending of theſe tatters towards the other cloud. They ſeldom come into contact; but after coming very near in ſome parts, they as plainly recede, either in whole, or by bending their arms away from each other.

But during this confuſed motion, the whole maſs of ſmall clouds approaches the great one above it; and when near it, the clouds of the lower maſs frequently coaleſce with each other before they finally coaleſce with the upper cloud: But as frequently the upper cloud increaſes without them. Its lower ſurface, from being level and ſmooth, now becomes ragged, and its tatters ſtretch down towards the others, and long arms are extended towards the ground. The heavens now darken apace, the whole maſs ſinks down; wind ariſes, and frequently ſhifts in ſqualls; ſmall clouds are now moving ſwiftly in various directions; lightning now darts from cloud to cloud. A ſpark is ſometimes ſeen coexiſtent through a vaſt horizontal extent, of a crooked ſhape, and of different brilliancy in its different parts. Lightning ſtrikes between the clouds and the earth—frequently in two places at once. A continuation of theſe ſnaps rarifies the cloud; and in time it diſſipates. This is accompanied by heavy rain or hail; and then the upper part of the clouds is high and thin.

During this progreſs of the ſtorm, the thunder rod is ſtrongly electrified; chiefly when the principal cloud is over head. The ſtate of the electricity frequently changes from poſitive to negative—almoſt every flaſh, however diſtant, occaſions a ſudden ſtart of the electroſcope, and then a change of the electricity. When the cloud is more uniform, the electricity is ſo too.

8
Sources of atmoſpheric electricity.

The queſtion now is, In what manner does the air acquire this electricity? How come its different parts to be in different ſtates, and to retain this difference for a length of time? and how is the electric equilibrium reſtored with that rapidity, and to that extent, that we obſerve in a thunder ſtorm? For we know that air is a very imperfect conductor, and tranſmits electricity to ſmall diſtances only, and very ſlowly. We ſhall mention ſeveral circumſtances, which are known facts in electricity, and muſt frequently concur, at leaſt, with the other cauſes of this grand phenomenon.

Air is rendered electrical in a great variety of ways.

1. All operations which excite electricity in other bodies have the ſame effect on air. It is electrified by friction. When blown on any body, ſuch as glaſs, &c. that body exhibits electricity by a ſenſible electroſcope. We therefore conclude that the air has acquired the oppoſite electricity from this rubber. A glaſs veſſel, exhauſted of air, and broken in the dark, gives a loud crack, and a very ſenſible flaſh of light. An air-gun, diſcharged (without a ball) in the dark, does the ſame. Blowing on an electric with a pair of bellows never fails to excite it. In ſhort, the facts to this purpoſe are numberleſs.

2. Electricity is produced by a number of chemical operations, which are continually going on. The melting and freezing of electric bodies in contact with each other, ſuch as chocolate in its moulds, wax-candles in their moulds, ſealing-wax, &c. Nay, it is highly probable that any body, in paſſing from its fluid to its ſolid form, or the contrary, is electrical. This is the caſe when a ſolution of Glauber's ſalt, or of nitre, in water, is made to cryſtallize all at once by agitation.

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The ſolution of bodies in their menſtrua is, in like manner, productive of electricity in many caſes. Thus iron or chalk, while diſſolving in the ſulphuric acid, produce negative electricity in the mixture, and poſitive in the electric vapours which ariſe from them.

A moſt copious ſource of electricity is the converſion of water into elaſtic ſteam by violent heats. When this is done in a proper apparatus, the electricity of the liquid is negative, and the vapour is poſitive. But if this be accompanied by a decompoſition of the water, the liquid is ſometimes ſtrongly negative. Thus, when water evaporates ſuddenly from a red hot ſilver cup, the cup is ſtrongly negative; but if from clean red hot iron, ſo that the iron is calcined, and inflammable air produced, the iron is poſitive. If the decompoſition of the water is ſufficiently copious to do more than compenſate for the negative electricity produced by the mere expanſion of the water into ſteam, the electricity is poſitive; but not otherwiſe. Water expanded from a piece of red hot coal always gives negative electricity, and this frequently very ſtrong. Theſe experiments ſhould always be made in metalline veſſels. If made in glaſs veſſels, the glaſs takes a charge, which expends the produced electricity, and remains nearly neutral, ſo that the production of electricity is not obſerved. Theſe facts are to be found among many experiments of Mr Sauſſure. But there is here a very wide field of new inquiry, which cannot fail of being very inſtructive, and particularly in the preſent queſtion. We ſee ſome of the effects very diſtinctly in ſeveral phenomena of thunder and lightning. Thus, the great eruptions of Ætna and Veſuvius are always accompanied by forked lightnings, which are ſeen darting among the volumes of emitted ſmoke and ſteam. Here is a very copious converſion of water into elaſtic ſteam; and here alſo it is moſt reaſonable to expect a copious decompoſition of water, by the iron and coally matters, which are expoſed to the joint action of fire and water. Theſe two electricities will be oppoſite; or when not oppoſite, will not be equal: in either of which caſes, we have vaſt maſſes of ſteam in ſtates fit for flaſhing into each other.

A fact more to our purpoſe is, that if a ſilk or linen cloth, of a downy texture, be moiſtened or damped, and hung before a clear fire to dry, the fibres briſtle up, and on bringing the finger, or a metal knob, near them, they are plainly attracted by it. We found them negatively electric. This ſhews that the ſimple ſolution of water in air produces electricity. And this is the chief operation in Nature connected with the ſtate of the atmoſphere. It is thus that the watery vapours from all bodies, and particularly the copious exſudation of plants, diſappear in our atmoſphere. There can be no doubt but that the oppoſite electricity will be produced by the precipitation of this vapour; that is, by the formation of clouds in clear air. When damp, but clear air in one veſſel expands into an adjoining veſſel, from which the air has been exhauſted, a cloud appears in both, and a delicate electrometer is affected in both veſſels; but our apparatus was not fitted for aſcertaining the kind of electricity produced. Here then is another unexplored field of experiment. We got two veſſels made, having diaphragms of thin ſilk. Theſe were damped, and ſet into two tubs of water, of very different temperatures. Dry air was then blown through them, and came from their ſpouts ſaturated with water. The ſpouts were turned toward each other. Being of very different temperatures, the ſtreams produced a cloud upon mixing together, and a ſtrong negative electricity was produced. We even found that an electrometer, placed in a veſſel filled with condenſed air, was affected when this air was allowed to ruſh out by a large hole.

Laſtly, we know that the tourmaline, and many of the columnar cryſtals, are rendered electrical by merely heating and cooling. Nay, Mr Canton found that dry air became negative by heating, and poſitive by cooling, even when it was not permitted to expand or contract.

When water is precipitated, and forms a cloud, it is reaſonable to expect that it will have the electricity of the air from which it is precipitated. This may be various, but in general negative: For the heat by which the air was enabled to diſſolve the water made it negative; and much more the friction on the ſurface of the earth. But as heat cauſed it to diſſolve the water, cold will make it precipitate it; and we ſhould therefore expect that the air will be in the ſtate in which it was when it took up the water. But if it be cooled ſo faſt as to precipitate it in the form of rain, or ſnow, or hail, we may expect poſitive electricity. Accordingly, in ſummer, hail ſhowers always ſhew ſtrong poſitive electricity; ſo does ſnow when falling dry.

Here, then, are copious ſources of atmoſpheric electricity. The mere expanſion and condenſation of the air, and ſtill more the ſolution and precipitation of watery vapours in it, are perhaps ſufficient to account for all the inequality of electric ſtate that we obſerve in the atmoſphere.

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The maſſes of air thus differently conſtituted are evidently diſpoſed in ſtrata. The clouds are ſeen to be ſo. Theſe clouds are not the ſtrata, but the boundaries of ſtrata; which, from the very nature of things, are in different ſtates with reſpect to the ſuſception or precipitation of water. When two ſuch ſtrata are thus adjoining, they will ſlowly act on each other's temperature, and by mixing will form a thin ſtratum of cloud along their mutual confines. If the one ſtratum has any motion relative to the other, and be in the ſmalleſt degree diſturbed, they will mix to a greater depth in each; and this mixture will not be perfectly uniform. The extreme mobility of air will greatly increaſe this jumble of the adjoining parts of the two ſtrata, and will give the cloud a greater thickneſs. If the jumble has been very great, ſo as to puſh one of them through the other, we ſhall have great towering clouds, perhaps pervading the whole thickneſs of the ſtratum of air. We take theſe clouds to be like great foggy bladders, ſuperficially opaque where they have come into contact with the ſurrounding ſtratum of air, but tranſparent within.

When the wind, or ſtratum in motion, does not puſh all the quieſcent air before it, it generally gets over it, and then flows along its upper ſide, and, by a partial mixing, produces a fleecy cloud, as already deſcribed. We may obſerve here, by the way, that the motion of thoſe fleecy clouds is by no means a juſt indication of the motion of the ſtratum; it is nearly the motion compoſed of the half of the motions of the two.

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This is in all probability the ſtate of the atmoſphere, conſiſting of ſtrata of clear air many hundred yards thick,

thick, ſeparated from each other by thin fleeces of clouds, which have been produced by the mixture of the two adjoining ſtrata. This is no fancy; for we actually ſee the ſky ſeparated by ſtrata of clouds at a great diſtance from each other. And we ſee that theſe ſtrata maintain their ſituations, without farther admixture, for a long time, the bounding clouds continuing all the while to move in different directions. In the year 1759, during the ſiege of Quebec, a hard gale blew one day from the weſtward, which made it almoſt impracticable to ſend a number of proviſion boats to our troops ſtationed above the town. While the men were tugging hard at the oars againſt the wind, and hardly advancing, though the tide of flood favoured them, the French threw ſome bombs to deſtroy the boats. One of theſe burſt in the air, near the top of its flight, which was about a quarter of a mile high. The round ball of ſmoke produced by the exploſion remained in the ſame ſpot for above ſeven minutes, and diſappeared by gradual diffuſion. The lower air was moving to the eaſtward at leaſt 30 feet per ſecond.

In 1783, when a great fleet rendezvouſed in Leith Roads, the ſhips were detained by an eaſterly wind, which had blown for ſix weeks without intermiſſion. The ſky was generally clear; ſometimes there was a thin fleece of clouds at a great height, moving much more ſlowly in the ſame direction with the wind below. During the laſt eight days, the upper current was from the weſtward, as appeared by the motion of the upper clouds. High towering clouds came down the river, with a little rain; the ſtrata were jumbled, and the whole atmoſphere grew hazy and uniform: then came thunder, and heavy rain, and the wind below ſhifted to the weſtward.

Thus it is ſufficiently evinced, that the atmoſphere frequently conſiſts of ſuch ſtrata, well diſtinguiſhed from each other: their appearance and progreſs leave us no room to doubt but that they come from different quarters, and had been taken up or formed at different places, and in different circumſtances, and therefore differing in reſpect of their electrical ſtates.

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The conſequence of their continuing long together would be a gradual but ſlow progreſs of their electricity to a ſtate of equilibrium. The air is perhaps never in a perfectly dry ſtate, and its moiſture will cauſe the electricity to diffuſe itſelf gradually. It is not beyond the power of our mathematics to aſcertain the progreſs of this approximation to the electric equilibrium. We ſee ſomething very like it in the curious experiments of Beccaria with mirror plates laid together, and charged by means of a coating on the outer plates. Theſe plates were found to conſiſt of alternate ſtrata of poſitive and negative electricity, which gradually penetrated through the plates, and coaleſced till they were reduced to two ſtrata; perhaps in time the electricity would have diſappeared entirely by theſe two alſo coaleſcing. In the ſame manner there would be a ſlow transfuſion of ſenſible electricity through theſe ſtrata without any ſenſible appearances. If any collateral cauſes ſhould make a part more damp than the reſt, there would be a more briſk transference through it, accompanied with faint flaſhes of lambent lightning.

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But thunder requires a rapid communication, and a reſtoration of electric equilibrium in an inſtant, and to a vaſt extent. The means for this are at hand, furniſhed by Nature. The ſtrata of charged air are furniſhed with a coating of cloud. The lower ſtratum is coated on the underſide by the earth.

13 Manner in which this is effected by a coating of cloud.

When a jumble is made in any of the ſtrata, a precipitation of vapour muſt generally follow. Thus a conductor is brought between the electrical coatings. This will quickly enlarge, as we ſee that in our little imitations the knobs of our conductors inſtantaneouſly arrange any particles of duſt which chance to lie in the way, in ſuch a manner as to complete the line of conduct, and occaſion a ſpark to fly at a much greater diſtance than it would have leaped if no duſt had been interpoſed. We have often procured a diſcharge between two knobs which were too far aſunder, by merely breathing the damp air between them. In this manner the interpoſed cloud immediately attracts other clouds, grows ragged by the paſſage of electricity through clear air, where it cauſes a precipitation by altering the natural equilibrium of its electricity; for a certain quantity of electricity may be neceſſary for air's holding a certain quantity of vapour. Accordingly we ſee in a thunder ſtorm that ſmall clouds continually and ſuddenly form in parts formerly clear. Whatever cauſes thunder, does in fact promote this precipitation.

Theſe clouds have the electricity of the ſurrounding air, and muſt communicate it to others in an oppoſite ſtate, and within reach. They muſt approach them, and muſt afterwards recede from them, or from any that are in the ſame ſtate of electricity with themſelves. Hence their ragged forms, and the ſimilar form of the under ſurface of the great cloud; hence their continual and capricious ſhifting from place to place: they are carriers, which give and take between the other clouds, and they may become ſtepping ſtones for the general diſcharge.

If a ſmall cloud form a communication with the ground, and the great cloud be poſitive or negative, we muſt have a complete diſcharge, and all the electrical phenomena, with great violence; for this coating of vapour is abundantly complete for the purpoſe. It conſiſts of ſmall veſicles, which are ſufficiently near each other for diſcharging the whole air that is in their interſtices. A phial coated with amalgam is by no means fully coated. If we hold it between the eye and the light, we ſhall ſee that it is only covered with a number of detached points of amalgam, which looks like a cobweb. Yet this glaſs is almoſt completely diſcharged by a ſingle ſpark, the reſiduum being hardly perceptible.

14 The diſcharge is commonly between the clouds

The general ſcene of thunder is the heavens; and it is by no means a frequent caſe that a diſcharge is made into the earth. The air intervening between the earth and the loweſt coating is commonly very much confuſed in conſequence of the hills and dales, which, by altering the currents of the winds, toſs up the inferior parts, and mix them with thoſe above. This generally keeps the earth pretty much in the ſame electrical ſtate as the loweſt ſtratum of the clouds.

15 Which are horizontally diſtant.

Nor are the great thunder ſtorms in general inſtances of the reſtoration of equilibrium between two ſtrata immediately incumbent on each other. They ſeem, for the moſt part, to be ſtrokes between two parcels of air which are horizontally diſtant. This, however, we do not affirm with great confidence. Our chief reaſon for thinking ſo is, that in theſe great ſtorms the ſpark or ſhaft of forked lightning is directed horizontally, and

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ſometimes ſeen at once through an extent of ſeveral miles.

16
Particular account of forked lightning, and explanation of the long continued and rumbling noiſe of thunder.

The nature of this ſpark has not, we think, been properly conſidered. It is ſimply compared to a long electrical ſpark, which we conceive to be drawn through pure air, and is conſidered as marking the actual tranſference of electricity from one end to the other. But this we doubt very much. We are certain of having obſerved ſhafts of lightning at one and the ſame inſtant ſtretching horizontally, though with many capricious zigzags and lateral ſputterings, at leaſt five miles. We cannot conceive this to have been the ſtriking diſtance, becauſe the greateſt vertical diſtance of the ſtrata is not the half of this. We rather think that it is a ſimultaneous range of diſcharges, each accompanied with light, differently bright according to the electrical capacity of the cloud into which it is made; and if there is a real tranſference of electric matter on this occaſion (which we do not affirm), it is only of a ſmall quantity from one cloud to the next adjoining. This we think confirmed by the ſound of thunder. It is not a ſnap, incomparably louder than our loudeſt ſnap from coated glaſs; but a long continued, rumbling, and *very unequable* noiſe. There is no doubt but that this ſnap was almoſt ſimultaneous through the whole extent of the ſpark; but its different parts are conveyed to our ear in time, and are therefore heard by us in ſucceſſion; and it is not an uniform roar, but a rumbling noiſe, unequally loud, according as the different parts of the ſnap are indeed differently loud. We ſhould hear a noiſe of the ſame kind if we ſtood at one end of a long line of ſoldiers, who diſcharged their muſquets (differently loaded) in the ſame inſtant. When any part of the ſpark is very near us, and is not very diffuſe, the ſnap begins with great ſmartneſs, and continues for ſome time, not unlike the violent tearing of a piece of ſtrong ſilk; after which it becomes more and more mellow as it comes from a greater diſtance. We do not, however, affirm, that the whole extenſive ſpark and ſnap are co-exiſtent or ſimultaneous. The cloud is, in all probability, but an indifferent conductor, and even a ſenſible time may elapſe during the propagation of the ſpark to a great diſtance. Beccaria obſerved this in a line of 250 feet of chain, lying looſely on the ground, and conſiſting of near 6000 links. He thought that it employed a full ſecond; but when the chain was gently ſtretched, the communication ſeemed inſtantaneous.

17
Obſervations on the electric ſpark.

We cannot help thinking that even the electrical ſnap between two metal knobs is of the ſame kind. Not a quantity of luminous matter which iſſues from the one and goes to the other, but a light that is excited or produced in different material interjacent particles of air or other interpoſed matter. The angular and ſputtering form is quite incompatible with the motion of a ſimple luminous point. Nay, our chemical knowledge here comes in aid, and obliges us to ſpeculate about the manner in which this light is produced. Whence does it come? It may be produced by two knobs of ice. We know that water conſiſts of vital and inflammable air, which have already emitted the light which made an ingredient of their compoſition. The ſpark therefore does not come from the ice. Is it then from the air? If ſo, perhaps water is produced, or rather ſomething elſe, for there is not always inflammable air at hand to compoſe water. Yet the tranſference of electricity has decompoſed the air, or has robbed it of part of its light. The remainder may not be water; but it is no longer air. Is not this confirmed by the peculiar ſmell which always accompanies electric ſparks? and the peculiar taſte, not unlike the taſte felt on the tongue when it is touched by the zinc in the experiments on GALVINISM? Even the fine pencil of light which flows from a point poſitively electrified, appears through a magnifying glaſs to conſiſt, not of luminous lines, but of lines of luminous points. And theſe points are of different brilliancy and different colour, both of which are inceſſantly changing. And be it farther obſerved, that theſe lines are curves, diverging from each other, and convex to the axis. This circumſtance indicates a mutual repulſion, ariſing, in all probability, from the expanſion of the air. And, laſtly, no ſpark nor light of any kind can be obtained in a ſpace perfectly void of air.

All theſe circumſtances concur in explaining the nature of the ſhaft of forked lightning. It is a ſeries of appearances excited in the intervening medium, and which produce ſome chemical change in it. Thunder, when it ſtrikes a houſe, always leaves a peculiar ſmell. Inflammable air has alſo a peculiar and very diſagreeable ſmell. The ſmell produced by electricity greatly reſembles the ſmell produced by ſtriking two pieces of quartz together.

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Mr Deluc ſuppoſes that the electrical ſpark, as it is exhibited in thunder, is always accompanied by the decompoſition of air now ſo familiarly known, and that this is the origin of the deluge of rain which commonly finiſhes the ſtorm. But this is not in the ſmalleſt degree probable. The decompoſition extends ſurely no farther than where the light is ſeparated; and we ſhould no more expect a deluge of rain, even if we had inflammable air ready at hand, than we expect drops of water in our electrical experiments. Something different from water follows this decompoſition, total or partial, of the vital air; and the water which we do obſerve to accompany thunder, is no more than what we ſhould expect from the copious precipitation of water in a cloudy form. Mr Sauſſure's obſervations aſſure us that the particles of a cloud are veſicles. Indeed no perſon who has looked narrowly at a fog, or has obſerved how large the particles are of the cloud which forms in a receiver when we ſuddenly diminiſh the denſity of the air, and who obſerves how ſlowly theſe particles deſcend, can doubt of their being hollow veſicles. We cannot perhaps explain their formation; but there they are. We can hardly conceive them receiving the commotion which accompanied the ſnap without collapſing by the agitation. Perhaps the very ceſſation of their electricity may produce this effect. They will therefore no longer float in the air, but fall, and unite, and come to the ground in rain. We may expect this rain to be copious, for it is the produce of two ſtrata of clouds. It greatly contributes to the putting an end to the ſtorm, by paſſing through the ſtrata, and helping to reſtore the equilibrium.

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One may at firſt expect that a ſingle clap of thunder will reſtore the equilibrium of any extent of clouds, and we require an explanation of their frequent repetition before this is accompliſhed. This is not difficult, and the fact is a confirmation of the above theory, which is conſiderably different from the generally received notions nder.

tions of the ſubject. We conſider the ſtratum of clear air as the charged electric; poſitive on one ſide, and negative on the other, and coated with conducting clouds. When the diſcharge is made, the ſtate of electricity is indeed changed through the whole ſtratum, but the equilibrium is by no means completed. The ſtratum is perhaps a quarter of a mile in thickneſs. The diſcharge does not immediately affect all this: but does it ſuperficially, leaving the reſt unbalanced. It is like the reſiduum which is left in a Leyden phial when the diſcharge has been made by means of a ſpark drawn at a diſtance. It is ſtill more like the reſiduum of the diſcharge of a Leyden phial that is coated only in patches on one ſide. Each of theſe patches diſcharges what is immediately under it and round it to a certain ſmall diſtance, but leaves a part beyond this ſtill charged. This redundant electricity gradually diffuſes itſelf into the ſpaces juſt now diſcharged; and, after ſome conſiderable time has elapſed, another diſcharge may be made. In like manner, the electricity remaining in the interior of the ſtratum diffuſes itſelf, comes within the action of the coating, and may be again diſcharged by a clap of thunder. We have a ſtill better parallel to this in Beccaria's experiments with two or more plates of glaſs laid together. After the firſt diſcharge, the internal ſurfaces will exhibit certain electricity. Lay the plates together, and, after ſome time, the electricity of the inner ſurfaces will be different, and another diſcharge may be obtained.

Magnetiſm affords the beſt illuſtration of this. If a magnet be brought near a piece of ſoft iron, lying below a paper on which iron filings are lightly ſtrewed, it will inſtantly induce a north pole on one end and a ſouth pole on the other; and this will be diſtinctly obſerved by the way in which theſe filings will arrange themſelves. But if, inſtead of ſoft iron we place a bar of hard tempered ſteel, the ſouth pole will be but a ſmall matter removed from the north pole; but by continuing the magnet long in the ſame place, the diſtribution of magnetiſm in the piece of hard ſteel will gradually advance along the bar, and after a long time the neutral point will be almoſt in the middle of the bar, and the ſouth pole will be at the farther end. See Magnetism, in this *Suppl.*

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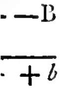
We ſaid that the clouds were the uſual ſcenes of the violent electric phenomena. We imagine that the greateſt part of the thunder ſtrokes which have been felt have been of the kind which Lord Mahon, now Lord Stanhope, calls the returning ſtroke. If two clouds A and B are incumbent over the plain *a* and *b*; and if A be poſitive and B negative, the earth will be maintained in a negative ſtate at *a*, and a poſitive ſtate at *b*. If the diſcharge be now made between the clouds A and B, the electricity muſt inſtantly ruſh up through a conductor at *a*, and down through one at *b*, and each place will have a ſtroke. The ſame thing will happen if the negative cloud B is above the poſitive cloud A, but not in ſo great a degree; for the negative electricity at *a* will now be much leſs than in the other caſe, becauſe it is induced only by the prevalence of the poſitive cloud A over the more remote negative cloud B.



This returning ſtroke explains, much better than we can by any direct ſtroke, the capricious effects of thunder. A perſon at Vienna received a terrible ſhock by having his hand on a thunder-rod during a violent exploſion which he ſaw above three miles diſtant. Sparks are obſerved at thunder-rods at every the moſt diſtant flaſh of lightning.

Thunder.

21
Beccaria's theory of thunder not juſt.

Beccaria has a different theory of thunder. He imagines that the different parts of the earth are in different ſtates of electricity, and that the clouds are the reſtoring conductors. But this does not accord with what we know of electricity. The earth is ſo good a conductor, that Dr Watſon could not obſerve any time loſt in communicating the electricity to the diſtance of more than four miles. It is very true, that the earth is almoſt always in a ſtate of very unequal, and even oppoſite, electricity in its different parts; but this ariſes from the variety of clouds ſtrongly electrified in the oppoſite way. This induces electricity, or diſturbs the natural uniform diffuſion of electricity, juſt as the bringing magnets or loadſtones into the neighbourhood of a piece of iron, without touching it, renders it magnetical in its different parts. While they continue in their places, the piece of iron will be magnetical, and differently ſo in its different parts.

Such are the thoughts which occur to us on this ſubject. But we by no means affirm that we have given a full account of the procedure of Nature; we have only pointed out ſeveral neceſſary conſequences of the known laws of electricity, and of its production in the atmoſphere by means of natural operations which are continually going on. Theſe *muſt* operate, and produce an electrical ſtate of the atmoſphere greatly reſembling what we obſerve: and we have ſhewn, from the acknowledged doctrines of electricity, how this want of equilibrium may be removed, and muſt be removed, by the ſame operations of Nature. The equilibrium muſt be reſtored by means of the conducting coating furniſhed by the clouds. But theſe may be the leaſt conſiderable of Nature's reſources; and the ſubject is ſtill an unexplored field, in the examination of which we may hope to make great progreſs, in conſequence of our daily increaſing knowledge of the chemical ſtate of the atmoſphere.

22
Dr Franklin's invention of a guard againſt thunder.

Knowledge is valuable chiefly as it is uſeful. No man ever ſaw the propriety of this apothegm more ſtrongly than Dr Franklin, or more aſſiduouſly adhered to it in the courſe of a long and ſtudious life. However greatly we may admire his ſagacity, penetration, and logical diſcrimination, in the diſcoveries he has made in the ſcience of electricity, and his diſcovery of the identity of electricity and thunder, we muſt acknowledge infinitely greater obligations to him for putting it in our power to ward off the fatal, and formerly inevitable ſtroke, of this awful agent in the hands of Nature.

Dr Franklin conſiders the earth as performing the office of a conductor in reſtoring the electric equilibrium of the atmoſphere, which has been diſturbed by the inceſſant action of the unwearied powers of Nature.

He obſerves that the uſual preference will be given to the beſt conductors. In this reſpect, a metal rod far ſurpaſſes the brick, ſtone, timber, and other materials which compoſe our buildings, eſpecially when they are dry, as is uſually the caſe in the thundery ſeaſon. He therefore adviſes us to place metalline conductors in the way of the atmoſpherical electricity, in thoſe places where it is moſt likely to ſtrike, and to continue them down to the moiſt earth, at ſome depth under the ſurface. Nay, as it has been found that thunder has not in every inſtance ſtruck the higheſt parts of buildings, he adviſes to raiſe the metalline conductors to ſome conſiderable height above the building, the more certainly to invite the electricity to take this courſe.

23 Directions for conſtructing it.

To enſure ſucceſs, he obſerves that the electrical ſhock diſſipates water, and even metalline conductors when too ſmall. He therefore adviſes to make the conductor at leaſt half an inch ſquare, none of that ſize having ever been deſtroyed, though ſmaller have, by the thunder: yet even theſe had conducted the thunder to the ground with perfect ſafety to the building.

No part of a conductor muſt terminate in the building; for the electricity accumulates exceedingly at the remote extremities of all long rods, and tends to fly off with great force, eſpecially if another conductor is near. This aids the accumulation, by acquiring at its upper end an electricity oppoſite to that of the lower end of the other: and this effect, produced by the influence of a poſitive cloud, makes the upper and negative end of the lower portion of a divided conductor draw more electricity to the lower end of the upper portion. This redundant electricity, ſtrongly attracted by the negative lower portion, flies off with great violence through the air; or if ſurrounded with any matter capable of converſion into elaſtic vapour by heat, burſts it with irreſiſtible force. Thus the thunder, acting on the vane ſpindle of St Bride's ſteeple in London, ſprung from its lower end to the upper end of an iron window bar, and burſt the ſtone in which it was fixed, by expanding the moiſture into ſteam. In like manner it burſt the ſtone at the lower end of this bar, to make its way to an iron cramp which connected the oppoſite ſides of the ſteeple; from this it ſtruck to another cramp; and ſo from cramp to cramp, till it reached the gutter leads of the church, burſting and throwing off the ſtonework in many places.

All interruptions muſt therefore be carefully avoided, and the whole muſt be made as much as poſſible one continued metal rod.

Farther, Dr Franklin, obſerving the ſingular property which ſharp points poſſeſs of drawing off the electricity in ſilence, adviſes us to finiſh our conductor with a fine point of gilt copper, which cannot be blunted by ruſt.

24 Is the thunder rod an effectual and ſafe contrivance?

But as thus raiſing the conductor, and pointing it, are ſo many invitations to the thunder to take this courſe; and as we cannot be certain that the quantity thus invited may not be more than what the rod can conduct with ſafety—it has appeared to Dr Wilſon, and other able electricians, that it will be ſafer to give abundance of conduct to what may unavoidably viſit us, without inviting what might otherwiſe have gone harmleſsly by.

This was attentively conſidered by Dr Franklin, Dr Watſon, Mr Canton, Dr Wilſon, and others, met as a committee of the Royal Society, at the deſire of the Board of Ordnance, to contrive a conductor for the powder magazine at Purfleet.

We think that the theory of induced electricity, founded on Dr Frankin's diſcoveries, and confirmed by all the later inventions of the electrophorus, condenſer, &c. will decide this queſtion in the moſt ſatisfactory manner.

25 Scientifi account the ſtate electrici induced a buildi by a thu der clou

When a cloud poſitively electrified comes over a building, it renders it negatively electrical in all its parts, if of conducting materials, and even the ground on which it ſtands. This effect is more remarkably produced if the ſtructure is of a tall and ſlender ſhape, like a ſteeple or a rod. Therefore the external electrical fluid is attracted by the building with greater force than if it had conſiſted of materials leſs conductive. A diſcharge will therefore be made through it in preference to any neighbouring building, becauſe it is more eminently negative. For the ſame reaſon, if there are two buildings equal and ſimilar, one of them being a good conductor, and the other being a leſs perfect one, the perfect conductor, becoming more powerfully negative, the cloud will become more ſtrongly poſitive over this houſe than over the other, and the ſtroke will be made through it.

26 And on thunder rod.

The ſame thing muſt obtain in a perfect conductor continued from the top to the foundation of a houſe, built of worſe conducting materials. The conductor becoming more eminently negative than any other part of the building, the electric fluid will be more ſtrongly attracted by it, accumulated in its neighbourhood, and will all be diſcharged through it, ſo long as it is able to conduct.

If the building is of great extent, the proximity of one part of the building to the thunder cloud may produce an accumulation of electrical fluid in its neighbourhood, in preference to a more perfect, but remote, conductor. But when the diſtances from the cloud are not very unequal, the accumulation will always be in the neighbourhood of the perfect conductor; and this will determine the diſcharge that way. The accumulation in the neighbourhood of the rod will be ſmall indeed, when the rod is ſmall; but then it is denſe, and the whole of electric phenomena ſhew that it is the denſity, and not the quantity, of accumulation which produces the violent tendency to fly off; it is this alone which makes it impoſſible to confine electricity in a body which terminates in a ſharp point.

For the ſame reaſon, bodies of the ſame materials and ſhape will increaſe the accumulation in the adjoining part of the cloud in proportion as they are nearer to it, or more advanced beyond the reſt of the building.

And bodies of ſlender ſhape, and pointed, will produce this accumulation in their neighbourhood in a ſtill more remarkable degree, and determine the courſe of the diſcharge with ſtill greater certainty.

But it is evident that a metallic rod, no higher than the reſt of the building, may occaſion an accumulation in the adjoining part of a near thunder cloud ſufficient to produce a diſcharge, when the building itſelf, conſiſting of imperfect conductors, would not have provoked the diſcharge at all. It may therefore be doubted whether we have derived any advantage from the conductor.

27 Effect o interrup tions in condu

To judge properly of this, we muſt conſider houſes as they really are, conſiſting of different materials, in very different ſhapes and ſituations; and particularly as having many large pieces of metal in their conſtruction, in various poſitions with regard to the cloud, the ground, and to each other. Suppoſe all the reſt of the building to be of non-conducting materials. When a poſitive thunder cloud comes overhead, every piece of metal in the building becomes electrical, without having received any thing as yet from the cloud; that end of

each

each which is neareſt the cloud becoming negative, and the remote end poſitive. But, moreover, the electricity of one increaſes the electricity of its neighbour. Then the moſt elevated becomes more ſtrongly attractive at its upper end than it would have been had the others been away; and therefore produces a greater accumulation in the nearer part of the thunder cloud than it would otherwiſe have done, and it will receive a ſpark. By this its lower end becomes more overcharged, and this makes the upper end of the next more undercharged, and the ſpark is communicated to it, and ſo on to the ground; which would not have happened without this ſucceſſion of conductors. Thus it is eaſy to conceive, that the accumulation in the cloud is juſt inſufficient to produce a diſcharge—While things are in this ſtate, juſt ready to ſnap, ſhould a man chance to paſs under a bell wire, or under a luſtre hanging by a chain, his body will immediately augment the poſitive electricity of the lower end of the conductor above him, and thus will augment the negative electricity of its upper end. This again will produce the ſame effect in the conductor above it: and thus each conductor becomes more overcharged at its lower end, and more undercharged at the upper end. Before this, every thing was juſt ready to ſnap. All will now ſtrike at once. The cloud will be diſcharged through the houſe, and the man will be the ſacrifice, the whole diſcharge being made through his body. This needs no demonſtration for any well-informed electrician. Thoſe who have only ſuch a knowledge of the theory as can be gathered from the writings of Prieſtley, Cavallo, and other popular authors, may convince themſelves of the truth of what is here delivered in the following manner.

In dry weather, and the moſt favourable circumſtances for good electrical experiments, let a very large globe, ſmoothly covered with metal, and well inſulated, be as highly electrified as poſſible, without expoſing it to a rapid diſſipation. To enſure this circumſtance (which is important) let it be electrified till it begins to ſputter, and note the ſtate of the electrometer. Diſcharge this electricity, and electrify it to about half of this intenſity. Provide three or four inſulated metal conductors, about three inches long and an inch diameter, terminated by hemiſpheres, and all well poliſhed.

Having electrified the globe, as above directed, bring one of the inſulated conductors ſlowly up to it, and note its diſtance when it receives a ſpark. In doing this, take care that there be no conducting body near the remote end of the inſulated conductor. It will be beſt to puſh it gradually forward by means of a long glaſs rod. Withdraw the conductor, diſcharge its electricity, reſtore the globe to its former electricity, indicated by an electrometer, and repeat this experiment till the greateſt ſtriking diſtance is exactly diſcovered. Now ſet another of the inſulated conductors about half an inch behind the firſt, and puſh them forward together, by a glaſs rod, till a ſpark is obtained. The ſtriking diſtance will be found greater than before. Then repeat this laſt experiment, with this difference, that the two conductors are puſhed forward by taking hold of the remote one. The ſtriking diſtance will be found much greater than before. Laſtly, puſh forward the two conductors, the remote one having a wire communicating with the ground, till they are a ſmall matter *without* the ſtriking diſtance; and, leaving them in this ſituation, take any little conducting body, ſuch as a braſs ball fixed on the end of a glaſs rod, and paſs it briſkly through between the globe and the neareſt conductor, or through between the two conductors, taking care that it touch neither of them in the paſſage. It will be ſeen that, however ſwift the paſſage is made, there will be a diſcharge through all the four bodies. The inference from this is obvious and demonſtrative.

A very remarkable inſtance of this fact was ſeen at the chapel in Tottenham Court Road, London. A man, going into the chapel by the eaſt door, was killed by the thunder, which came down from the little bell-houſe, along the bell-wire, and the rod of the clock pendulum, from the end of which it leaped to ſome iron work above the door, and from thence, from nail to nail, till it reached the man's head.

This interruption of conduct, which is almoſt unavoidable in the conſtruction of any building, is the cauſe of moſt of the accidents that are recorded; for when the ends of thoſe communicating conductors are incloſed in materials of leſs conducting power, the electricity, in making its way to the next in a very denſe ſtate, never fails to explode every thing which can be converted into elaſtic vapour by heat. There is always a ſufficient quantity of moiſture in the ſtone or brickwork for this purpoſe; and moſt vegetable ſubſtances contain moiſture or other expanſible matter. The ſtone, brick, or timber, is burſt, and thrown to a conſiderable diſtance; or if kept together by a weight of wall, the wall is ſhattered. It is worth remarking that although no force whatever ſeems able to prevent this exploſion, the quantity of matter exploded is extremely ſmall; for the ſtones are never thrown to a greater diſtance than they would have been by two or three grains of gunpowder properly confined.

All theſe accidents will be prevented by giving a ſufficient uninterrupted conduct; and it is proper to make uſe of ſuch a conductor, although it may invite many diſcharges which would not otherwiſe happen. So long as the conductor is ſufficient for the purpoſe, there ſeems to be no doubt of the propriety of this maxim.

28
A thunder rod will protect even when it is not able to diſcharge the whole thunder.

But the moſt ſerious objection remains. As we are certain that theſe conductors, whether raiſed above the building or not, will produce diſcharges through them which otherwiſe would not have happened, and as we are quite uncertain whether the quantity contained in a thunder cloud may not greatly exceed what the thunder rod can conduct without being diſſipated in ſmoke, it ſeems very dangerous thus to invite a ſtroke which our conductor may not be able to diſcharge. In particular, it is reaſonable to believe that the ſtrata of electrified clouds which come near the earth loſe much of their electricity by paſſing over the ſharp points of trees, &c. while thoſe which are much higher may retain their electricity undiminiſhed, and paſs on. May it not therefore happen, that our conductor will invite a fatal ſtroke, which would have gone harmleſsly by?

The doubt is natural, and it is important.

Let us ſuppoſe a very extenſive and highly electrified cloud, in a poſitive ſtate, to come within ſuch a diſtance from a building as *juſt not to ſtrike it*, if unprovided with a conductor, but which will moſt certainly ſtrike the ſame building furniſhed with a conductor; and let the electricity be ſo great that the conductor ſhall be diſſipated in ſmoke before even a ſmall part of it is diſcharged—What will be the fate of the building? We believe that it will be perfectly ſafe.

However rapid we may ſuppoſe that motion by which electricity is communicated, it is ſtill motion, and time elapſes during the propagation. The cloud is diſcharged, not in a very inſtant, but in a very ſhort time. Part of the cloud is therefore diſcharged, while it explodes the conductor, and the electricity of the remainder is now too weak (by our ſuppoſition) to ſtrike the building no longer furniſhed with a conductor. This muſt be the caſe, however large and powerful the cloud may be, and however ſmall the conductor.

But ſuppoſe that the cloud has come ſo near as to ſtrike the building unprovided with a conductor. Then as much will be diſcharged through the building as it can conduct; and if the quantity be too great, the building will be deſtroyed: but let a conductor (though inſufficient) be added. The diſcharge will be made through it as long as it laſts, and the remainder only will be diſcharged through the houſe, ſurely with much leſs danger than before.

The truth of theſe concluſions from theory is fully verified by fact. When the church of Newbury in New England was ſtruck by lightning in 1755, a bell wire, no bigger than a knitting needle, conducted the thunder with perfect ſafety to the building as far down the ſteeple as the wire reached, though the ſtroke was ſo great that the wire had been exploded, and no part of it remained, but only a mark along the wall occaſioned by its ſmoke. From the termination of the wire to the ground the ſteeple was exceedingly ſhattered, and ſtones of great weight were thrown out from the foundation (where they were probably moiſter) to the diſtance of 20 and 30 feet.

Another remarkable inſtance happened in the ſummer palace at St Peterſburg. A Heyduk and a ſoldier of a foot regiment were ſtanding centinels at the door of the jewel-chamber: the Heyduk, with his ſcimitar reſting on his arm, was careleſsly leaning on the ſoldier, who had his muſket ſhouldered. Both were ſtruck down with lightning; and the ſoldier was killed, his left leg ſcorched, and his ſhoes burſt. The Heyduk had received no damage, but felt himſelf tripped up, as if a great dog had run againſt him. A narrow ſlip of gold lace, which was ſewed along the ſeam of his jacket and pantaloon breeches, reaching to his ſhoes, had been exploded on the left ſide. This ſeems to have been his protection. In all probability, the ſtroke came to both along the muſket (or perhaps to the Heyduk along the ſcimitar). The Heyduk had a complete, though inſufficient, conductor, and was ſafe. The ſoldier had not, and was killed. The puſh felt by the former probably aroſe from the exploſion of the lace.

It ſeems therefore plain that metalline conductors are always a protection; that advancing them above the building, increaſes their protection; and that pointing them may ſometimes enable them to diminiſh a ſtroke, by diſcharging part of the electricity ſilently.

Dr Franklin having formed all his notions of thunder from his pre-eſtabliſhed theory, and having ſeen the principal phenomena ſo conformable to it, was naturally led to expect this conformity in caſes which he could not eaſily examine preciſely by experiment. Accordingly, in his firſt diſſertation, he affirmed that a fine point always diſcharges a thunder cloud ſilently, and at a great diſtance. The analogous experiments in artificial electricity are ſo beautiful and ſo perſpicuous, that this confidence in the protecting power of fine points is not ſurpriſing: and this confidence was rendered almoſt complete by a moſt ſingular caſe which fell under his own obſervation. He was awakened one night by loud cracks in his ſtair caſe, as if ſome perſon had been laſhing the wainſcoating with a great horſewhip. He thought it ſo, and got up in anger to chide the idle fool. On looking out at his chamber door, he ſaw that the diſturbance proceeded from electric exploſions at ſome interruptions of his conductor. He ſaw the electricity paſs, ſometimes in bright ſparks, producing thoſe loud thwacks, and ſometimes in a long continued ſtream of denſe white dazzling light as big as his finger, illuminating the ſtair-caſe like ſunſhine, and making a loud noiſe like a cutler's wheel. Had the cloud (ſays he) retained all this till it came within ſtriking diſtance, the conſequences would have been inconceivably dreadful. Yet not long after this he found that he had been in a miſtake; for the houſe of Mr Watt in Philadelphia, furniſhed with a finely pointed conductor, was ſtruck by a terrible clap of thunder, and the point of the conductor was melted down about two inches. This is perhaps the only inſtance on record of a finely-pointed *conductor* being ſtruck. The board room at the powder magazine at Purfleet was indeed ſtruck, though provided with a conductor; but the ſtroke was through another part of the building. St Peter's church, Cornhill, has been eight times ſtruck between 1772 and 1787; while St Michael's, in its neighbourhood, and much higher, has never had a ſtroke ſince 1772, when it was furniſhed with an excellent pointed conductor by Mr Nairne.

29 A point conduct may for times b ſtruck.

Dr Franklin having ſeen the above exception to his rule, and reflected on it, acknowledges that there are caſes where a pointed conductor may be ſtruck, viz. when it ſerves as a ſtepping ſtone, to *complete* a canal of conveyance already near completed. A *ſmall* cloud may ſometimes ſerve as a ſtepping ſtone (like the man coming under a luſtre) for the electricity to come out of a great cloud, and diſcharge through the pointed conductor. Whenever it comes to the ſtriking diſtance from the conductor, it will explode at once; whereas the great cloud itſelf muſt have come nearer, and had its force gradually diminiſhed. It is remarkable that a point, employed in this way in artificial electricity, muſt be brought nearer to another body than a ball need be, before it can receive a ſtroke. The difference is about one-third of the whole. Nairne found, that a ball nine-tenths of an inch in diameter, exploded at the diſtance of nine inches, and a point at ſix inches diſtance.

We muſt alſo obſerve that a pointed conductor can have no advantage over a blunt one in the caſe of a returning ſtroke; which is perhaps the moſt common of any. This depends on another diſcharge, which is made perhaps at a great diſtance. This was moſt diſtinctly the caſe in the inſtance mentioned ſome time ago, of the perſon at Vienna who had a ſhock from a thunder rod by an exploſion far diſtant. This thunder rod was a very fine one, furniſhed with five gilt points.

Still, however, this property of ſharp points was greatly over-rated by Dr Franklin, and thoſe who took all their o ank- er- the ction nted ctors.

their notions of electricity from the ſimple diſcoveries of his ſagacious mind. Unfortunately Dr Franklin had not cultivated mathematical knowledge; and, ever eager after diſcovery, and ardent in all his purſuits, his wonderful penetration carried him through, and ſeldom alluwed him to reſt long on falſe concluſions. He was certainly one of the greateſt *philoſophers*: and a little erudition would perhaps have brought him ſide by ſide with Newton. It was reſerved, however, for Lord C. Cavendiſh and for Æpinus, to ſubject the inveſtigations of Franklin to number and meaſure. By ſtudying what they have written on the ſubject, or even the view which we have given of their theory in the article ELECTRICITY *(Suppl.)*, the reader will be fully convinced, that a point has little or no advantage over a ball, with reſpect to a thunder cloud which is brought to the thunder rod by a briſk wind; although when it comes ſlowly up during an almoſt perfect calm, it may diſcharge all that can be diſcharged without a ſnap. The conſtipation in a point is indeed very great, but the quantity conſtipated is moderate; and therefore its action, at any conſiderable diſtance, is but trifling. All this is fully verified by Dr Wilſon's judicious experiments in the Pantheon. He had a prodigious quantity of electrified ſurface ſuſpended there, and made a pointed apparatus come to its ſtriking diſtance with a motion which he could regulate and meaſure. And he found that with the very moderate velocity of twelve feet in a ſecond, he never failed of procuring a very ſmart ſtroke. The experiments made in the uſual way by the partiſans of ſharp points (for it became a matter of indecent party) were numberleſs, and decidedly in their favour. The great and juſt authority of Dr Franklin, who was one of the committee, procured them ſtill more conſideration, or at leaſt hindered people from ſeeing the force of Dr Wilſon's reaſoning. It is ſomewhat ſurpriſing, that Dr Wilſon, a lover of mathematical learning, and a good judge, as appears from his publication of the papers of Mr Robins, did not himſelf ſee the full force of his own experiments. He had not ſurely ſtudied either Æpinus or Cavendiſh. He indeed frequently ſays, that the ſtate of the electricity in a thunder cloud, and in coated glaſs, is exceedingly different; and that the firſt extends its ſenſible influence much farther than the laſt, when both have the ſame quantity of electricity. But he ſeems not to have formed to himſelf any adequate notion of the difference. Had he done this, he would have ſeen that he has diſpoſed his great electrified ſurface very improperly. It ſhould have been collected much nearer his pointed apparatus, that this might, if poſſible, have been within the ſphere of attraction of every part of his artificial cloud. He would then have found reſults, ſome of which would have been much more favourable to his own general opinion, while others would have exhibited the peculiarities of the ſharp point in a more ſhowy manner than any thing we have ſeen.

31 nder very e coat- aſs;

Reaſoning from the true theory of coated glaſs, we ſhall learn that, when the glaſs is exceedingly thin, the accumulation of electricity, or the charge, will be exceedingly great; while the external appearance, or apparent energy, of the electricity may be hardly ſenſible, and will extend to a very ſmall diſtance. Thus, a circular plate of coated glaſs, ſix inches in diameter and one-twentieth thick, when electrified ſo as to make an electrometer diverge 50 degrees, contains about 60 times as much electricity as a braſs plate, of the ſame diameter, electrified to the ſame degree; and theſe two will have the ſame influence on an electrometer placed at a diſtance from them, and will give a ſpark nearly at the ſame diſtance. The ſpark from the coated glaſs will be bright, and will give a ſhock; while that from the braſs plate will be trifling. The cauſe of the equality of influence is, that the poſitive electricity of the one ſide of the coated glaſs is almoſt balanced by the negative electricity of the other ſide, and the unbalanced part is about $\frac{1}{59}$th of the whole. If we now take a braſs plate of $46\frac{1}{2}$ inches in diameter, and electrify it to the ſame degree with the coated glaſs, we ſhall find that it will require the ſame number of turns of the machine to bring it to this ſtate, or to charge the coated glaſs. They contain the ſame quantity of electricity, and the ſpark of both will give the ſame ſhock. But this large plate will have a much wider influence: a perſon coming within ten feet of it will ſee his hair bend towards it, and feel like a cobweb on his face.

32 And the influence of ſharp points is trifling.

It may be farther demonſtrated that the power of a point to abſtract the electricity to a given degree from the large plate, is vaſtly ſmaller than its power to abſtract it to the ſame degree from the coated plate. This is different in the different degrees of the abſtraction, and cannot be expreſſed by any one number.

All theſe conſiderations taken together, ſhew us that the pointed conductor has little advantage over the ball in the circumſtance above mentioned. It has however, an advantage, and therefore ſhould be employed; and in the caſe of a calm, or very gentle progreſs of the thunder cloud, the advantage may be very great.

33 An extenſive and ſubſtantial metalline conductor is the chief ſecurity.

Thus we think the queſtion decided; and the only remaining conſideration is the quantity of metallic conduct that ſhould be given. Prudence teaches us not to ſpare, eſpecially in very lofty buildings. The conductor on the dome of St Paul's in London conſiſts of four iron ſtraps, each four inches broad and one half an inch thick. This conductor was once made red hot by a thunder ſtroke. No inſtance has been found of a rod one half an inch ſquare being exploded. The accident at Mr Watt's houſe in Philadelphia is curious. The braſs wire which terminated the rod had been ten inches long and one fourth thick at the baſe, and two one-half inches were melted. It was unable, therefore, to conduct that ſtroke when its diameter was leſs than one-ſixteenth of an inch.

We recommend lead or copper in preference to iron. Iron waſtes by ruſt, and by exfoliating retains water, which may be dangerous by its expanſion. A ſtrap of lead, two inches broad and one-fourth thick, ſtapled down to the roof or wall with braſs ſtaples, ſecures us from all riſks from neglect. An iron rod, or one faſtened with iron cramps, requires frequent inſpection, to ſee that nothing has failed or waſted by ruſt. The point or points ſhould ſurely be copper. It would be very proper to connect all the leads of the ridges, gutters, and ſpouts, with the conductor, by ſtraps of lead. This will greatly extend its protection.

A great extent of building is not ſufficiently ſecured by one conductor. And a powder magazine ſhould have ſome erected round it at a diſtance on maſts.

Maxims in a Thunder Storm.

Avoid being under trees—but be near them: do not avoid rain. When in a room, avoid the fire ſide, which would bring you into the neighbourhood of the higheſt part of the houſe, viz. the ſtack of chimneys. The bell-wire, the grate, the fire irons—are bad neighbours. Nay, the foot of the chimney is not a good one, eſpecially if it has ever caked together by burning (A). Go to the middle of the room, and ſit down, if not near a luſtre, or any thing hanging from the ceiling. Avoid mirrors, or gilded mouldings.

Thunder *Bay*, in Lake Huron, lies about half way between Saganna Bay and the N. W. corner of the lake. It is about 9 miles acroſs either way; and is thus called from the thunder frequently heard there. —*Morſe.*

Thunder Clouds, in phyſiology, are thoſe clouds which are in a ſtate fit for producing lightning and thunder. See the preceding article.

THURMAN, a townſhip in Waſhington county, New York; taken from Queenſburg, and incorporated in 1792.—*Morſe.*

THUS, in ſea-language, a word uſed by the pilot in directing the helmſman or ſteerſman to keep the ſhip in her preſent ſituation when ſailing with a ſcant wind, ſo that ſhe may not approach too near the direction of the wind, which would ſhiver her ſails, nor fall to leeward, and run farther out of her courſe.

TIAGA *Point*, or *Cape*, on the weſt coaſt of New-Mexico, is a rough head land, 8 leagues from the valley of Colima.—*Morſe.*

TIAOGU, an ancient Indian town, about 150 miles up the Suſquehannah river.—*ib.*

TIBER *Creek*, a ſmall ſtream which runs ſoutherly through the city of Waſhington, and empties into Potowmac river. Its ſource is 236 feet above the level of the tide in the creek; the waters of which and thoſe of Reedy Branch may be conveyed to the Preſident's houſe, and to the capitol.—*ib.*

TIBERIAS (anc. geog.), the laſt town of Galilee, ſituated on the ſouth ſide of the lake Tiberias; built by Herod the Tetrarch, and called *Tiberias* in honour of the Emperor Tiberius; diſtant 30 ſtadia from Hippus, 60 from Gadara, and 120 from Scythopolis: whence it appears to have been at no great diſtance from where the Jordan runs out of the lake. It is a number of times mentioned by St John the Evangeliſt. Pliny places it on the weſt extremity of the lake, commending the ſalubrity of its hot waters. Jerome ſays, the ancient name was *Chennereth*; which, if true, will account for the name of the lake.

TIBERON, *Cape*, a round black rock on the S. W. part of the ſouthern peninſula of the iſland of St Domingo, and forms the N. W. limit of the bay of Tiberon.—*Morſe.*

Tiberon, or *Tiburon*, a bay and village on the S. W. part of the iſland of St Domingo. The bay is formed by the cape of its name on the N. W. and Point Burgau on the S. E. a league and three-fourths apart. The ſtream called a river, falls in at the head of the bay, on the weſtern ſide of the village; which ſtands on the high-road, and, according to its courſe along the ſea-ſhore, 10 leagues ſouth of Cape Dame Marie, 20 from Jeremie, and 32 by the winding of the road from Les Cayes. The cape is in lat. 18 20 30 N. and in long. 76 52 40 W. The exports from Cape Tiberon, from Jan. 1, 1789, to Dec. 31, of the ſame year, were 1000lbs white ſugar—377,800lbs brown ſugar—600,002lbs coffee—13,672lbs cotton—1,088lbs indigo—and ſmall articles to a conſiderable amount. Total value of duties on exportation, 2,465 dollars 76 cents. —*ib.*

Tiberon, a fort, near the town or village above mentioned; taken by the French, the 21ſt March, 1795. —*ib.*

TICKLE *Harbour*, on the eaſt coaſt of Newfoundland, fifteen leagues from Bonaventura Port.—*ib.*

Tickle *Me Quickly*, a name given by Britiſh ſeamen to a fine, little, ſandy bay of Terra Firma, on the Iſthmus of Darien, at the N. W. end of a reef of rocks, having good anchorage and ſafe landing. The extremity of the rocks on one ſide, and the Samballas Iſlands (the range of which begins from hence) on the other ſide, guard it from the ſea, and ſo form a very good harbour. It is much frequented by privateers.—*ib.*

TICONDEROGA, in the State of New-York, built by the French in the year 1756, on the north ſide of a peninſula formed by the confluence of the waters iſſuing from Lake George into Lake Champlain. It is now a heap of ruins, and forms an appendage to a farm. Its name ſignifies *Noiſy*, in the Indian language, and was called by the French *Corillor*. Mount Independence, in Addiſon county, Vermont, is about 2 miles S. E. of it, and ſeparated from it by the narrow ſtrait which conveys the waters of Lake George and South river into Lake Champlain. It had all the advantages that art or nature could give it, being defended on 3 ſides by water ſurrounded by rocks, and on half of the fourth by a ſwamp, and where that fails, the French erected a breaſt-work 9 feet high. This was the firſt fortreſs attacked by the Americans during the revolutionary war. The troops under General Abercrombie were defeated here in the year 1758, but it was taken the year following by Gen. Amherſt. It was ſurpriſed by Cols. Allen and Arnold, May 10, 1775, and was retaken by Gen. Burgoyne in July, 1777.—*ib.*

Tierra *Auſtral del Eſpiritu Santo*, called by Bougainville,

(A) In the terrible thunder ſtroke on Leven Houſe in Scotland, the two great ſtreams of electricity had taken the courſe of the vents which had been moſt in uſe, but not to get at the iron work, for it had branched off from the vents, at a great diſtance from the bottom. The chief conductors through the building had been various gilded mouldings, gilded leather hangings, gilded ſcreens, picture frames, and the foil of mirrors. In this progreſs the ſteps have been ſo many, and ſo capricious, that no line of progreſs can be traced, according to any principle. The thunder ſeems to have electrified at once the whole of the leaden roof, and, beſides the two main tracks along the vents, to have afterwards darted at every metal thing in its way. The loweſt point of the track was a leaden water ciſtern; which, however, received no damage; but a thick ſtone wall was burſt through to get at it.

ville, *The Archipelago of the Great Cyclades*, and by Capt. Cook, *The New Hebrides*, may be conſidered as the eaſtern extremity of the vaſt Archipelago of *New Guinea*. Theſe iſlands are ſituated between the latitudes of 14 29 and 20 4 S. and between 169 41 and 170 21 E. long. from Greenwich, and conſiſt of the following iſlands, ſome of which have received names from the different European navigators, and others retain the names which they bear among the natives; viz. Tierra Auſtral del Eſpiritu Santo, St Bartholomew, Mallicollo, Pic de l'Etoile, Aurora, Iſle of Lepers, Whitſuntide, Ambrym, Paoon, Shepherds Iſles, Sandwich, Erromango, Immer, Tanna, Erronan, Annatom, Apee, Three Hills, Montagu, Hinchinbrook, and Erromanga. Quiros, who firſt diſcovered theſe iſlands, in 1606, deſcribes them, as "richer and more fertile than Spain, and as populous as they are fertile; watered with fine rivers, and producing ſilver, pearls, nutmegs, mace, pepper, ginger, ebony of the firſt quality, wood for the conſtruction of veſſels, and plants which might be fabricated into ſail-cloth and cordages, one ſort of which is not unlike the hemp of Europe." The inhabitants of theſe iſlands, he deſcribes, as of ſeveral different races of men; black, white, mulatto, tawny, and copper-coloured; a proof, he ſuppoſes, of their intercourſe with various people. They uſe no fire arms, are employed in no mines, nor have they any of thoſe means of deſtruction which the genius of Europe has invented. Induſtry and policy ſeem to have made but little progreſs among them: they build neither towns nor fortreſſes; acknowledge neither king nor laws, and are divided only into tribes, among which there does not always ſubſiſt a perfect harmony. Their arms are the bow and arrows, the ſpear and the dart, all made of wood. Their only covering is a garment round the waiſt, which reaches to the middle of the thigh. They are cleanly, of a lively and grateful diſpoſition, capable of friendſhip and inſtruction. Their houſes are of wood, covered with palm leaves. They have places of worſhip and burial. They work in ſtone, and poliſh marble, of which there are many quarries. They make flutes, drums, wooden ſpoons, and from the mother of pearl, form chiſſels, ſciſſars, knives, hooks, ſaws, hatchets, and ſmall round plates for necklaces. Their canoes are well built and neatly finiſhed. Hogs, goats, cows, buffaloes, and various fowls and fiſh, for food are found in abundance on and about theſe iſlands. Added to all theſe and many other excellencies theſe iſlands are repreſented as having a remarkably ſalubrious air, which is evinced by the healthy, robuſt appearance of the inhabitants, who live to a great age, and yet have no other bed than the earth. Such is the deſcription which Quiros gives of theſe iſlands in and about which he ſpent ſome months, and which he repreſents to the king of Spain as "the moſt delicious country in the world; the garden of Eden, the inexhauſtible ſource of glory, riches, and power to Spain." On the north ſide of the largeſt of theſe iſlands, called *Eſpiritu Santo*, is a bay, called *San Felipe* and *Sant-Yago*, which, ſays Quiros, "penetrates 20 leagues into the country; the inner part is all ſafe, and may be entered with ſecurity, by night as well as by day. On every ſide, in its vicinity, many villages may be diſtinguiſhed, and if we may judge by the ſmoke which riſes by day, and the fires that are ſeen by night, there are many more in the interior parts." The harbour in this bay, was named by Quiros, *La Vera Cruz*, and is a part of this bay, and large enough to admit 1000 veſſels. The anchorage is on an excellent bottom of black ſand, in water of different depths, from 6 to 40 fathoms, between two fine rivers.—*ib.*

TIERRA DEL FUEGO, ſeveral iſlands at the ſouthern extremity of America. They take their name from a volcano on the largeſt of them. They are all very barren and mountainous; but from what Mr Forſter ſays, in his Voyage to the South Sea, the climate does not appear to be ſo rigorous and tempeſtuous as it is repreſented in Anſon's Voyage. Upon the lower grounds and iſlands, that were ſheltered by the high mountains, Mr Forſter found ſeveral ſorts of trees and plants, and a variety of birds. Among the trees was Winter's bark-tree, and a ſpecies of *arbutus*, loaded with red fruit of the ſize of ſmall cherries, which were very well taſted. In ſome places there is alſo plenty of celery. Among the birds was a ſpecies of duck, of the ſize of a gooſe, which ran along the ſea with amazing velocity, beating the water with its wings and feet. It had a gray plumage, with a yellow bill and feet, and a few white quill-feathers. At the Falkland Iſlands it is called a *loggerhead-duck*. Among the birds are alſo plenty of geeſe and falcons. The rocks of ſome of the iſlands are covered with large muſcle-ſhells, the fiſh of which is well flavoured. The natives of this country are ſhort in their perſons, not exceeding five feet ſix inches at moſt, their heads large, their faces broad, their cheek bones prominent, and their noſes flat. They have little brown eyes, without life; their hair is black and lank, hanging about their heads in diſorder, and beſmeared with train-oil. On the chin they have a few ſtraggling ſhort hairs inſtead of a beard. The whole aſſemblage of their features forms the moſt loathſome picture of miſery to which human nature can poſſibly be reduced. Thoſe which Mr Forſter ſaw had no other clothing than a ſmall piece of ſeal ſkin, which hung from their ſhoulders to the middle of their back, being faſtened round the neck with a ſtring: the reſt of their body was perfectly naked. Their natural colour ſeems to be an olive brown, with a kind of gloſs, reſembling that of copper; but many of them diſguiſe themſelves with ſtreaks of red paint, and ſometimes, though ſeldom, with white. Their whole character is a ſtrange compound of ſtupidity, indifference, and inactivity. They have no other arms than bows and arrows; and their inſtruments for fiſhing are a kind of fiſh-gigs. They live chiefly on ſeals fleſh, and like the fat oily part moſt. There is no appearance of any ſubordination among them; and their mode of life approaches nearer to that of brutes than that of any other nation.

TIGNARES, the chief town of the captainſhip of Rio Grande in Brazil.—*Morse.*

TILLANDSIA, the large barren WILD PINE of the Weſt Indies; a genus of the monogynia order, belonging to the hexandria claſs of plants. It is called *Caragatua* by Father Plumier, and is a paraſitic plant, and ought perhaps, in ſtrict propriety, to be denominated an *aquatic*: for although it is ſuſpended in the air among the branches of lofty trees, to whoſe boughs it is faſtened by its numerous roots; yet it is not indebted to thoſe boughs, like the miſletoe and other paraſitic plants, for nouriſhment, but merely for ſupport; provident Nature having, in a very extraordinary manner, ſupplied this with other means to preſerve its exiſtence:

For the leaves, which much reſemble thoſe of the pine-apple, but are larger, ſurround this plant in a circular manner; each leaf being terminated near the ſtalk with a hollow bucket, which contains about half a pint of water. It is by theſe numerous ſmall reſervoirs of water that the roots, as well as every other part of this plant, are ſupplied with nouriſhment without the help of any earth. The flouriſhing condition of this plant, as well as the great growth of fig-trees, upon barren rocks, ſhews that water is of greater uſe to vegetation than earth.

One contrivance of Nature in this vegetable, ſays Dr Sloane, is truly admirable. The ſeed is crowned with many long downy threads, not only that it may be carried every where by the wind, but that by thoſe threads, when driven through the boughs, it may be held faſt, and ſtick to the arms and prominent parts of the barks of trees. So ſoon as it ſprouts or germinates, although it be on the under part of a bough, its leaves and ſtalks riſe perpendicular or erect: if they aſſumed any other direction, the ciſtern or reſervoir juſt mentioned, made of the hollow leaves, could not hold water, which is neceſſary to the life and nouriſhment of the plant. In ſcarcity of water this reſervoir is uſeful, not to the plant only, but to men, and even to birds and all ſorts of inſects, which come thither in troops, and ſeldom go away without refreſhment.

To the ſame purpoſe, Dampier, in his voyage to Campeachy relates, "that the wild pine has leaves that will hold a pint and an half or quart of rain-water, which refreſhes the leaves, and nouriſhes the roots. When we find theſe pines, we ſtick our knives into the leaves, juſt above the root; and the water guſhing out we catch it in our hats, as I myſelf have frequently done, to my great relief."

TIMÆUS, a Greek hiſtorian, the ſon of Andronicus, who was eminent for his riches and excellent qualities, was born at Tauromenium in Sicily, and flouriſhed in the time of Agathocles. He wrote ſeveral books, and among the reſt an hiſtory of his own country; but they are all loſt.

Timæus, a famous Pythagorean philoſopher, was born at Locres in Italy, and lived before Plato. There is ſtill extant a ſmall treatiſe of his on Nature and the Soul of the World, written in the Doric dialect. This treatiſe, which is to be found in the works of Plato, furniſhed that great Philoſopher with the ſubject of his treatiſe intitled *Timæus*.

TIMMISKAMAIN *Lake*, in Lower-Canada, is about 30 miles long and 10 broad, having ſeveral ſmall iſlands. Its waters empty into Utawas river, by a ſhort and narrow channel, 30 miles N. of the N part of Nepiſſing lake. The Indians named Timmiſcamaings reſide round this lake.—*Morſe*.

TINICUM, two townſhips of Pennſylvania; the one in Buck's county, the other in that of Delaware.—*ib*.

TINKER'S *Iſland*, one of the Elizabeth Iſlands, on the coaſt of Maſſachuſetts, off Buzzard's Bay, 8 miles from the main land of Barnſtable county. It is the ſecond in magnitude, and the middle one of the 3 largeſt. It is about 3 miles long from north to ſouth, and about a mile and a half broad from eaſt to weſt; and between this and Naſhawn Iſland is a channel for ſloops and ſmall veſſels, as there is alſo between it and Slocum's Iſland, about a mile farther to the weſtward.—*ib*.

TINMOUTH, a townſhip of Nova-Scotia on the eaſtern coaſt. It was formerly called Pictou, and lies about 40 miles from Truro.—*ib*.

Tinmouth, a townſhip of Vermont, Rutland county, and contains 935 inhabitants.—*ib*.

TINNING, the covering or lining of any thing with melted tin, or with tin reduced to a very fine leaf. Looking-glaſſes are foliated or *tinned* with thin plates of beaten tin, by a proceſs deſcribed under the title Foliating, *Encycl*.

Kettles, ſauce-pans, and other kitchen utenſils, which are uſually made of copper, are tinned by the following proceſs: The ſurface to be tinned, if of new copper, ſhould firſt be cleaned or ſcoured with ſalt and ſulphuric acid (vitriolic acid) diluted with water. This, however, is not always done; ſome workmen contenting themſelves with ſcouring it with ſand perfectly dry, or with ſcales of iron. Powdered roſin is then ſtrewed over it; and when the veſſel or utenſil is conſiderably heated, melted tin is poured into it, and rubbed with flax coiled hard over the ſurface to be coated. This tin may be either pure, ſuch as that known by the name of *grain-tin*; or a compoſition conſiſting of two parts of tin and one of lead. For very obvious reaſons, we ſhould certainly prefer the pure tin; but the generality of workmen give the preference to the compoſition, becauſe the ſurface coated with it appears more brilliant. The tin is not always put into the veſſel in a liquid ſtate; for ſome workmen ſtrew it in ſmall pieces over the ſurface to be coated, and then heat the veſſel till the tin melt, when they rub it as formerly.

In tinning old veſſels which have been tinned before, the proceſs is ſomewhat different. In theſe caſes, the ſurface is firſt ſcraped with an inſtrument proper for the purpoſe, or ſcoured with the ſcales of iron, which may be always found in a blackſmith's ſhop: it is then ſtrewed over with ſal ammoniac in powder, inſtead of roſin, or an infuſion of ſal ammoniac in ſtale urine is boiled in it till the urine be evaporated, and it is then tinned with pure tin; the compoſition of tin and lead being in this caſe never uſed. The tin, while liquid, is rubbed into the ſurface with a piece of ſal ammoniac, inſtead of a bundle of flax. When iron veſſels are to be tinned, they are firſt cleaned with muriatic acid, after which the proceſs is the ſame as in the tinning of old copper.

In the year 1785, Mr John Poulain of Mortlake, Surry, obtained a patent for the diſcovery of a new compoſition for tinning veſſels, eſpecially ſuch as are uſed for culinary purpoſes. This compoſition conſiſts of grain-tin one pound, good malleable iron one ounce and a half, platinum one drachm, ſilver one pennyweight, gold three grains; the whole muſt be well fuſed together in a crucible, with one ounce of pounded borax, and two ounces of pounded glaſs, and then caſt in ſmall ingots. The compoſition, to be fit for uſe, muſt be heated and put in a metal mortar, alſo heated over a fire, and well pounded with a heated metal peſtle; when it is well pounded, make an ingot of it, by putting it on the fire in a mould made of iron plate, in which mould the compoſition muſt be well ſtirred and let to cool; then it is fit for uſe. To apply the compoſition, firſt tin the utenſil or veſſel with grain-tin and ſal ammoniac, as is uſually done in the common way of tinning; clean well the tinned part of the metal utenſil or veſſel,

veſſel, and then apply a coat of the compoſition with ſal ammoniac, as is uſually done in the common way of tinning; and when the compoſition is well ſpread, let it cool; then make it a little red-hot in all its parts, to neal it, and plunge the metal utenſil or veſſel, while yet hot, in cold water; then, with a ſharp ſcraper, ſcrape and rub off the rough or grumous particles of the compoſition applied on the metal utenſil or veſſel, and ſcour it well with ſand. The ſame operation muſt be repeated for every coat of the compoſition that is applied; two coats of the compoſition are quite ſufficient for culinary utenſils or veſſels, and a thin coat of grain tin may be applied over the laſt coat of the compoſition, to ſmooth it. The author adds, that his compoſition may be employed for covering or plating the ſurfaces of all materials made of copper, braſs, iron, and other metals or mixtures of metals, and that it ſhould be applied with a charcoal fire in preference to any other fire. All this may be true, and it may be a very valuable coating to copper; but the ſcarcity, high price, and infuſibility of platinum, muſt for ever prevent it from coming into very general uſe.—We think that even the *Enamelling of Veſſels for the Kitchen* muſt be more common. See that article in this *Supplement.*

The following proceſs is leſs expenſive, whilſt the coating given by it is exceedingly durable, adds ſtrength to the copper veſſel, and ſecures it much longer than the common tinning from the action of acids:

When the veſſel has been prepared and cleaned in the uſual manner, it muſt be roughened on the inſide by being beat on a rough anvil, in order that the tinning may hold better, and be more intimately connected with the copper. The proceſs of tinning muſt then be begun with perfectly pure grained tin, having an addition of ſal ammoniac inſtead of the common colophonium or reſin. Over this tinning, which muſt cover the copper in an even and uniform manner throughout, a ſecond harder coat muſt be applied, as the firſt forms only a kind of medium for connecting the ſecond with the copper. For this ſecond tinning you employ pure grained tin mixed with zinc in the proportion of two to three, which muſt be applied alſo with ſal ammoniac ſmooth and even, ſo that the lower ſtratum may be entirely covered with it. This coating, which, by the addition of the zinc, becomes pretty hard and ſolid, is then to be hammered with a ſmoothing hammer, after it has been properly rubbed and ſcoured with chalk and water; by which means it becomes more ſolid, and acquires a ſmooth compact ſurface.

Veſſels and utenſils may be tinned in this manner on both ſides. In this caſe, after being expoſed to a ſufficient heat, they muſt be dipped in the fluid tin, by which means both ſides will be tinned at the ſame time.

As this tinning is exceedingly durable, and has a beautiful colour, which it always retains, it may be employed for various kinds of metal inſtruments and veſſels which it may be neceſſary to ſecure from ruſt.

TINPLATE, called in Scotland *White-iron*, is a thin plate of iron covered with tin, to which it is united by chemical affinity. See Chemistry, n° 122. *Suppl.*

TINSIGNAL, a rich ſilver mine in the province of Coſta Rica.—*Morse.*

TINTA, a juriſdiction in the empire of Peru; wherein is the famous ſilver mine called Condonoma.—*ib.*

TINTAMARE, a river of Nova-Scotia, which is navigable 3 or 4 miles up for ſmall veſſels.—*ib.*

TINTO, a river of Terra Firma, 20 leagues to the eaſt of Cape Honduras.—*ib.*

TIOGA, a townſhip of Pennſylvania, in Luzerne county.—*ib.*

Tioga, a county of New York, bounded eaſt by Otſego, weſt by Ontario, north by Onondago, and ſouth by the State of Pennſylvania. It contains the towns of Newtown, Union, Chemung, Owego, Norwich, Jerico, and Chenengo, in which are 1,165 electors, according to the State cenſus of 1796. The courts of common pleas and general ſeſſions of the peace for the county are held on the firſt Tueſdays in May, October, and February, in every year, alternately at Chenengo, in the town of Union, and at Newtown Point, in the town of Chemung. Some curious bones have been dug up in this county. About 12 miles from Tioga Point, the bone or horn of an animal was found, 6 feet 9 inches long; 21 inches round, at the long end, and 15 inches at the ſmall end. It is incurvated nearly to an arch of a large circle. By the preſent ſtate of both the ends, much of it muſt have periſhed; probably 2 or 3 feet from each end.—*ib.*

Tioga *Point*, the point of land formed by the confluence of Tioga river with the eaſt branch of Suſquehannah river. It is about 5½ miles ſoutherly from the line which divides New-York State from Pennſylvania, and is about 150 miles N. by W. of Philadelphia, and 20 S. E. of Newtown. The town of Athens ſtands on this point of land.—*ib.*

Tioga *River*, a branch of the Suſquehannah, which riſes in the Alleghany Mountains in about lat. 42, and running eaſtwardly, empties into the Suſquehannah at Tioga Point, in lat. 41 57. It is navigable for boats about 50 miles. There is ſaid to be a practicable communication between the ſouthern branch of the Tioga, and a branch of the Alleghany, the head waters of which are near each other. The Seneca Indians ſay they can walk 4 times in a day from the boatable waters of the Alleghany, to thoſe of the Tioga, at the place now mentioned.—*ib.*

TIOOKEA, an Iſland in the South Pacific Ocean, one of thoſe called George's Iſlands. S. lat. 14 27, W. long. 144 56.—*ib.*

TIPRA, the name of certain mountainous diſtricts to the eaſtward of Bengal, inhabited by a people of very ſingular manners. As every thing which contributes a ſingle fact to the hiſtory of human nature is intereſting to the philoſopher, the reader will be pleaſed with the following account of the religion, laws, and manners of theſe people, taken from the 2d volume of the *Aſiatic Reſearches.*

Though they acknowledge one Creator of the univerſe, to whom they give the name of Pa'tiva'n, they believe that a deity exiſts in every tree, that the ſun and moon are gods, and that whenever they worſhip thoſe ſubordinate divinities Pátiyán is pleaſed. This is very ſimilar to the religious creed of ancient Greece and Rome, differing only with reſpect to creation, which, in the proper ſenſe of the word, the Greeks and Romans ſeem not to have admitted.

If any one of theſe mountaineers, called in the memoir Cucis, put another to death, the chief of the tribe, or other perſons who bear no relation to the deceaſed, have no concern in puniſhing the murderer; but if the murdered perſon have a brother or other heir, he may take blood for blood; nor has any man whatever a right to prevent or oppoſe ſuch retaliation.

When a man is detected in the commiſſion of theft or other atrocious offence, the chieftain cauſes a recompenſe to be given to the complainant, and reconciles both parties; but the chief himſelf receives a cuſtomary fine, and each party gives a feaſt of pork or other meat to the people of his reſpective tribe.

In ancient times, it was not a cuſtom among them to cut off the heads of the women whom they found in the habitations of their enemies; but it happened once that a woman aſked another, why ſhe came ſo late to her buſineſs of ſowing grain? ſhe anſwered, that her huſband was gone to battle, and that the neceſſity of preparing food and other things for him had occaſioned her delay. This anſwer was overheard by a man at enmity with her huſband; and he was filled with reſentment againſt her, conſidering, that as ſhe had prepared food for her huſband for the purpoſe of ſending him to battle againſt his tribe, ſo in general, if women were not to remain at home, their huſbands could not be ſupplied with proviſion, and conſequently could not make war with advantage. From that time it became a conſtant practice to cut off the heads of the enemy's women, eſpecially if they happen to be pregnant, and therefore confined to their houſes: and this barbarity is carried ſo far, that if a Cuci aſſail the houſe of an enemy, and kill a woman with child, ſo that he may bring two heads, he acquires honour and celebrity in his tribe, as the deſtroyer of two foes at once.

As to the marriages of this wild nation, when a rich man has made a contract of marriage, he gives four or five head of *gayáls* (the cattle of the mountains) to the father and mother of the bride, whom he carries to his own houſe: Her parents then kill the *gayáls;* and having prepared fermented liquors and boiled rice with other eatables, invite the father, mother, brethren, and kindred of the bridegroom to a nuptial entertainment. When a man of ſmall property is inclined to marry, and a mutual agreement is made, a ſimilar method is followed in a lower degree; and a man may marry any woman except his own mother. If a married couple live cordially together, and have a ſon, the wife is fixed and irremoveable; but if they have no ſon, and eſpecially if they live together on bad terms, the huſband may divorce his wife, and marry another woman.

They have no idea of heaven or hell, the reward of good, or the puniſhment of bad, actions; but they profeſs a belief, that when a perſon dies, a certain ſpirit comes and ſeizes his ſoul, which he carries away; and that whatever the ſpirit promiſes to give at the inſtant when the body dies, will be found and enjoyed by the dead; but that if any one ſhould take up the corſe and carry it off, he would not find the treaſure.

The food of this people conſiſts of elephants, hogs, deer, and other animals; of which if they find the carcaſes or limbs in the foreſts, they dry them, and eat them occaſionally.

When they have reſolved on war, they ſend ſpies before hoſtilities are begun, to learn the ſtations and ſtrength of the enemy, and the condition of the roads; after which they march in the night, and two or three hours before daylight make a ſudden aſſault with ſwords, lances, and arrows: if their enemies are compelled to abandon their ſtation, the aſſailants inſtantly put to death all the males and females, who are left behind, and ſtrip the houſes of all their furniture; but ſhould their adverſaries, having gained intelligence of the intended aſſault, be reſolute enough to meet them in battle, and ſhould they find themſelves overmatched, they ſpeedily retreat and quietly return to their own habitations. If at any time they ſee a ſtar very near the moon, they ſay, "to-night we ſhall undoubtedly be attacked by ſome enemy;" and they paſs that night under arms with extreme vigilance. They often lie in ambuſh in a foreſt near the path, where their foes are uſed to paſs and repaſs, waiting for the enemy with different ſorts of weapons, and killing every man or woman who happens to paſs by: in this ſituation, if a leech, or a worm, or a ſnake, ſhould bite one of them, he bears the pain in perfect ſilence; and whoever can bring home the head of an enemy, which he has cut off, is ſure to be diſtinguiſhed and exalted in his nation. When two hoſtile tribes appear to have equal force in battle, and neither has hopes of putting the other to flight, they make a ſignal of pacific intentions, and, ſending agents reciprocally, ſoon conclude a treaty; after which they kill ſeveral head of *gayáls*, and feaſt on their fleſh, calling on the ſun and moon to bear witneſs of the pacification: but if one ſide, unable to reſiſt the enemy, be thrown into diſorder, the vanquiſhed tribe is conſidered as tributary to the victors; who every year receive from them a certain number of *gayáls*, wooden diſhes, weapons, and other acknowledgments of vaſſalage. Before they go to battle, they put a quantity of roaſted *álus* (eſculent roots like potatoes), and paſte of rice-flour, into the hollow of bamboos, and add to them a proviſion of dry rice with ſome leathern bags full of liquor: then they aſſemble, and march with ſuch celerity, that in one day they perform a journey ordinarily made by letter-carriers in three or four days, ſince they have not the trouble and delay of dreſſing victuals. When they reach the place to be attacked, they ſurround it in the night, and at early dawn enter it, putting to death both young and old, women and children, except ſuch as they chooſe to bring away captive: they put the heads, which they cut off, into leathern bags; and if the blood of their enemies be on their hands, they take care not to waſh it off. When after this ſlaughter they take their own food, they thruſt a part of what they eat into the mouths of the heads which they have brought away, ſaying to each of them, "Eat, quench thy thirſt, and ſatisfy thy appetite; as thou haſt been ſlain by my hand, ſo may thy kinſmen be ſlain by my kinſmen!" During their journey, they have uſually two ſuch meals; and every watch, or two watches, they ſend intelligence of their proceedings to their families. When any one of them ſends word that he has cut off the head of an enemy, the people of his family, whatever be their age or ſex, expreſs great delight, making caps and ornaments of red and black ropes; then filling ſome large veſſels with fermented liquors, and decking themſelves with all the trinkets they poſſeſs, they go forth to meet the conqueror, blowing large ſhells, and ſtriking plates of metal, with other rude inſtruments of muſic. When both parties are met, they ſhow extravagant joy, men and women dancing and ſinging together; and if a married man has brought an enemy's head, his wife wears a head dreſs with gay ornaments, the huſband and wife alternately pour fermented liquor into each other's mouths, and ſhe waſhes his bloody hands with the ſame liquor which they are drinking. Thus they go revelling, with exceſſive merriment, to their place of abode; and having piled up the heads of their enemies in the court yard of their chieftain's houſe, they ſing and dance round the pile; after which they kill ſome *gayáls* and hogs with their ſpears; and having boiled the fleſh, make a feaſt on it, and drink the fermented liquor. The richer men of this race faſten the heads of their foes on a bamboo, and fix it on the graves of their parents, by which act they acquire great reputation. He who brings back the head of a ſlaughtered enemy, receives preſents from the wealthy of cattle and ſpirituous liquor; and if any captives are brought alive, it is the prerogative of thoſe chieftains, who were not in the campaign, to ſtrike off the heads of the captives. Their weapons are made by particular tribes; for ſome of them are unable to fabricate inſtruments of war.

In regard to their civil inſtitutions; the whole management of their houſehold affairs belongs to the women; while the men are employed in clearing foreſts, building huts, cultivating land, making war, or hunting game and wild beaſts. Five days (they never reckon by months or years) after the birth of a male child, and three days after that of a female, they entertain their family and kinſmen with boiled rice and fermented liquor; and the parents of the child partake of the feaſt. They begin the ceremony with fixing a pole in the court yard; and then killing a *gayál* or a hog with a lance, they conſecrate it to their deity; after which all the party eat the fleſh and drink liquor, cloſing the day with a dance and with ſongs. If any one among them be ſo deformed, by nature or by accident, as to be unfit for the propagation of his ſpecies, he gives up all thought of keeping houſe, and begs for his ſubſiſtence, like a religious mendicant, from door to door, continually dancing and ſinging. When ſuch a perſon goes to the houſe of a rich and liberal man, the owner of the houſe uſually ſtrings together a number of red and white ſtones, and fixes one end of the ſtring on a long cane, ſo that the other end may hang down to the ground; then, paying a kind of ſuperſtitious homage to the pebbles, he gives alms to the beggar; after which he kills a *gayál* and a hog, and ſome other quadrupeds, and invites his tribe to a feaſt: the giver of ſuch an entertainment acquires extraordinary fame in the nation, and all unite in applauding him with every token of honour and reverence.

When a *Cúcì* dies, all his kinſmen join in killing a hog and a *gayál;* and, having boiled the meat, pour ſome liquor into the mouth of the deceaſed, round whoſe body they twiſt a piece of cloth by way of ſhroud: all of them taſte the ſame liquor as an offering to his ſoul; and this ceremony they repeat at intervals for ſeveral days. Then they lay the body on a ſtage, and kindling a fire under it, pierce it with a ſpit and dry it; when it is perfectly dried, they cover it with two or three folds of cloth, and, encloſing it in a little caſe within a cheſt, bury it under ground. All the fruits and flowers that they gather within a year after the burial they ſcatter on the grave of the deceaſed: but ſome bury their dead in a different manner; covering them firſt with a ſhroud, then with a mat of woven reeds, and hanging them on a high tree. Some, when the fleſh is decayed, waſh the bones, and keep them dry in a bowl, which they open on every ſudden emergence; and, fancying themſelves at a conſultation with the bones, purſue whatever meaſures they think proper; alleging that they act by the command of their departed parents and kinſmen. A widow is obliged to remain a whole year near the grave of her huſband; where her family bring her food: if ſhe die within the year, they mourn for her; if ſhe live, they carry her back to her houſe, where all her relations are entertained with the uſual feaſt of the *Cúcis*.

If the deceaſed leave three ſons, the eldeſt and the youngeſt ſhare all his property; but the middle ſon takes nothing: if he have no ſons, his eſtate goes to his brothers; and if he have no brothers, it eſcheats to the chief of the tribe.

TIRESIAS, a famous ſoothſayer of antiquity, was the ſon of Everes and the nymph Chariclo. Pherecydes ſays, that Minerva being accidentally ſeen by Tireſias, as ſhe was bathing with Chariclo in the fountain of Hippocrene, the goddeſs was enraged, and declared that he ſhould ſee nothing more: on which he inſtantly loſt his ſight; but afterwards received from the goddeſs ſuperior endowments. Others ſay, that Juno ſtruck him ſtone-blind for deciding a caſe between Jupiter and her, to her diſſatisfaction; for which Jupiter gave him the faculty of divination: He was the moſt celebrated prophet in the Grecian annals. Ulyſſes is ordered by Circe to conſult him in the ſhades.

> There ſeek the Theban bard depriv'd of ſight,
> Within irradiate with prophetic light.

But, beſides the honour done to him by Homer, Sophocles makes him act a venerable and capital part in his tragedy of Oedipus. Callimachus aſcribes to Minerva the gift of his ſuperior endowments; the pre-eminence of his knowledge is likewiſe mentioned by Tully in his firſt book of Divination. And not only Tireſias is celebrated by Diodorus Siculus, but his daughter Daphne, who, like her father, was gifted with a prophetic ſpirit, and was appointed prieſteſs at Delphos. She wrote many oracles in verſe, from whence Homer was reported to have taken ſeveral lines, which he interwove in his poems. As ſhe was often ſeized with a divine fury, ſhe acquired the title of *ſibyl*, which ſignifies "enthuſiaſt." She is the firſt on whom it was beſtowed: in aftertimes this denomination was given to ſeveral other females that were ſuppoſed to be inſpired, and who uttered and wrote their predictions in verſe; which verſe being ſung, their function may be juſtly ſaid to unite the prieſthood with prophecy, poetry, and muſic.

TISBURY, a ſmall fiſhing town on the ſouth ſide of the iſland of Martha's Vineyard, 9 miles from Chilmark, and 97 from Boſton. The townſhip was incorporated in 1671, and contains 1142 inhabitants. It is in Duke's county, Maſſachuſetts, and in 1796 the eaſterly part was incorporated into a ſeparate townſhip. —*Morſe.*

TISCAN, a village of Ouenca, and department of Alanſis, in Quito, in South-America, which was entirely deſtroyed by an earthquake, but the inhabitants eſcaped, and removed to a ſafer ſituation. The marks of this dreadful convulſion of nature are ſtill viſible.—*ib.*

TISRI, or Tizri, in chronology, the firſt Hebrew month of the civil year, and the 7th of the eccleſiaſtical or ſacred year. It anſwered to part of our September and October.

TITHING-Men, are now a kind of petty conſtables, elected by pariſhes, and ſworn in their offices in the court-leet, and ſometimes by juſtices of the peace, &c. There is frequently a tithing-man in the ſame town with a conſtable, who is, as it were, a deputy to execute the office in the conſtable's abſence; but there are ſome things which a conſtable has power to do, that tithing men and head-boroughs cannot intermeddle with. When there is no conſtable of a pariſh, his office and the authority of a tithing man ſeems to be all one under another name.

TITHONUS, in fabulous hiſtory, the ſon of Laomedon king of Troy, and the brother of Priamus; was beloved by Aurora, who carried him to Delos, thence to Ethiopia, and at laſt to heaven, where ſhe prevailed on the Deſtinies to beſtow upon him the gift of immortality: but forgot to add that of youth, which could only render the preſent valuable. At length Tithonus grew ſo old that he was obliged to be rocked to ſleep like an infant; when Aurora, not being able to put an end to his miſery by death, transformed him into a graſshopper; which renews its youth by caſting his ſkin, and in its chirping retains the loquacity of old age.

TITICACA, an iſland of S. America, in the South Pacific Ocean, near the coaſt of Peru.—*Morſe.*

Titicaca, or *Chucuito*, a lake of Charcas, in Peru; and is the largeſt of all the known lakes in S. America. It is of an oval figure, with an inclination from N. W. to S. E. and about 80 leagues in circuit. The water is, in ſome parts, 70 or 80 fathoms deep. Ten or twelve large, beſides a greater number of ſmaller ſtreams fall into it. The water of this lake, though neither ſalt nor brackiſh, is muddy, and has ſomething ſo nauſeous in its taſte, as not to be drank. One of the moſt ſplendid temples in the empire was erected on an iſland in this lake, by the Yncas. The Indians, on ſeeing the violent rapacity of the Spaniards, are thought to have thrown the immenſe collection of riches in the temple, into this lake. But theſe valuable effects were thrown into another lake, in the valley of Orcos, 6 leagues S. of Cuſco, in water 23 or 24 fathoms deep. Towards the S. part of Titicaca Lake, the banks approach one another, ſo as to form a kind of bay, terminating in a river, called El Deſaguadero, or the drain; and afterwards forms the Lake of Paria, which has no viſible outlet. Over the river El Deſaguadero ſtill remains the bridge of ruſhes, invented by Capac-Yupanqui, the fifth Ynca, for tranſporting his army to the other ſide, in order to conquer the provinces of Collaſuyo. The Deſaguadero is here between 80 and 100 yards in breadth, flowing with a very impetuous current, under a ſmooth, and, as it were, ſleeping ſurface. The Ynca, to overcome this difficulty, ordered 4 very large cables to be made of a kind of graſs, which covers the lofty heaths and mountains of that country, and by the Indians called Ichu: ſo that theſe cables were the foundation of the whole ſtructure. Two of theſe being laid acroſs the water, faſcines of dry juneira, and totora, two ſpecies of ruſhes, were faſtened together, and laid acroſs the cables. On this again the two other cables were laid, and covered with ſimilar faſcines ſecurely faſtened on, but of a ſmaller ſize than the firſt, and arranged ſo as to form a level ſurface. And by this means the Ynca procured a ſafe paſſage for his army. This bridge of ruſhes, which is about five yards broad, and one yard and a half above the ſurface of the water, is carefully repaired, or rebuilt, every ſix months by the neighbouring provinces, in purſuance of a law made by that Ynca; and ſince often confirmed by the kings of Spain, on account of its vaſt uſe, it being the channel of intercourſe between thoſe provinces on each ſide the Deſaguadero.—*ib.*

TITLE for orders, in the church of England, is an aſſurance of being employed and maintained as an officiating clergyman in ſome cathedral or parochial church, or other place of Divine worſhip. And, by the *33d Canon*, "no one is to be ordained but in order to be a curate or incumbent, or to have ſome miniſter's place in ſome church, or except he be fellow, conduct, or chaplain, in ſome college in one of the univerſities, or be maſter of arts of five years ſtanding, and live there at his own coſt." By the ſame canon, the biſhop who ordains a clerk without title, is bound to keep him till he prefer him to ſome eccleſiaſtical living.

TIVERTON, a townſhip of Rhode-Iſland, in Newport county, having the eaſtern Paſſage and part of Mount Hope Bay on the W. and N. W. the State of Maſſachuſetts on the N. and E. and Little-Compton townſhip on the ſouth. It contains 2,453 inhabitants, including 25 ſlaves. It is about 13 miles N. N. E. of Newport.—*Morſe.*

TIZON, a river in the N. W. part of S. America, 600 miles from New-Spain. In a journey made thus far, in 1606, the Spaniards found ſome large edifices, and met with ſome Indians who ſpoke the Mexican language, and who told them, that a few days journey from that river, towards the N. was the kingdom of Tollan, and many other inhabited places whence the Mexicans migrated. It is, indeed, confirmed by Mr Stewart, in his late travels, that there are civilized Indians in the interior parts of America. Beyond the Miſſouri, he met with powerful nations who were courteous and hoſpitable, and appeared to be a poliſhed and civilized people, having regularly built towns, and enjoying a ſtate of ſociety not far removed from the European; and indeed to be perfectly equal wanted only iron and ſteel.—*ib.*

TLASCALA, or *Los Angelos*, a province of New-Spain.—*ib.*

TOA, one of the two rivers, Bajamond being the other, which empty into the harbour of Porto Rico, in the iſland of that name in the Weſt-Indies.—*ib.*

TOAHOUTU, one of the two ſmall iſlands to the N. eaſtward of the S. end of Otaha Iſland, one of the Society Iſlands, in the South Pacific Ocean.—*ib.*

TOAMENSING, two townſhips of Pennſylvania; the one in Montgomery county, the other in that of Northampton.—*ib.*

TOBY's *Creek*, an eaſtern branch of Alleghany river, in Pennſylvania: its ſouthern head water is called Little Toby's Creek. It runs about 55 miles in a W. S. W. and W. courſe, and enters the Alleghany about 20 miles below Fort Franklin. It is deep enough for batteaux for a conſiderable way up, thence by a ſhort portage to the W. branch of Suſquehannah, by which a good a good communication is formed between Ohio, and the eaſtern parts of Pennſylvania.—*ib.*

TOCAYMA, a city of Terra Firma, and in New Granada.—*ib.*

TOD of wool, is mentioned in the ſtatute 12 Carol. II. c. 32. as a weight containing 2 ſtone, or 28 pounds.

TOGOSAHATCHEE *Creek*, a water of Oakmulgee river, in Georgia.—*Morſe.*

TOLLAND, a county of Connecticut, bounded N. by the State of Maſſachuſetts, S. by New-London county, E. by Windham, and W. by Hartford county. It is ſubdivided into 9 townſhips, and contains 13,106 inhabitants, including 47 ſlaves. A great proportion of the county is hilly, but the ſoil is generally ſtrong and good for grazing.—*ib.*

TOLLAND, the chief town of the above county, was incorporated in 1715, and is about 18 miles N. E. of Hartford. It has a Congregational church, court-houſe, gaol, and 20 or 30 houſes, compactly built, in the centre of the town.—*ib.*

TOLU, a town of Terra Firma, S. America, with a harbour on a bay of the N. Sea. The famous balſam of the ſame name comes from this place; 114 miles S. W. of Carthagena. N. lat. 9 36, W. long. 75 22. —*ib.*

TOMACO, a large river of Popayan, and Terra Firma, S. America, about 9 miles N. E. of Galla Iſle. About a league and a half within the river is an Indian town of the ſame name, and but ſmall, the inhabitants of which commonly ſupply ſmall veſſels with proviſions, when they put in here for refreſhment.—*ib.*

TOMAHAWK *Iſland*, on the eaſt coaſt of Patagonia, is 24 miles N. E. of Seal's Bay.—*ib.*

TOMBA *River*, on the coaſt of Peru, is between the port of Hilo and the river of Xuly or Chuly. There is anchorage againſt this river in 20 fathoms, and clean ground. Lat. 17 50 S.—*ib.*

TOMBIGBEE *River*, is the dividing line between the Creeks and Chactaws. Above the junction of Alabama and Mobile rivers, the latter is called the Tombigbee river, from the fort of Tombigbee, ſituated on the weſt ſide of it, about 96 miles above the town of Mobile. The ſource of this river is reckoned to be 40 leagues higher up, in the country of the Chickaſaws. The fort of Tombigbee was captured by the Britiſh, but abandoned by them in 1767. The river is navigable for ſloops and ſchooners about 35 leagues above the town of Mobile: 130 American families are ſettled on this river, that have been Spaniſh ſubjects ſince 1783.—*ib.*

TOMBUCTOO, a large city in North Africa, and capital of a kingdom of the ſame name. It has for ſome years paſt been the great object of European reſearch, being one of the principal marts for that extenſive commerce which the Moors carry on with the Negroes. The hopes of acquiring wealth in this purſuit, and zeal for propagating their religion, have filled this extenſive city with Moors and Mahomedan converts; the king himſelf, and all the chief officers of ſtate are Moors; and they are ſaid to be more ſevere and intolerant in their principles than any other of the Mooriſh tribes in this part of Africa. Mr Park was informed, by a venerable old Negro, that when he firſt viſited Tombuctoo, he took up his lodging at a ſort of public inn, the landlord of which, when he conducted him into his hut, ſpread a mat on the floor, and laid a rope upon it; ſaying, "if you are a Muſſulman, you are my friend, ſit down; but if you are a Kafir, you are my ſlave; and with this rope I will lead you to market." The reigning ſovereign of Tombuctoo, when Mr Park was in Africa, was named *Abu Abrahima.* He was reported to poſſeſs immenſe riches, and his wives and concubines were ſaid to be clothed in ſilk, and the chief officers of ſtate live in conſiderable ſplendour. The whole expenſe of his government is defrayed by a tax upon merchandize, which is collected at the gates of the city.

Of that city very little is known with accuracy, as it has never been viſited by any European. It is the largeſt on the Niger, Houſſa only excepted; and probably contains from 60,000 to 80,000 inhabitants. In ſome of the Gazetteers, its houſes are ſaid to be built in the form of bells; but they are probably ſuch buildings as thoſe of Sego, which ſee in this *Supplement.* Tombuctoo, according to Major Rennel, is in 16° 30′ N. Lat. and 1° 33′ E. Long. from Greenwich.

TOMINA, a juriſdiction in the archbiſhopric of La Plata in Peru. It begins about 18 leagues S. E. from the city of Plata; on its eaſtern confines dwell a nation of wild Indians, called Chiriguanos. It abounds with wine, ſugar and cattle.—*Morſe.*

TOMISCANING, a lake of N. America, which ſends its waters ſouth eaſtward through Ottawas river, into Lake St Francis in St Lawrence river. The line which ſeparates Upper from Lower Canada, runs up to this lake by a line drawn due north, until it ſtrikes the boundary line of Hudſon's Bay, or New-Britain. —*ib.*

TOMPSONTOWN, a village of Pennſylvania, in Mifflin county, containing about a dozen houſes. It is 22 miles from Lewiſtown.—*ib.*

TOM's *Creek*, in New-Jerſey, which ſeparates the towns of Dover and Shrewſbury.—*ib.*

TOMSOOK, in the language of Bengal, a bond.

TONDELO, a river at the bottom of the Gulf of Campeachy, in the S. W. part of the Gulf of Mexico; 15 miles due weſt of St Annes, and 24 eaſt of Guaſickwalp. It is navigable for barges and other veſſels of from 50 to 60 tons.—*Morſe.*

TONEWANTO, the name of a creek and Indian town, in the north-weſtern part of New-York. The creek runs a weſtward courſe and enters Niagara river oppoſite Grand Iſland, 8 miles N. of Fort Erie. It runs about 40 miles, and is navigable 28 miles from its mouth. The town ſtands on its S. ſide, 18 miles from Niagara river. Alſo the Indian name of Fiſhing Bay, on Lake Ontario.—*ib.*

TONGATABOO, one of the Friendly Iſlands, in the S. Pacific Ocean, about 60 miles in circuit, but rather oblong, and wideſt at the E. end. It has a rocky coaſt, except to the N. ſide, which is full of ſhoals and iſlands, and the ſhore is low and ſandy. It furniſhes the beſt harbour or anchorage to be found in theſe iſlands. The iſland is all laid out in plantations, between which are roads and lanes for travelling, drawn in a very judicious manner for opening an eaſy communication from one part of the iſland to another. S. lat. 21 9, W. long. 174 46. Variation of the needle, in 1777, was 9 53 E.—*ib.*

TONTI, an iſland at the mouth of Lake D'Urſe, at at the eaſtern extremity of Lake Ontario, is within the Britiſh territories; 11 miles N. E. of Point au Goelans, and 12 W. of Grand Iſland, having ſeveral iſles between it and the latter.—*ib.*

TONTI, or *Tonty*, a river which empties through the N. ſhore of Lake Erie; 22 miles W. by N. of Riviere a la Barbue.—*ib.*

TONTORAL, *Cape*, on the coaſt of Chili, in S. America, 15 leagues to the N. of Guaſca, and in lat. 27 30 S.—*ib.*

TOOBAUAI, one of the Society Iſlands, in the S. Pacific Ocean, not more than 5 or 6 miles acroſs in any part. S. lat. 23 25, W. long. 149 23.—*ib.*

TOOSCHCONDOLCH, an Indian village on the N. W. coaſt of N. America, of conſiderable importance in the fur trade; ſituated on a point of land between two deep ſounds. N. lat. 53 2, W. long. 131 30.—*ib.*

TOOTH-ACHE, a well known excruciating pain (ſee *Encycl.*), for the alleviation, and even the cure of which, many ſpecifics have been offered to the public. Of one of the moſt extraordinary of theſe, there is an account, in a ſmall work publiſhed at Florence in 1794, by profeſſor Gerbi, who gives the deſcription of an inſect, a kind of *curculio*, which, from its property of allaying the tooth-ache, has received the epithet of *antiodontalgicus*, and which is found on a ſpecies of thiſtle, *carduus ſpinoſiſſimus*. The flowers of this thiſtle, when analyſed, gave the acid of galls, the muriatic acid, oxalat of lime, extractive matter, and a very little reſin. On the bottom of the calyx, which ſupports the flowers, there are often found excreſcences like the gall nut, which are at firſt ſpheroidal, afterwards cylindric, and at length aſſume the figure of two hemiſpheres: they conſiſt of the like component parts with the flowers, but contain more reſin, and far more oxalat of lime; as the gall apple of the oak, according to the experiments of M. Branchi, which are here mentioned, contains more of the acid of galls than the bark and other parts of the oak, in which he could diſcover no ſulphuric acid. The inſect, according to the author's obſervations, eats not only the parenchyma, but alſo the veſſels and fibres of the leaves. The egg, before the worm makes its appearance, is nouriſhed by the ſap of the plant, and of the above excreſcences, in which it reſides, by means of the attractive power that the egg poſſeſſes for certain vegetable juices and ſubſtances. The excreſcences ariſe by the accumulation of a ſolid ſubſtance, which is precipitated from the nouriſhing juices of the thiſtle, diminiſhed by nouriſhing the egg and the worm. This inſect, the eggs of which are depoſited in theſe excreſcences, is, together with the *curculio* of the centaury, a new ſpecies. It is of a longiſh figure; covered below with ſhort yellow hair, and above with golden yellow velvety ſpots. Its corſlet is variegated with ſpecks; and the covering of its wings with ſpecks and ſtripes. It has a ſhort proboſcis, and ſhews ſome likeneſs to the *curculio villoſus* of Geoffroy. Its larva repreſents a ſort of ichneumon. By chemical analyſis it exhibits ſome traces of common ſalt; by diſtillation with a ſtrong dry heat, ſome volatile lixivious ſalts; and it contains beſides theſe, ſome gelatinous, and a little ſebaceous and ſlimy extractive matter. If about a dozen or fifteen of theſe inſects, when in the ſtate of larva, or even when come to perfection, be bruiſed and rubbed ſlowly between the fore finger and the thumb, until they have loſt their moiſture, and if the painful tooth, where it is hollow, be touched with that finger, the pain ceaſes ſometimes inſtantaneouſly. This power or property the finger will retain for a year, even though it be often waſhed and uſed. A piece of ſhammoy leather will ſerve equally well with the finger. Of 629 experiments, 401 were attended with complete ſucceſs. In two of theſe caſes, the hollow teeth aroſe from ſome fault in the juices: in the reſt they were merely local. If the gums are inflamed, the remedy is of no avail.

To the truth of this tale the reader will give what credit he pleaſes; but it is ſurely very difficult to believe, that a living finger, continually perſpiring, can retain for a year the moiſture imbibed from this inſect. But it ſeems there are other inſects which have the property of curing the tooth-ache; ſuch as the *carabus chryſocephalus* of Roſſi; the *carabus ferrugineus* of Fabricius; the *coccinella ſeptem punctata* (the lady bird); the *chryſomela populi*, and the *chryſomela ſanguinolenta*. It would appear, therefore, that this property belongs to various kinds of the *coleoptera*.

The idea of theſe inſects being endowed with the property of curing the tooth-ache is not confined to Italy; for Dr Hirſch, dentiſt to the court of Weimar, aſſerts (*Verkundiger*, September 24, 1798) that he employed them with the happieſt effect, except in ſome caſes where his patients were females. He ſays, that he took that ſmall inſect, found commonly among corn, *coccinella ſeptem punctata*, and bruiſed it between his fingers. He then rubbed the fingers with which he had bruiſed it, till they became warm at the points, and touched with them the unſound parts of the gums, as well as the diſeaſed tooth. Dr Hirſch adds, that he made the ſame experiment a few days after with equal ſucceſs, though he had not bruiſed a new inſect with his fingers. He ſeems to think that, to enſure the efficacy of the proceſs, the inſect ſhould be alive; becauſe when dead, its internal parts, in which he preſumes the virtue chiefly reſides, become dried up, leaving only the wings and an empty ſhell; and therefore propoſes to phyſicians to turn their attention to the finding out of ſome method for preſerving the virtue of the inſect ſo that its efficacy may be in full vigour throughout the year.

Beſides theſe beetles, charcoal has been recommended as an anodyne in the tooth-ache; but whether it operates merely by filling the hollow of the tooth, and thereby preventing the acceſs of atmoſpheric air to the nerve, or by any of its ſingular and hitherto unknown qualities, ſeems not to have been well aſcertained.

TOOTOOCH, a ſmall low iſland in Nootka Sound, on the N. W. coaſt of North-America, on the eaſtern ſide of which is a conſiderable Indian village; the inhabitants of which wear a garment apparently compoſed of wool and hair, moſtly white, well fabricated, and probably by themſelves.—*Morſe.*

TOPIA, a mountainous, barren part of New-Biſcay province in Mexico, North-America; yet moſt of the neighbouring parts are pleaſant, abounding with all manner of proviſions.—*ib.*

TOPSFIELD, a townſhip of Maſſachuſetts, Eſſex county, containing 780 inhabitants. It is 8 miles weſterly of Ipſwich, and 39 N. by E. of Boſton.—*ib.*

TOPSHAM, a townſhip of Vermont, in Orange county,

county, weſt of Newbury, adjoining. It is watered by ſome branches of Wait's river, and contains 162 inhabitants.—*ib.*

Topsham, a townſhip of the Diſtrict of Maine, in Lincoln county, 32 miles in circumference, and more than 25 miles is waſhed by water. It is bounded on the N. W. by Little river; N. by Bowdoin and Bowdoinham; E. by Cathance and Merry Meeting Bay; S. and S. W. by Amariſcoggin river, which ſeparates it from Brunſwick in Cumberland county. The inhabitants amount to 826 ſouls, and they live in ſuch eaſy circumſtances, that none have ever been ſo poor as to ſolicit help from the pariſh. It was incorporated in 1764. A few Engliſh attempted to ſettle here in the end of the laſt, or beginning of the preſent century. Theſe were cut off by the natives. Some families ventured to ſettle in this hazardous ſituation in 1730; from which period, until the peace of 1763, the inhabitants never felt wholly ſecure from the natives. It is 37 miles S. by W. of Hallowell, and 156 N. by E. of Boſton; and is nearly in lat. 44 N. and long. 70 W. —*ib.*

TOR, a town of Aſia, in Arabia Petræa, ſeated on the Red Sea, with a good harbour, defended by a caſtle. There is a handſome Greek convent, in whoſe garden are fountains of bitter water, which they pretend are thoſe rendered ſweet by Moſes, by throwing a piece of wood into them. Some think that this town is the ancient Elana. E. Long. 31. 25. N. Lat. 28. 0.

TORBAY, a town on the eaſtern coaſt of Nova-Scotia; 22 miles S. W. of Roaring Bull Iſland, and 100 N. E. of Halifax.—*Morse.*

TORBEK, a village on the ſouth ſide of the ſouth peninſula of the iſland of St Domingo; 3 leagues N. W. of Avache Iſland.—*ib.*

TORELLI (Joſeph), was born at Verona on the 4th of November 1721. His father Lucas Torelli, who was a merchant, dying while young Torelli was but an infant, he was left entirely to the care of his mother Antonia Albertini, a Venetian lady of an excellent character. After receiving the firſt rudiments of learning, he was placed under the Ballerini, who, obſerving the genius of the boy, prevailed upon his mother to ſend him to complete his education at Patavia. Here he ſpent four years entirely devoted to ſtudy, all his other paſſions being abſorbed by his thirſt for knowledge.

The unſullied innocence of his life, and the prudence and gravity of his conduct, ſoon attracting the attention of his maſters, they not only commended him with eagerneſs, but performed to him the part of parents, converſed with him familiarly about their reſpective ſciences, and read over to him privately the lectures which they had to deliver. This was the caſe particularly with Hercules Dondinus, under whom Torelli ſtudied juriſprudence. But he by no means confined himſelf to that ſcience alone. The knowledge which he acquired was ſo general, that upon whatever ſubject the converſation happened to turn, he delivered his ſentiments upon it in ſuch a manner that one would have thought he had beſtowed upon it his whole attention.

After receiving the degree of Doctor, he returned home to the enjoyment of a conſiderable fortune; which putting it into his power to chooſe his own mode of living, he determined to devote himſelf entirely to literary purſuits. He reſolved, however, not to cultivate one particular branch to the excluſion of every other, but to make himſelf maſter of one thing after another, as his humour inclined him; and he was particularly attentive to lay an accurate and ſolid foundation. Though he declined practiſing as a lawyer, he did not on that account, relinquiſh the ſtudy of law. The Hebrew, Greek, Latin, and Italian languages, occupied much of his time. His object was to underſtand accurately the two firſt, and to be able to write and ſpeak the two laſt with propriety and elegance. Beſides theſe languages, he learned French, Spaniſh, and Engliſh. On the laſt, in particular, he beſtowed uncommon pains; for he was peculiarly attached to the Britiſh nation, and to Britiſh writers, whom he peruſed with the greateſt attention; not merely to acquire the language, but to imbibe alſo that force and loftineſs of ſentiment for which they are ſo remarkable. Nay, he even began an Italian tranſlation of Paradiſe Loſt.

He likewiſe made himſelf acquainted with ethics, metaphyſics, and polemical divinity; to which laſt ſubject he was induced to pay attention by the cuſtom of his country. With ancient hiſtory he was very familiarly acquainted, calling in to his aſſiſtance, while engaged in that ſtudy, the aids of chronology, geography, and criticiſm. This laſt art, indeed, by means of which what is counterfeit may be diſtinguiſhed from what is genuine, what is interpolated from what is uncorrupted, and what is excellent from what is faulty, he carried about with him as his counſellor and his guide upon all occaſions.

The theory of *muſic* he ſtudied with attention, preferring thoſe powerful airs which make their way into the ſoul, and rouſe the paſſions at the pleaſure of the muſician. His knowledge of *pictures* was held in high eſtimation by the artiſts themſelves, who were accuſtomed to aſk his opinion concerning the fidelity of the deſign, the harmony of colours, the value of the picture, and the name of the painter. He himſelf had a collection, not remarkably ſplendid indeed, but exceedingly well choſen. *Architecture* he ſtudied with ſtill greater attention, becauſe he conſidered it as of more real utility. Nor did he neglect the purſuits of the *antiquarian*, but made himſelf familiarly acquainted with coins, gems, medals, engravings, antique veſſels, and monuments. Indeed ſcarce any monumental inſcriptions were engraved at Verona which he had not either compoſed or corrected. With the *antiquities* of his own country he was ſo intimately acquainted, that every perſon of eminence, who viſited Verona, took care to have him in their company when they examined the curioſities of the city.

But theſe purſuits he conſidered merely as amuſements; mathematics and the belles lettres were his ſerious ſtudies. Theſe ſtudies are, in general, conſidered as incompatible; but Torelli was one of the few who could combine the gravity of the mathematician with the amenity of the muſes and graces, and who handle the compaſs and the plectrum with equal ſkill. Of his progreſs in mathematics, ſeveral of his treatiſes, and eſpecially his edition of Archimedes, publiſhed ſince his death by the univerſity of Oxford, are ſufficient proofs. Nor was his progreſs in the more pleaſing parts of literature leſs diſtinguiſhed. In both theſe ſtudies he was partial to the ancients, and was particularly hoſtile to the poetry and the literary innovations of the French.

Nothing could be purer or more elegant than his Latin ſtyle, which he had acquired at the expenſe of much time and labour. His Latin tranſlation of Archimedes is a ſufficient proof of this, and is indeed really wonderful, if we conſider that the Romans, being far inferior to the Greeks in mathematical knowledge, their language was of neceſſity deſtitute of many neceſſary words and phraſes. He wrote the Italian language with the claſſic elegance of the 14th and 15th centuries. Witneſs his different works in that language, both in proſe and verſe. He tranſlated the whole of Æſop's Fables into Latin, and Theocritus, the *Epithalamium* of Catullus, and the *comedy* of Plautus, called *Pſeudolus*, into Italian verſe. The two firſt books of the Æneid were alſo tranſlated by him with ſuch exactneſs, and ſo much in the ſtile of the original, that they may well paſs for the work of Virgil himſelf.

His life, like his ſtudies, was drawn after the model of the ancient ſages. Frugal, temperate, modeſt, he exhibited a ſtriking contraſt to the luxurious manners of his age. In religion he adhered ſtrictly, though not ſuperſtitiouſly, to the opinions of his anceſtors. He was firm to his reſolutions, but not fooliſhly obſtinate; and ſo ſtrict an obſerver of equity, that his probity would have remained inviolate, even though there had been no law to bind him to juſtice. He never married, that he might have leiſure to devote himſelf, with leſs interruption, to his favourite ſtudies. Every one readily found admiſſion to him, and no man left him without being both pleaſed and inſtructed; ſuch was the ſweetneſs of his temper, and the readineſs with which he communicated information. He adhered with great conſtancy to his friendſhips. This was particularly exemplified in the caſe of Clemens Sibiliatus, who has favoured the world with the life of Torelli. With him he kept up the cloſeſt connection from a ſchool boy till the day of his death. He was peculiarly attached likewiſe to many men of diſtinction, both in Italy and Britain. He died in Auguſt 1781, in the 70th year of his age.

The following is a complete liſt of his works, his edition of Archimedes excepted, which was not publiſhed till after his death:

1. "Lucubratio Academica, ſivi Somnium Jacobi Pindemontii, &c." Patavii, 1743.—2. "Animadverſiones in Hebraicum Exodi Librum et in Græcum lxx Interpretationem;" Veronæ, 1744.—3. "De principe Gulæ incommodo, ejuſque remedio, Libri duo;" Coloniæ Agrippinæ, 1744.—4 "De Probabili Vitæ Morumque Regula;" Colonæ, 1747.—5. "Li due primi Canti dell' Iliade (di Scipione Maffei) e lie due primi dell' Eneide di Giuſeppe Torelli tradotti in verſi Italiani;" Verona, 1749.—6. "Gli ſteſſi due canti dell' Eneide riſtampati ſoli lo ſteſſo anno per lo ſteſſo Ramanzini."—7. "Scala de Meriti a capo d'anno Trattato Geometrico;" Verona, 1751.—8. "De Nihilo Geometrico, lib. 2.;" Veronæ, 1758—9. "Lettera intorno a due paſſi del Purgatorio di Dante Alighiero;" *ib.* 1760.—10. "Della Denominazione del corrente anno vulgarmente detto 1760 in Bologna per Lelio della Volpe."—11. "Il pſeudolo. Comedia, &c. e ſi aggiunge la traduzione d'alcuni Idilli di Teocritoe di Moſco;" Firenze, 1765.—12. "Inno a Maria Virgine nella Feſtivita della ſua Concezione;" Verona, 1766.—13. "Lettera a Miladi Vaing-Reit premeſſa al libro che ha per titalo xii. lettere Ingleſi, con altra lettera all'autore della ſuddetta;" Verona, 1767.—14. "Elegia di Tommaſo Gray, Poeta Ingleſe, in un Cimetero Campeſtre in verſi Italiani rimati;" Verona, 1767.—15. "Geometrica;" Veronæ, 1769.—16. "Demonſtratio antiqui Theorematis de motuum commixtione;" Veronæ, 1774.—17. "Lettera ſupra Dante contro il Signor di Voltaire;" Verona, 1781.—18. "Poemetto di Catullo ſu le Nozze di Peleo e Tetite, ed un Epitalamio dello ſteſſo;" 1781.—19. "Œſopi Fabulæ."—20. "Teocrito tradotto, in verſi Toſcani."—21. "Elementi d'Euclide tradotti nell idioma Italiano."—22. "Elementorum Proſpectivæ, libri duo."

TORMENTIN *Cape*, on the W. ſide of the Straits of Northumberland, or Sound, between the iſland of St John's and the E. coaſt of Nova-Scotia, is the N. point of the entrance to Bay Vert. It is due weſt from Governor's Iſland, on the S. E. coaſt of the iſland of St John's. In ſome maps this point is called *Cape Sturm*. —*Morse*.

TORONTO, a Britiſh ſettlement on the north-weſtern bank of Lake Ontario, 53 miles N. by W. of Fort Niagara. N. lat. 44 1, W. long. 79 10 —*ib.*

TORPEDO, or CRAMP FISH, has been deſcribed under the generic title RAJA; and an attempt made to explain its electrical phenomena in the article ELECTRICITY, n° 258, &c. (Both theſe articles are in the *Encyclopædia*). From ſome late diſcoveries, however, of Volta and others, the ſhock given by the torpedo appears much more analagous to the ſhock of GALVANISM than to that of common electricity; and even the electrical organs of the fiſh ſeem to reſemble the apparatus with which thoſe diſcoveries in galvaniſm were made.

In the 63d volume of the Philoſophical Tranſactions, Mr Hunter deſcribes the electric organ of the torpedo as conſiſting of a number of columns varying in their length from an inch and a half to a quarter of an inch, with diameters about two-tenths of an inch. The number of columns in each organ of the torpedo which he preſented to the Royal Society was about 470; but in a very large torpedo which he diſſected, the number of columns in one organ was 1182. Theſe columns were compoſed of films parallel to the baſe of each; and the diſtance between each partition of the columns was $\frac{1}{150}$th of an inch. From theſe facts, the reader will find the anomalies of torpedinal electricity (ſuppoſing it the ſame with common electricity) accounted for in a very ingenious and philoſophical manner by Mr Nicholſon, at p. 358 of the firſt volume of his valuable journal. We paſs on, however, to point out the reſemblance between it and the lately diſcovered phenomena in galvaniſm.

Take any number of plates of copper, or which is better, of ſilver, and an equal number of tin, or, which is much better, of zinc, and a like number of diſcs, or pieces of card, or leather, or cloth (A), or any porous ſubſtance

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(A) Woollen or linen cloth appear to be more durable, and more ſpeedily ſoaked, than card.

ſubſtance capable of retaining moiſture. Let theſe laſt be ſoaked in pure water, or, which is better, ſalt and water or alkaline leys. The ſilver or copper may be pieces of money. Build up a pile of theſe pieces; namely, a piece of ſilver, a piece of zinc, and a piece of wet card: then another piece of ſilver, a piece of zinc, and a piece of wet card; and ſo forth, in the ſame order (or any other order, provided the pieces ſucceed each other in their turn), till the whole number intended to be made uſe of is builded up. The inſtrument is then completed.

In this ſtate it will afford a perpetual current of the galvanic influence through any conductor communicating between its upper and lower plates; and if this conductor be an animal, it will receive an electrical ſhock as often as the touch is made, by which the circuit is completed. Thus if one hand be applied to the lower plate, and the other to the upper, the operator will receive a ſhock, and that as often as he pleaſes to lift his finger and put it down again.

This ſhock reſembles the weak charge of a battery of immenſe ſurface; and its intenſity is ſo low that it cannot make its way through the dry ſkin. It is therefore neceſſary that a large ſurface of each hand ſhould be well wetted, and a piece of metal be graſped in each, in order to make the touch; or elſe that the two extremities of the pile ſhould communicate with ſeparate veſſels of water, in which the hands may be plunged.

The commotion is ſtronger the more numerous the pieces. Twenty pieces will give a ſhock in the arms, if the above precautions be attended to. One hundred pieces may be felt to the ſhoulders. The current acts on the animal ſyſtem while the circuit is complete, as well as during the inſtant of commotion, and the action is abominably painful at any place where the ſkin is broken.

That this influence, whatever it may be, has a ſtriking reſemblance to the repeated ſhocks given by the torpedo, is obvious; but what it really is in itſelf muſt be aſcertained, if it can be aſcertained at all, by future experiments. Mr Nicholſon indeed, from whoſe Journal we have taken this account of Volta's apparatus and its effects, ſeems confident that theſe effects proceed from an electrical ſtream or current; but this mode of operation is quite foreign from all the laws of electricity known to us. The galvanic influence in this apparatus appears to move perpetually in a circle; to which we are acquainted with no fact in electricity that is at all ſimilar. Galvaniſm, too, ſeems capable of accumulation, even while ſurrounded by conducting ſubſtances, which is quite inconſiſtent with all that we *diſtinctly* know of electricity and its laws.

That the energy of the apparatus, however, is the effect of an electric ſtream or current, our ingenious author thinks proved by the condenſer with which Sig. Volta aſcertained the kind of the electricity, and obtained its ſpark. He finds the action ſtrongeſt, or moſt pungent, on wounds on the minus ſide of the apparatus, or where the wounds give out electricity; a fact alſo obſervable in the common electric ſpark.

The theory of the learned inventor ſeems to be, that it is a property of ſuch bodies as differ in their power of conducting electricity, that when they are brought into contact they will occaſion a ſtream of the electric matter. So that if zinc and ſilver be made to communicate immediately by contact, there will be a place of good conducting energy; and if they be made to communicate mediately by means of water, there will be a place of inferior conducting energy: and wherever this happens, there will be a ſtream or current produced in the general ſtock of electricity. This is not deduced as the conſequence of other more ſimple facts; but is laid down as a general or ſimple principle grounded on the phenomena. If ſo, is it not a *petitio principii?* That ſuch bodies as zinc and ſilver, when properly diſpoſed, pruduce a ſtream or current, or ſomething analogous to a ſtream or current, in the galvanic fluid, follows indeed indiſputably from the phenomena; but it by no means follows from the ſame phenomena that galvaniſm is electricity; for electricity ſeems ſubject to different laws. See ELECTRICITY and THUNDER, both in this *Supplement*.

It muſt be acknowledged that the diſcovery of the galvanic ſhock and ſpark, and of the apparent exiſtence of two oppoſite ſtates of galvaniſm correſponding to poſitive and negative electricity, conſiderably increaſe the analogy; which in the article GALVANISM, *Suppl.* we have admitted to be very ſtriking: but ſuppoſing no fallacy in any of Volta's experiments, we do not think that theſe diſcoveries amount to any thing like a demonſtration of the concluſions which have been drawn from them. It is by no means certain that light is eſſentially connected with the electric fluid; for we know that it is not eſſentially connected with heat; (See *THERMOMETRICAL Spectrum*, in this *Suppl.*) The flaſh, for example, of lightning may be merely an extrication of light, in conſequence of the action of electricity upon the atmoſphere in its paſſage, or on the bodies upon which it impinges; and there are many inſtances of a ſimilar extrication, as in the colliſion of two pieces of flint, where neither electricity nor galvaniſm were ever ſuſpected to have any ſhare in producing the phenomenon. Why may not the progreſs of the galvanic fluid have a ſimilar effect in this inſtance with that of electricity, though the two fluids be eſſentially different between themſelves? But we have more to ſay on this ſubject.

Meſſrs Nicholſon and Carliſle conſtructed an apparatus ſimilar to that of Volta, which gave them a ſhock as before deſcribed, and a very acute ſenſation wherever the ſkin was broken. Their firſt reſearch was directed to aſcertain that the ſhock they felt was really an electrical phenomenon. For this purpoſe the pile was placed upon Bennett's gold leaf electrometer, and a wire was then made to communicate from the top of the pile to the metallic ſtand or foot of the inſtrument; ſo that the circuit of the ſhock would have been through the leaves, if they had diverged; but no ſigns of electricity appeared. Recourſe was then had to the revolving doubler; of which the reader will find an account in our Supplementary article ELECTRICITY, n° 203. The doubler had been previouſly cleared of electricity by twenty turns in connection with the earth. The negative divergence was produced in the electrometer. Repeated experiments of this kind ſhewed that the ſilver end was in the minus, and the zinc end in the plus ſtate.

Here a pile of 17 half crowns, with a like number of pieces of zinc, and of paſteboard ſoaked in ſalt water, though it gave a ſevere ſhock, exhibited no ſymptoms of electricity till aſſiſted by the doubler. Will it be ſaid that this aroſe from want of intenſity in the galvanic ſhock? We can only reply, that a much leſs intenſe ſhock of electricity would have produced a ſenſible divergence in the inſtrument without the doubler. What was the cauſe of this difference? We have, however, no doubt but that electricity was concerned in this phenomenon; for we have ſhewn elſewhere (ſee THUNDER, *Suppl.*), that either *electricity* is produced, or the equilibrium of the electrical fluid diſturbed, by every chemical ſolution; and we ſhall ſee immediately that chemical ſolutions are perpetually going on in Volta's apparatus.

Very early in the courſe of this experiment, the contacts being made ſure by placing a drop of water upon the upper plate, Mr Carliſle obſerved a diſengagement of gas round the touching wire. This gas, though very minute in quantity, evidently ſeemed to have the ſmell afforded by hydrogen when the wire of communication was ſteel. This, with ſome other facts, led Mr Nicholſon to propoſe to break the circuit by the ſubſtitution of a tube of water between two wires. They therefore inſerted a braſs wire through each of two corks inſerted in a glaſs tube of half an inch internal diameter. The tube was filled with New River water, and the diſtance between the points of the wires in the water was one inch and three quarters. This compound diſcharger was applied ſo that the external ends of its wire were in contact with the two extreme plates of a pile of 36 half crowns, with the correſponding pieces of zinc and paſteboard. A fine ſtream of minute bubbles immediately began to flow from the point of the lower wire in the tube which communicated with the ſilver, and the oppoſite point of the upper wire became tarniſhed, firſt deep orange, and then black. On reverſing the tube, the gas came from the other point, which was now loweſt; while the upper, in its turn, became tarniſhed and black. Reverſing the tube again, the phenomena again changed their order. In this ſtate the whole was left for two hours and a half. The upper wire gradually emitted whitiſh filmy clouds, which, towards the end of the proceſs, became of a pea-green colour, and hung in perpendicular threads from the extreme half inch of the wire, the water being rendered ſemiopaque by what fell off, and in a great part lay, of a pale green, on the lower ſurface of the tube, which, in this diſpoſition of the apparatus, was inclined about forty degrees to the horizon. The lower wire of three quarters of an inch long, conſtantly emitted gas, except when another circuit, or complete wire, was applied to the apparatus; during which time the emiſſion of gas was ſuſpended. When this laſt mentioned wire was removed, the gas re-appeared as before, not inſtantly, but after the lapſe of four beats of a half ſecond clock ſtanding in the room. The product of gas, during the whole two hours and a half, was two-thirtieths of a cubic inch. It was then mixed with an equal quantity of common air, and exploded by the application of a lighted waxed thread.

Meſſrs Nicholſon and Carliſle had been led, by their reaſoning on the firſt appearance of hydrogen, to expect a decompoſition of the water; but it was with no little ſurprize that they found the hydrogen extricated at the contact with one wire, while the oxygen fixed itſelf, in combination with the other wire, at the diſtance of almoſt two inches. This new fact ſtill remains to be explained, and ſeems, ſays Mr Nicholſon, to point at ſome general law of the agency of electricity in chemical operations. Does it not as naturally ſuggeſt a ſuſpicion that galvaniſm is not electricity; eſpecially as we are informed, by Mr Cruickſhank of Woolwich, that Meſſrs Nicholſon and Carliſle diſcovered, that "galvaniſm decompoſes water with much greater facility than electricity, and with phenomena ſomewhat different?" What the particular differences are, he does not ſay; but we learn from Mr Nicholſon himſelf, that from the general tenor of his experiments, it appears to be eſtabliſhed, that the decompoſition of water by galvaniſm is more effectual the leſs the diſtance is between the wires, but that it ceaſes altogether when the wires are in contact.

Mr Nicholſon concludes his memoir with mentioning conciſely the effects of a pile of 100 half crowns, and a chemical incident, which appears to be the moſt remarkable of thoſe which he has yet obſerved.

The pile was ſet up with pieces of green woollen cloth ſoaked in ſalt water. It gave ſevere ſhocks, which were felt as high as the ſhoulders. The tranſition was much leſs forcible through a number of perſons, but it was very perceptible through nine. The ſpark was frequently viſible when the diſcharge was made in the dark, and a gleam of light was alſo, in ſome inſtances, ſeen about the middle of the column at the inſtant of the exploſion. The aſſiſtants were of opinion that they heard the ſnap.

The extrication of the gaſes was rapid and plentiful by means of this apparatus. When copper wires were uſed for the broken circuit, with muriatic acid diluted with 100 parts of water in the tube, no gas, nor the leaſt circulation of the fluid was perceived, when the diſtance of the wires was two inches. A ſhort tube, with two copper wires very near each other in common water, was made part of the circuit, and ſhewed by the uſual phenomena, that the ſtream of electricity was rapidly paſſing. The wires in the muriatic acid were then ſlided within the third of an inch of each other. For the ſake of brevity he avoids enumerating the effects which took place during ſeveral hours, and ſimply ſtates, that the minus wire gave out ſome hydrogen during an hour; while the plus wire was corroded, and exhibited no oxyd; but a depoſition of copper was formed round the minus, or lower wire, which began at its lower end: that no gas whatever appeared in this tube during two hours, though the depoſition was going on, and the ſmall tube ſhewed the continuance of the electric ſtream; and that the depoſition, at the end of four hours, formed a ramified metallic vegetation, nine or ten times the bulk of the wire it ſurrounded.

In this experiment, it appeared that the influence of electricity increaſing the oxydability of the upper wire, and affording naſcent hydrogen from the lower, cauſed the latter to act as the precipitant of a ſolution of one and the ſame metal.

Mr Nicholſon, we ſee, continues to call it electricity with the utmoſt confidence, as if it could not poſſibly be any thing elſe; and yet he ſays that the galvanic ſhock is much leſs forcible when paſſed through a number of perſons than when paſſed only through one. This, we believe, does not hold in the ſhocks of common electricity; and the difference probably ariſes from the cuticle

ticle obſtructing the paſſage of the one and not of the other. Volta himſelf ſays, that *this* electricity, for he too is deſirous to prove it electricity, does not diffuſe itſelf through the air. It is ſo univerſally known that very dry air is no conductor of electricity, that he muſt mean, on this occaſion, air not uncommonly dry; otherwiſe the non-diffuſion of *this* electricity through air would not diſtinguiſh it, as he ſeems to admit it does, from common electricity. But what occaſions this diſtinction, if the two electricities be the ſame?

Lieutenant-colonel Haldane, well known in the ſcientific world, made experiments with Volta's pillar, both in a horizontal and in a vertical poſition. With a large pillar, placed vertically, he obtained very weak ſigns of electricity. He connected the apparatus with the conductor of an electrical machine, and found the effect rather impeded than aſſiſted by the common electric ſtream. He placed the plate of Bennet's electrometer in the circuit, without producing electric ſigns. He found that the galvanic apparatus, placed between the outſide and inſide of a jar, prevented its charging, and that it is alſo capable of conducting the charge, though not rapidly: and, on the whole, from the very minute exhibition of the attractive and repellent powers, while the cauſticity, the ſhock, and the oxydation, are ſo very powerful, he cannot be perſuaded that electricity is the principal agent, though ſome might be generated, or diſengaged, during the operation of the apparatus.

This is exactly our own opinion, which is ſtrongly corroborated by the reſults of ſome very curious experiments made by Mr Cruickſhank of Woolwich. Theſe experiments our limits permit us not to detail. They were made with a view to aſcertain the nature and relative proportions of the gaſes obtained from water and other fluids by this influence; and the author thinks himſelf authoriſed to conclude from them:

1. That hydrogen gas, mixed with a very ſmall proportion of oxygen and ammonia, is ſomehow diſengaged at the wire connected with the ſilver extremity of the machine; and that this effect is equally produced, whatever the nature of the metallic wire may be, provided the fluid operated upon be pure water.

2. That where metallic ſolutions are employed inſtead of water, the ſame wire which ſeparates the hydrogen revives the metallic calx, and depoſits it at the extremity of the wire in its pure metallic ſtate; in this caſe no hydrogen gas is diſengaged. The wire employed for this purpoſe may be of any metal.

3. That of the earthy ſolutions, thoſe of magneſia and argil only are decompoſed by the ſilver wire; a circumſtance which ſtrongly favours the production of ammonia.

4. That when the wire connected with the zinc extremity of the pile conſiſts either of gold or platinum, a quantity of oxygen gas, mixed with a little azote and nitrous acid, is diſengaged; and the quantity of gas thus obtained is a little better than $\frac{1}{3}$d of the hydrogen gas ſeparated by the ſilver wire at the ſame time.

5. That when the wire connected with the zinc is ſilver, or any of the imperfect metals, a ſmall portion of oxygenous gas is likewiſe given out; but the wire itſelf is either oxydated or diſſolved, or partly oxydated and partly diſſolved: indeed, the effect in this caſe produced upon the metal is very ſimilar to that of the concentrated nitrous acid, where a great deal of the metal is oxydated, and but a ſmall quantity held in ſolution.

6. That when the gaſes obtained by gold or platinum wires are collected together and exploded over mercury, the whole nearly diſappears and forms water, with probably a little nitrous acid; for there was always a thick white vapour perceived for ſome time after the exploſion. The reſiduary gas, in this caſe, appeared to be azote.

In reflecting on theſe experiments, it would appear that in ſome of them the water muſt be decompoſed: but how this can be effected is by no means ſo eaſily explained. For example, it ſeems extremely myſterious how the oxygen ſhould paſs ſilently from the extremity of the ſilver wire to that of the zinc wire, and there make its appearance in the form of gas. It is to be obſerved, likewiſe, that this effect takes place which ever way the wires are placed, and whatever bends may be interpoſed between their extremities, provided the diſtance be not too great. On conſidering theſe facts more minutely, it appeared to Mr Cruickſhank that the eaſieſt and ſimpleſt mode of explanation would be, to ſuppoſe that the galvanic influence (whatever it may be) is capable of exiſting in two ſtates, that is, in an oxygenated and deoxygenated ſtate; that when it paſſes from metals to fluids containing oxygen, it ſeizes their oxygen, and becomes oxygenated; but when it paſſes from the fluid to the metal again, it aſſumes its former ſtate, and becomes deoxygenated. Now when water is the fluid interpoſed, and the influence enters it from the ſilver ſide deoxygenated (and we ſuppoſe that it always paſſes from the deoxygenated to the oxygenated ſide), it ſeizes the oxygen of the water, and diſengages the hydrogen, which accordingly appears in the form of gas; but when the influence enters the zinc wire, it parts with the oxygen, with which it had formerly united; and this either eſcapes in the form of gas, unites with the metal to form an oxyd, or, combined with a certain portion of water, &c. may, according to the German chemiſts, form nitrous acid. When a metallic ſolution is the interpoſed fluid, the effect produced may be explained in two ways; but the ſimpleſt is to ſuppoſe that the influence, in paſſing from the ſilver wire, ſeizes the oxygen of the metallic calx, and afterwards depoſits it on entering the zinc one. In this caſe no gas ſhould appear at the ſilver wire; but when a perfect metal is employed, oxygen ſhould be diſengaged from the zinc wire: and this, as has been already mentioned, is exactly what takes place.

What our author conſiders as the ſtrongeſt argument in favour of this hypotheſis, and what we conſider as an argument equally ſtrong to prove that galvaniſm differs eſſentially from electricity, is, that all fluids which do not contain oxygen, are incapable of tranſmitting the galvanic fluid, ſuch as alcohol, æther, the fat, and eſſential oils, as he has proved by direct experiment; but on the contrary, that all thoſe which do contain oxygen conduct it more or leſs readily, as all aqueous fluids, metallic ſolutions, and acids, more eſpecially the concentrated ſulphuric acid; which it decompoſes. In this laſt inſtance, the oxygen produced can hardly be aſcribed to the decompoſition of water; for this acid, when properly concentrated, does not contain any ſenſible quantity. By this theory alſo we can readily explain the oxydation of the zinc plates in the machine; where the fluid in paſſing from the different pairs of plates appears to be alternately oxygenated and deoxygenated. Although I am not (ſays Mr Cruickſhank) by any means entirely ſatisfied with this hypotheſis, yet as it is the only one by which I can explain the different phenomena, it was thought adviſable to throw it out, merely with a view to induce others to reaſon upon the ſubject, and to incite them to make experiments, by which alone truth can be aſcertained.

We approve heartily of his conduct. It is for the ſame reaſon, and not to maintain at all hazards any preconceived opinion of our own, that we have urged every objection that occurs to us againſt the hypotheſis of the identity of galvaniſm and electricity. Theſe fluids or influences appear to us to differ eſſentially; but ſtill we admit that future experiments and future reaſonings *may remove* our objections, which, however, ought never to be loſt ſight of *till* they be removed. If ingenious men, adopting implicitly the hypotheſis of Volta and Mr Nicholſon, ſhall inſtitute a ſet of experiments to aſcertain the laws of the galvanic influence, they will be very apt to make their experiments ſupport their hypotheſis, inſtead of employing them as guides to the temple of truth. Mr Nicholſon ſays, that in all the experiments made by him and Mr Carliſle, the action of the inſtrument was freely tranſmitted through the uſual conductors of electricity (meaning, we ſuppoſe, metals and watery fluids), but that it was ſtopped by glaſs and other non-conductors. We have experienced the ſame thing, and ſo far we acknowledge a ſtriking reſemblance between galvaniſm and electricity; but, on the other hand, we have never been able to make any accumulation of galvaniſm by means of coated electrics, whilſt Mr Cruickſhank found that the galvanic influence cannot be tranſmitted through alcohol, ether, or eſſential oils. In theſe inſtances, the difference between galvaniſm and electricity ſeems to be as ſtriking as the reſemblance is in the others. Indeed theſe differences between the one and the other are ſo many and ſo great, that M. Fabbroni attributes the phenomena of galvaniſm not to electricity, but to a chemical operation; to the tranſition of oxygen into a combination, and to the formation of a new compound. He had obſerved, in repeating the common experiment, that if he wiped his tongue as accurately as poſſible, the ſenſation of taſte excited by the two metals was ſo diminiſhed as to be hardly diſtinguiſhed. The ſaliva, or ſome other moiſture, muſt therefore be of ſome importance in this phenomenon. He afterwards inſtituted a ſet of very proper experiments; from which it appeared to him that an evident chemical action takes place in the operations of galvaniſm, and that it is unneceſſary to ſeek farther for the nature of the new ſtimulus. Galvaniſm (he ſays) is manifeſtly a combuſtion or oxydation of the metals; and the ſtimulating principle may be either the caloric which is diſengaged, or the oxygen which paſſes into new combinations; or the new metallic ſalt; but which of theſe he has not aſcertained.

Without adopting or rejecting theſe concluſions, we recommend them to the attention of our chemical readers; for it is only by expert and ſcientific chemiſts that we expect the nature and properties of galvaniſm to be aſcertained. In the mean time it is proper to obſerve, that the pile of Volta continues in order for about three days, and ſcarcely three; and that on account of the corroſion of the fæces of the zinc, it is neceſſary to renew them previous to each conſtruction of the pile. This may be done by ſcraping or grinding, or by cleaning them with diluted muriatic acid.

To avoid the trouble of conſtantly repiling the pieces of ſilver and zinc, Mr Cruickſhank conſtructed a kind of trough of baked wood, 26 inches in length, 1.7 inches deep, and 1.5 inches wide; in the ſides of this trough grooves were made oppoſite to each other about the tenth of an inch in depth, and ſufficiently wide to admit one of the plates of zinc and ſilver when ſoldered together; three of theſe grooves were made in the ſpace of one inch and three tenths, ſo that the whole machine contained 60 pair of plates. A plate of zinc and ſilver, each 1 6 inches ſquare, well cemented together, were introduced into each of theſe grooves or notches, and afterwards cemented into the trough by a compoſition of roſin and wax, ſo perfectly that no water could paſs from one cell to the other, nor between the plates of zinc and ſilver. This circumſtance muſt be ſtrictly attended to, elſe the machine will be extremely imperfect. When all the plates were thus ſecured in the trough, the interſtices or cells formed by the different pairs of plates were filled with a ſolution of the muriat of ammonia, which here ſupplied the place of the moiſtened papers in the pile, but anſwered the purpoſe much better. It is hardly neceſſary to obſerve, that in fixing the zinc and ſilver plates, they muſt be placed regularly, as in the pile, *viz.* alternately zinc and ſilver, the ſilver plate being always on the ſame ſide. When a communication was made between the firſt and laſt cell, a ſtrong ſhock was felt in the arms, but ſomewhat different from that given by the pile, being quicker, leſs tremulous, and bearing a greater reſemblance to the common electrical ſhock. He conſtructed two of theſe machines, which contained in all 100 pair of plates; theſe when joined together gave a very ſtrong ſhock, and the ſpark could be taken in the day time at pleaſure; but what ſurpriſed him not a little, was the very ſlender power which they poſſeſſed in decompoſing water: in this reſpect they were certainly inferior to a pile of 30 pair, although ſuch a pile would not give a ſhock of one third the ſtrength.

This apparatus retained its power for many days, and would in all probability have retained it much longer, had not the fluid got between the dry ſurfaces of the metals. To remedy this defect, he ſoldered the zinc and ſilver plates together, and found that this method anſwers very well. The zinc plates may be cleaned at any time, by filling the different cells for a few minutes with the dilute muriatic acid. Although this apparatus may not entirely ſuperſede the pile, eſpecially if it ſhould be found to decompoſe water, &c. but ſlowly, yet in other reſpects it will no doubt be found very convenient and portable.

If this article be thought long, and if we appear to have loſt ſight of our original ſubject, the *Torpedo,* we have only to plead in excuſe for our conduct, that whilſt we could not avoid pointing out the reſemblance between the ſhock given by the torpedo and that by Volta's apparatus, we felt it a kind of duty to embrace the only opportunity that we ſhall have of laying before our readers the additional information reſpecting the phenomena of GALVANISM which we have received ed ſince the publication of that article. Theſe phenomena are yet new, and they are unqueſtionably important; indeed ſo very important, that to us it appears neither impoſſible, nor even improbable, that to the galvanic agency of metals and minerals may be attributed volcanoes and earthquakes.

TORRINGTON, or *Bedford's Bay*, on the ſouthern coaſt of Nova-Scotia, and its entrance is at America Point, about 3 miles N. of the town of Halifax. It has from 10 to 13 fathoms at its mouth, but the bay is almoſt circular, and has from 14 to 50 fathoms water in it. A prodigious ſea ſets into it in winter.—*Morse.*

Torrington, a townſhip of Connecticut, in Litchfield county, 8 miles N. of Litchfield.—*ib.*

TORTOISES, *the River of*, lies 10 miles above a lake 20 miles long, and 8 or 10 broad, which is formed by the Miſſiſſippi in Louiſiana and Florida. It is a large fine river, which runs into the country a good way to the N. E. and is navigable 40 miles by the largeſt boats.—*ib.*

TORTUE, an iſland on the N. ſide of the iſland of St Domingo, towards the N. W. part, about 9 leagues long from E. to W. and 2 broad. The W. end is nearly 6 leagues from the head of the bay of Mouſtique. The freebooters and buccaniers drove the Spaniards from this iſland in 1632; in 1638, the Spaniards maſſacred all the French colony; and in 1639, the buccaniers retook Tortue. In 1676, the French took poſſeſſion of it again.—*ib.*

TORTUGAS, *Dry*, ſhoals to the weſtward, a little ſoutherly from Cape Florida, or the S. Point of Florida, in North-America. They are 134 leagues from the bar of Penſacola, and in lat. 24 32 N. and long. 83 40 W. They conſiſt of 10 ſmall iſlands or keys, and extend E. N. E. and W. S. W. 10 or 11 miles; moſt of them are covered with buſhes, and may be ſeen at the diſtance of four leagues. The ſouth-weſt key, one of the ſmalleſt, but the moſt material to be known, is in lat. 24 32 N. and long. 83 40 W. From the S. W. part of this key, a reef of coral rocks extends about a quarter of a mile; the water upon it is viſibly diſcoloured.—*ib.*

Tortugas Harbour, *Turtle's Harbour*, or *Barracco de Tortugas*, on the coaſt of Brazil, in S. America, is 60 leagues at E. S. E. from the point or cape of Arbraſec, or Des Arbres Sec, and the ſhore is flat all the way from the gulf of Maranhao.—*ib.*

Tortugas, an iſland ſo named from the great number of turtle found near it, is near the N. W. part of the iſland of St Domingo.—*ib.*

Tortugas, or *Sal Tortuga*, is near the W. end of New-Andaluſia and Terra Firma. It is uninhabited, although about 30 miles in circumference, and abounding with ſalt. N. lat. 11 36, W. long. 65. It is 14 leagues to the weſt of Margaritta Iſland, and 17 or 18 from Cape Blanco on the main. There are many iſlands of this name on the north coaſt of South-America.—*ib.*

Tortugas *Point*, on the coaſt of Chili, and in the South Pacific Ocean, is the ſouth point of the port of Coquimbo, and 7 or 8 leagues from the Pajaros Iſlands. Tortugas road is round the point of the ſame name, where ſhips may ride in from 6 to 10 fathoms, over a bottom of black ſand, near a rock called the Tortugas. The road is well ſheltered, but will not contain above 20 or 30 ſhips ſafely. Ships not more than 200 tons burden may careen on the Tortugas rock.—*ib.*

TOSQUIATOSSY *Creek*, a north head water of Alleghany river, whoſe mouth is eaſt of Squeaughta Creek, and 17 miles north-weſterly of the *Ichua Town*.—*ib.*

TOTOWA, a place or village at the Great Falls in Paſſaik river, New-Jerſey.—*ib.*

TOTTERY, a river which empties through the ſouth-eaſtern bank of the Ohio, and is navigable with batteaux to the Occaſioto Mountains. It is a long river, and has few branches, and interlocks with Red Creek, or Clinche's river, a branch of the Tenneſſee. It has below the mountains, eſpecially for 15 miles from its mouth, very good land.—*ib.*

TOUCAN, or American Goose, is one of the modern conſtellations of the ſouthern hemiſphere, conſiſting of nine ſmall ſtars.

TOULON, a townſhip of New-York, in Ontario county. In 1796, 93 of the inhabitants were electors.—*Morse.*

TOWERHILL, a village in the townſhip of South-Kingſtown, Rhode-Iſland, where a poſt-office is kept. It is 10 miles weſt of Newport, and 282 from Philadelphia.—*ib.*

TOWNSHEND, a townſhip of Windham county, Vermont, weſt of Weſtminſter and Putney, containing 676 inhabitants.—*ib.*

Townshend, a townſhip of Middleſex county, Maſſachuſetts, containing 993 inhabitants. It was incorporated in 1732, and lies 45 miles northward of Boſton.—*ib.*

Townshend, a harbour on the coaſt of the Diſtrict of Maine, where is a bold harbour, having 9 fathoms water, ſheltered from all winds. High water, at full and change, 45 minutes after 10 o'clock.—*ib.*

TRACADUCHE, now *Carleton*, a ſettlement on the northern ſide of Chaleur Bay, about 5 leagues from the great river Caſquipibiac, in a ſouth-weſt direction. It is a place of conſiderable trade in cod-fiſh, &c.—*ib.*

TRACTORS, Metallic. See Perkinism in this *Suppl.*

TRACTRIX, in geometry, a curve line, called alſo Catenaria; which ſee, *Encycl.* and Arch. *Suppl.*

TRADESCANT (John), an ingenious naturaliſt and antiquary, was, according to Anthony Wood, a Fleming or a Dutchman. We are informed by Parkinſon, that he had travelled into moſt parts of Europe, and into Barbary; and from ſome emblems remaining upon his monument in Lambeth church-yard, it plainly appears that he had viſited Greece, Egypt, and other eaſtern countries. In his travels, he is ſuppoſed to have collected, not only plants and ſeeds, but moſt of thoſe curioſities of every ſort which, after his death, were ſold by his ſon to the famous Elias Aſhmole, and depoſited in his muſeum at Oxford. When he firſt ſettled in England cannot, at this diſtance of time, be aſcertained. Perhaps it was at the latter end of the reign of Queen Elizabeth, or the beginning of that of King James I. His print, engraven by Hollar before the year 1656, which repreſents him as a perſon very far advanced in years, ſeems to countenance this opinion. He lived in a great a great houſe at South Lambeth, where his muſeum was frequently viſited by perſons of rank, who became benefactors thereto: among theſe were King Charles I. (to whom he was gardener), Henrietta Maria his Queen, Archbiſhop Laud, George Duke of Buckingham, Robert and William Cecil, Earls of Saliſbury, and many other perſons of diſtinction. John Tradeſcant may therefore be juſtly conſidered as the earlieſt collector (in England) of every thing that was curious in natural hiſtory, viz. minerals, birds, fiſhes, inſects, &c. He had alſo a good collection of coins and medals of all ſorts, beſides a great variety of uncommon rarities. A catalogue of theſe, publiſhed by his ſon, contains an enumeration of the many plants, ſhrubs, trees, &c. growing in his garden, which was pretty extenſive. Some of theſe plants are, if not totally extinct, at leaſt become very uncommon, even at this time: though this able man, by his great induſtry, made it manifeſt, in the very infancy of botany, that there is ſcarce any plant extant in the known world that will not, with proper care, thrive in England.

When his houſe at South Lambeth, then called *Tradeſcant's Ark*, came into Aſhmole's poſſeſſion, he added a noble room to it, and adorned the chimney with his arms, impaling thoſe of Sir William Dugdale, whoſe daughter was his third wife; where they remain to this day.

It were much to be wiſhed, that the lovers of botany had viſited this once famous garden before, or at leaſt in the beginning of the preſent century. But this ſeems to have been totally neglected till the year 1749, when Dr Watſon and the late Dr Mitchell favoured the Royal Society with the only account now extant of the remains of Tradeſcant's garden.

When the death of John Tradeſcant happened is not known; no mention being made thereof in the regiſter-book of Lambeth church.

TRAJECTORY, a term often uſed, generally for the path of any body, moving either in a void, or in a medium that reſiſts its motion; or even for any curve paſſing through a given number of points. Thus Newton, Princip. lib. 1. prop. 22. propoſes to deſcribe a trajectory that ſhall paſs through five given points.

TRAITOR's ISLAND, one of the Archipelago called *NAVIGATOR's Iſlands*, in the South Sea (See that article, *Suppl.*). It is low and flat, with only a hill of ſome height in the middle; and is divided into two parts by a channel, of which the mouth is about 150 toiſes wide. It abounds with bannanas, yams, and the fineſt cocoa-nuts, which Perouſe ſays he ever ſaw. About twenty canoes approached the French ſhips without dread, traded with a good deal of honeſty, and never refuſed, like the natives of the archipelago of Navigators, to give their fruit before they were paid for it; nor, like them, did they give a preference to beads over nails and pieces of iron. They ſpoke, however, the ſame language, and had the ſame ferocious look; their dreſs, their manner of tatowing, and the form of their canoes, were the ſame; nor could we (ſays the author) doubt that they were one and the ſame people: they differed, indeed, in having univerſally two joints cut off from the little finger of the left hand; whereas, in the iſlands of Navigators, I only perceived two individuals who had ſuffered that operation. They were alſo of much lower ſtature, and far leſs gigantic make; a difference proceeding, no doubt, from the ſoil of theſe iſlands, which being leſs fertile, is conſequently leſs favourable to the expanſion of the human frame.

TRAMMELS, in mechanics, an inſtrument uſed by artificers for drawing ovals upon boards, &c. One part of it conſiſts of a croſs with two grooves at right angles; the other is a beam carrying two pins, which ſlide in thoſe grooves, and alſo the deſcribing pencil. All the engines for turning ovals are conſtructed on the ſame principles with the trammels: the only difference is, that in the trammels the board is at reſt, and the pencil moves upon it; in the turning engine, the tool, which ſupplies the place of the pencil, is at reſt, and the board moves againſt it. See a demonſtration of the chief properties of theſe inſtruments by Mr Ludlam, in the *Phil. Tranſ.* vol. lxx. p. 378, &c.

TRANQUILLITY, a place in Suſſex county, New-Jerſey, 8 miles ſoutherly of Newtown.—*Morſe.*

TRANSFORMATION, in geometry, is the changing or reducing of a figure, or of a body, into another of the ſame area, or the ſame ſolidity, but of a different form. As, to tranſform or reduce a triangle to a ſquare, or a pyramid to a parallelopipedon.

TRANSFORMATION of Equations, in algebra, is the changing equations into others of a different form, but of equal value. This operation is often neceſſary, to prepare equations for a more eaſy ſolution.

TRANSLATION, in literature, is a matter of ſo much importance, that no other apology can be made for the very imperfect manner in which it is treated in the *Encyclopædia*, than a candid declaration that it was impoſſible to enter at all upon the ſubject within the narrow limits to which we were then reſtricted by the proprietors of the work. The fundamental laws of tranſlation, which we gave from Dr Campbell of Aberdeen, we believe indeed to be unexceptionable; but the queſtion is, how are theſe laws to be obeyed?

In order that a tranſlator may be enabled to give a complete tranſcript of the ideas of the original work, it is almoſt needleſs to obſerve, that he muſt poſſeſs a perfect knowledge of both languages, *viz.* that of his author, and that into which he is to tranſlate; and that he muſt have a competent acquaintance with the ſubject of which his author treats. Theſe propoſitions we conſider as ſelf evident; but if any of our readers ſhall be of a different opinion, we refer them to an *Eſſay on the Principles of Tranſlation*, publiſhed 1797 by Cadell and Davies, London, where they will find our doctrine very clearly illuſtrated. It may be proper to add, that ſuch a knowledge of the Greek and Latin languages as merely enables a man to read them with eaſe and entertainment to himſelf, is by no means ſufficient to qualify him for tranſlating every Greek and Latin book, even though it treats of a ſubject with which he has a general acquaintance. The religious rites and ceremonies of the Greeks and Romans, as well as the radical words of their language, were derived from the Eaſt; and he who is an abſolute ſtranger to oriental literature, will be very liable to miſtake occaſionally the ſenſe of Greek and Roman authors who treat of religious ſubjects. We could illuſtrate the truth of this poſition by quotations from ſome of the moſt admired modern tranſlations of the Greek Scriptures, which we have no heſitation to ſay fall very ſhort of the authoriſed verſion in accuracy as well as in elegance. The divines employed by King

James to tranſlate the Old and New Teſtaments were profoundly ſkilled in the learning, as well as in the languages of the Eaſt; whilſt ſome of thoſe who have preſumed to improve their verſion ſeem not to have poſſeſſed a critical knowledge of the Greek tongue, to have known ſtill leſs of the Hebrew, and to have been abſolute ſtrangers to the dialect ſpoken in Judea in the days of our Saviour, as well as to the manners, cuſtoms, and peculiar opinions of the Jews ſects. Neither metaphyſical acuteneſs, nor the moſt perfect knowledge of the principles of tranſlation in general, will enable a man who is ignorant of theſe things to improve the authoriſed verſion either of the Goſpels or the Epiſtles; for ſuch a man knows not accurately, and therefore cannot give a complete tranſcript of the ideas of the original work.

But ſuppoſing the tranſlator completely qualified with reſpect to knowledge, it becomes a queſtion, whether he may, in any caſe, add to or retrench the ideas of his author? We are ſtrongly inclined to think, that, in no caſe, it is allowable to take ſuch liberties; but the ingenious and elegant eſſayiſt, whoſe work on the principles of tranſlation we muſt always quote with reſpect, is of a different opinion. "To give a general anſwer (ſays he) to this queſtion, I would ſay, that this liberty may be uſed, but with the greateſt caution. It muſt be further obſerved, that the ſuperadded idea ſhall have the moſt neceſſary connection with the original thought, and actually increaſe its force. And, on the other hand, that whenever an idea is cut off by the tranſlator it muſt be only ſuch as is an acceſſory, and not a principle, in the clauſe or ſentence. It muſt likewiſe be confeſſedly redundant, ſo that its retrenchment ſhall not impair or weaken the original thought. Under theſe limitations, a tranſlator may exerciſe his judgment, and aſſume to himſelf, in ſo far, the character of an original writer."

Of the judicious uſe, as he thinks it, of this liberty, the author quotes many examples, of which we ſhall ſelect three, as well calculated to illuſtrate our own ideas of the ſubject.

In the firſt book of the Iliad, Achilles, having reſolved, though indignantly, to give up Briſeis, deſires Petroclus to deliver her to the heralds of Agamemnon:

> Ὡς φατο· Πατροκλος δε φιλω επεπειθεθ’ ἑταιρω·
> Εκ δ’ αγαγε κλισιης Βρισηιδα καλλιπαρηον,
> Δωκε δ’ αγειν· τω δ’ αυτις ιτην παρα νηας Αχαιων·
> Ἡ δ’ ακεους’ ἁμα τοισι γυνη κιεν· *Ilias*, A. 345.

> Patroclus now th' unwilling beauty brought;
> She in ſoft ſorrows, and in penſive thought,
> Paſt ſilent, as the heralds held her hand,
> And oft look'd back, ſlow moving o'er the ſtrand.
> Pope.

Our author thinks, and we heartily agree with him, that the amplification in the three laſt lines of this verſion highly improves the effect of the picture; but we cannot conſider this amplification as a new idea ſuperadded. It was the object of Homer to inform his countrymen, that Briſeis went with the heralds *unwillingly*. This he does by the words ἡ δ’ ακεουσ’ ἁμα τοισι γυνη κιεν· and it is by no means improbable, that the rhythmical movement of the verſe may have preſented to the ancient Greeks the image of the lady, walking ſlowly and reluctantly along. This image, we are ſure, is not produced by a literal tranſlation of the Greek words into Engliſh; and therefore it was Pope's duty, not to add to the ideas of the original, but, by amplification, to preſent to his own countrymen the picture which Homer, by the ſuperiority of the Greek language and rythm, had preſented to his.

In the ninth book of the Iliad, where Phœnix reminds Achilles of the care he had taken of him while an infant, one circumſtance, extremely mean, and even diſguſting, is found in the original:

> ——— ὁτε δη σ’ επ’ εμοισιν εγω γουνασσι καθισσα;
> Οψου τ’ ασαιμι προταμων, και οινον επισχων·
> Πολλακι μοι κατεδευσας επι στηθεσσι χιτωνα,
> Οινου αποβλυζων εν νηπιεη αλεγεινη.

The literal verſion of theſe lines is indeed very groſs: "When I placed you before my knees, I crammed you with meat, and gave you wine, which you often vomited upon my boſom, and ſtained my clothes, in your troubleſome infancy:" but we cannot agree with our author, that the Engliſh reader is obliged to Pope for having altogether ſunk this nauſeous image. What is, or ought to be, our object in reading Homer? If it be merely to delight our ear with ſonorous lines, and pleaſe our fancy with grand or ſplendid images, the tranſlator certainly did right in keeping out of view this diſguſting picture of ſavage life; but when he did ſo, he cannot be ſaid to have given a complete tranſcript of his author's ideas. To pleaſe ourſelves, however, with ſplendid images, is not our only object when ſtudying the works of the ancient poets. Another, and in our opinion a more important object, is to acquire a lively notion of ancient manners; and if ſo, Pope groſsly miſleads the mere Engliſh reader, when, inſtead of the beaſtly image of Homer, he preſents him with the following ſcene, which he may daily meet with in his own family, or in the families of his friends:

> Thy infant breaſt a like affection ſhow'd,
> Still in my arms, an ever pleaſing load;
> Or at my knee, by Phœnix would'ſt thou ſtand,
> No food was grateful but from Phœnix hand:
> I paſs my watchings o'er thy helpleſs years,
> The tender labours, the compliant cares.

This is a picture of the domeſtic manners of Great Britain in the 18th century, and not of Greece in the heroic ages.

In the beginning of the eighth book of the Iliad, Homer puts into the mouth of Jove a very ſtrange ſpeech, ſtuffed with braggart vaunting and ludicrous images. This, as our author obſerves, is far beneath the dignity of the thunderer; but it is only beneath the dignity of the thunderer as our habits and modes of thinking compel *us* to conceive ſuch a being. The thunderer of the Greeks was a notorious adulterer and ſodomite, whoſe moral character ſinks beneath that of the meaneſt of our bravos; and as he had dethroned his father, and waged for ſome time a doubtful war with certain *earthly* giants, it does not appear to us that the boaſting ſpeech which Homer puts into his mouth is at all unſuitable to his acknowledged attributes. But whether it be or not, was not the tranſlator's concern. Homer, when he compoſed it, certainly thought it not unworthy of the thunderer; and whatever Pope's opinion might be, he had

had no right to ſubſtitute his own notions of propriety for thoſe of his author. The mythological tales of the poets, and more eſpecially of Homer and Heſiod, conſtituted, as every one knows, the religious creed of the vulgar Greeks (ſee POLYTHEISM, n° 33. *Encycl.*); and this circumſtance makes it doubly the duty of a tranſlator to give, on ſuch ſubjects, a fair tranſcript of his author's ideas, that the mere Engliſh reader, for whom he writes, may know what the ancients really thought of the objects of their idolatrous worſhip. This Pope has not done in the ſpeech under conſideration; and has therefore, in our opinion, deviated widely from the firſt and moſt important of the three general laws of tranſlation. Johnſon has apologized, we think ſufficiently, for many of Pope's embelliſhments of his author; but he has not attempted to make an apology for ſuch embelliſhments as alter the ſenſe. We cannot indeed conceive a pretence upon which it can ever be allowable in a tranſlator to add to the ideas of his author, to retrench, or to vary them. If he be tranſlating hiſtory, and find his author advancing what he *believes* to be falſe, he may correct him in a note; but he has no right to make one man utter, as his own, the belief or the ſentiments of another, when that belief, and thoſe ſentiments, are *not* his own. If he be tranſlating a work of ſcience, he may likewiſe correct the errors of his author in notes, as Dr Clerke corrected thoſe of Rohault; but no man has a right to give to a Rohault the ſcience of a Newton. The tranſlator of a poem may certainly employ amplification to place in a ſtriking light the images or the ſentiments of the original work; but he muſt not alter thoſe images or ſentiments ſo as to make that appear grand or elegant in the verſion, which is mean or diſguſting in the original. On every occaſion on which he takes ſuch liberties as theſe, he ceaſes to be a tranſlator, and becomes a faithleſs paraphraſt.

The ſecond general law of tranſlation, though certainly leſs important, is perhaps more difficult to be obſerved than the firſt. We have ſtated it in theſe words: (See TRANSLATION, *Encycl.*) "The ſtyle and manner of the original ſhould be preſerved in the tranſlation;" but it is obvious that this cannot be done by him who poſſeſſes not ſufficient taſte and judgment to aſcertain with preciſion to what claſs the ſtyle of the original belongs. "If a tranſlator fail in this diſcernment, and want this capacity, let him be ever ſo thoroughly maſter of the ſenſe of his author, he will preſent him through a diſtorting medium, or exhibit him in a garb that is unſuitable to his character." It would obviouſly be very improper to tranſlate the elegantly ſimple language of Cæſar into rounded periods like thoſe of *The Rambler*, or the Orations of Cicero into the language of Swift.

The chief characteriſtic of the hiſtorical ſtyle of the ſacred Scriptures is its ſimplicity; and that ſimplicity is, for the moſt part, well preſerved in the authoriſed verſion. It is, however, loſt in many of the modern verſions. Caſtalio's, for inſtance, though intitled to the praiſe of elegant latinity, and though, in general, faithful to the ſenſe of the original, yet exhibits numberleſs tranſgreſſions of the law which is now under conſideration. Its ſentences are formed in long and intricate periods, in which many ſeparate members are artfully combined; and we obſerve a conſtant endeavour at claſſical phraſeology and ornamented diction, inſtead of the beautiful ſimplicity of the original.

The verſion of the Scriptures by Arias Montanus is, in ſome reſpects, a contraſt to that of Caſtalio. By adopting the literal mode of tranſlation, Arias undoubtedly intended to give as faithful a picture as he could, both of the ſenſe and of the manner of the original. Not attending to the peculiar idioms of the Hebrew, Greek, and Latin tongues, which, in ſome reſpects, are very different from each other, he has, by giving to his Latin the combination and idioms of the two firſt of theſe languages, ſometimes made the ſacred writers talk abſurdly. In Latin, as every ſchool-boy knows, two negatives make an affirmative, whilſt in Greek they add force to the negation. *Χωρις εμου ου δυνασθε ουδεν* ſignifies, "Without me ye can do nothing," or, "Ye cannot *poſſibly* do any thing;" but Arias has tranſlated the words *ſine me non poteſtis facere nihil, i. e.* "without me ye cannot do nothing," or, "ye *muſt* do ſomething," which is directly contrary to the meaning of our Lord. It is not therefore by tranſlating literally or verbally that we can hope to preſerve the ſtyle and manner of the original.

To expreſs in florid or elevated language the ideas of an author who writes himſelf in a ſimple ſtyle, is not to give in the verſion a juſt picture of the original; but to attempt, for the ſake of verbal accuracy, to introduce into one language the peculiar idioms or conſtruction of another, is ſtill worſe, as in this mode of tranſlation the ſenſe, as well as the manner of the original, is loſt. The rule obviouſly is to uſe, in the verſion, the words and phraſeology which we have reaſon to believe that the author would himſelf have uſed, had he been maſter of the language into which we are tranſlating his ideas. Thus if we are to tranſlate into Engliſh a piece of elegantly ſimple Greek or Latin, we muſt make ourſelves completely maſter of the author's meaning, and, neglecting the Greek or Latin *idioms*, expreſs that meaning in elegantly ſimple Engliſh. We need not add, that when the language of the original is florid or grand, if that ſtyle be ſuited to the ſubject, the language of the tranſlation ſhould be florid or grand likewiſe; but care muſt always be taken that perſpicuity be not ſacrificed to ambitious ornaments of any kind; for ornaments which obſcure the ſenſe are worſe than uſeleſs.

If theſe reflections be juſt, it is obvious that a poem cannot be properly tranſlated into proſe. The mere ſenſe may doubtleſs be thus transferred from one language into another, as has generally been done by Macpherſon in his hobbling verſion of the Iliad, and perhaps more completely by a late tranſlator of Anacreon; but in ſuch a verſion, the ſtyle and manner of the original muſt neceſſarily be loſt. Of this the following accurate proſe tranſlation of Anacreon's ninth ode (on a dove) is a ſtriking inſtance:

"O lovely Pigeon! whence, whence do you fly? Whence, ſpeeding through the air, do you breathe, and diſtil ſo many perfumes? Who is your maſter? For it concerns me to know. 'Anacreon ſent me to a youth, —to Bathyllus, at preſent the prince, and diſpoſing of all things. Venus ſold me, receiving a little hymn in return. And I ſerve Anacreon in ſuch tranſactions as theſe: and now I carry his letters, ſuch as you ſee: and he affirms that he will immediately make me free.

But I will remain a ſervant with him although he may diſmiſs me: For wherefore does it behove me to fly, both over mountains, and fields, and to perch on trees, devouring ſome ruſtic food? Now indeed I eat bread, ſnatching it from the hands of Anacreon himſelf; and he gives to me the wine to drink which he drinks before me; and having drunk, I perhaps may dance, and cover my maſter with my wings; then going to reſt, I ſleep upon the lute itſelf. You have it all;—begone: you have made me more talkative, O mortal! than even a jay*."

How inferior is the general effect of this piece of proſe to that of the well-known poetical verſions of Addiſon and Johnſon? and yet the mere *ideas* of the original are perhaps more faithfully tranſcribed by this anonymous writer than by either of thoſe elegant tranſlators. The emotions indeed excited by the original are not here brought into view.

The third general law of tranſlation is ſo nearly allied to the ſecond, that we have very few directions to give for the obſervation of it. He who, in his verſion, preſerves the ſtyle and manner of the original, as we have endeavoured to ſhew that they *ought* to be preſerved, will, of courſe, give to the tranſlation the eaſe of original compoſition. The principal difficulty that he has to encounter in this part of his taſk, will occur in the tranſlating of idiomatical and proverbial phraſes. Hardly any two languages are conſtructed preciſely in the ſame way; and when the ſtructure of the Engliſh language is compared with that of the Greek and Latin, a remarkable difference between the ancient and modern tongues is found to pervade the whole. This muſt occaſion very conſiderable difficulty; but it is a difficulty which will be removed by a due obſervance of the former law, which directs the tranſlator to make his author ſpeak Engliſh in ſuch a ſtyle to Engliſhmen as he ſpoke his own tongue to his own countrymen, and of courſe to uſe the Engliſh idiom with Engliſh words. But what is to be done with thoſe proverbial phraſes of which every language has a large collection, and which allude to local cuſtoms and manners?

The ingenious author of the Eſſay ſo often quoted, very properly obſerves, in anſwer to this queſtion, that the tranſlation is perfect when the tranſlator employs, in his own language, an idiomatic phraſe correſponding to that of the original. "It is not (ſays he) poſſible perhaps to produce a happier inſtance of tranſlation by correſponding idioms, than Sterne has given* in the tranſlation of Slaukenbergius's tale. *Nihil me penitet hujus naſi*, quoth Pamphagus; that is, "My noſe has been the making of me." *Nec eſt cur pœniteat;* that is, "How the deuce ſhould ſuch a noſe fail?" *Miles peregrini in faciem ſuſpexit!* "The centinel looked into the ſtranger's face. Never ſaw ſuch a noſe in his life!"

"As there is nothing (continues our author) which ſo much conduces both to the eaſe and ſpirit of compotion as a happy uſe of idiomatic phraſes, there is nothing which a tranſlator, who has a moderate command of his own language, is ſo apt to carry to an extreme." Of this he gives many ſtriking examples from Echard's tranſlation of Terence and Plautus, for which we muſt refer the reader to the Eſſay itſelf. He obſerves, likewiſe, that in the uſe of idiomatic phraſes, a tranſlator frequently forgets both the country of his original author, and the age in which he wrote; and while he makes a Greek or Roman ſpeak French or Engliſh, he unwittingly puts into his mouth alluſions to the manners of modern France or England. This, to uſe a phraſe borrowed from painting, may be termed an offence againſt the *coſtume*. The proverbial expreſſion βατραχω ὑδωρ, in Theocritus, is of ſimilar import with the Engliſh proverb, *to carry coals to Newcaſtle;* and the Scotch, *to drive ſalt to Dyſart;* but it would be a groſs impropriety to uſe either of theſe expreſſions in the tranſlation of an ancient claſſic. Of ſuch improprieties our author points out many inſtances both in French and Engliſh tranſlations of the claſſics; and he might have increaſed the number by quotations from Blackwell's Memoirs of the Court of Auguſtus, where, inſtead of Roman ſenators and their wives, we meet with modern gentlemen and ladies, with *ſecretaries at war, paymaſters, commiſſary generals*, and *lord high admirals*. It is true the memoirs of the court of Auguſtus is no tranſlation; but with reſpect to coſtume, it is neceſſarily ſubject to the laws of tranſlation.

Offences againſt coſtume are often committed by the uſe of improper words as well as of improper phraſes. To introduce into dignified and ſolemn compoſition words aſſociated with mean and ludicrous ſubjects, is equally a fault in an original author and in a tranſlator; and it is obviouſly improper, in the tranſlation of works of very high antiquity, to make uſe of words which have but lately been admitted into the language of the tranſlator. Faults of this kind are very frequent in Dr Geddes's tranſlation of the Bible, as when the *paſſover* is called the *ſkipover;* the tabernacle of the congregation, the *convention-tent;* and a burnt-offering, a *holocauſt*. The firſt of theſe expreſſions preſents to the imagination an image profanely ludicrous; the ſecond, brings into our view the French Convention, which, we ſuſpect, occupied no ſmall portion of the Doctor's thoughts, when they ſhould have been wholly employed on the ſacred text; and the word *holocauſt*, which muſt be unintelligible to the mere Engliſh reader, is, in the mind of every man of letters, cloſely aſſociated with the abominable rites performed at the ſacrifices of the ancient heathens. But it is needleſs to point out faults of this kind in a work which is open to more ſerious objections, and which, we truſt, ſhall never be generally read. We are ſorry that truth compels us to ſay, that the novel expreſſions introduced by Dr Campbell into his verſion of the goſpels—ſuch as *confluence* for multitude, and *reign* for kingdom—are, to ſay the beſt of them, no improvements of the authoriſed verſion. We will not rank them with Dr Geddes's innovations, becauſe we will not claſs the great author of the *Diſſertation on Miracles* with a paradoxical Chriſtian of no communion; but we do not think that Dr Campbell's laurels were freſhened on his brow by the tranſlation of the Goſpels.

We ſhall conclude this article with the following reflections, taken from the Eſſay which has been ſo often quoted:

"If the order in which we have claſſed the three general laws of tranſlation be their juſt and natural arrangement, which, we preſume, will hardly be denied, it follows, that, in every caſe where it is necſſary to make a ſacrifice of one of theſe laws to another, a due regard ought to be paid to their rank and comparative importance. When the genius of the original language differs much from that of the tranſlation, it is often neceſſary

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ceſſary to depart from the author's manner in order to convey a faithful picture of his ſenſe; but it would be highly prepoſterous to depart, in any caſe, from the ſenſe, for the ſake of imitating the manner. Equally improper would it be, to ſacrifice either the ſenſe or manner of the original, if theſe can be preſerved conſiſtently with purity of expreſſion, to a fancied eaſe or ſuperior gracefulneſs of compoſition; and it is certain that the ſenſe may always be preſerved, though to purity of expreſſion the manner of the original muſt ſometimes be ſacrificed."

TRAP, a village in Talbot county, Maryland; about 6 miles S. E. of Oxford.—*Morse.*

Trap, *The*, a village of Pennſylvania, in Montgomery county, having about a dozen houſes, and a German Lutheran and Calviniſt church united. It is 9 miles from Morriſtown, 11 from Pottſgrove, and 26 from Philadelphia.—*ib.*

Trap, a village of Maryland, in Somerſet county, ſituated at the head of Wicomico Creek, a branch of the river Wicomico, 7 miles ſouth-weſt of Saliſbury, and 6 north of Princeſs Ann.—*ib.*

TRAPEZOID, ſometimes denotes a trapezium that has two of its ſides parallel to each other; and ſometimes an irregular ſolid figure, having four ſides not parallel to each other.

TRAPTOWN, a village of Maryland, in Frederick county, ſituated on Cotoctin Creek, between the South and Cotoctin Mountains, and 7 miles ſouth-weſterly of Fredericktown.—*Morse.*

TRAVERSE, in gunnery, is the turning a piece of ordnance about, as upon a centre, to make it point in any particular direction.

Traverse, in fortification, denotes a trench with a little parapet, ſometimes two, one on each ſide, to ſerve as a cover from the enemy that might come in flank.

Traverse, in a wet foſs, is a ſort of gallery, made by throwing ſauciſſons, joiſts, faſcines, ſtones, earth, &c. into the foſs, oppoſite the place where the miner is to be put, in order to fill up the ditch, and make a paſſage over it.

Traverse alſo denotes a wall of earth, or ſtone, raiſed acroſs a work, to ſtop the ſhot from rolling along it.

Traverse alſo ſometimes ſignifies any retrenchment, or line fortified with faſcines, barrels, or bags of earth, or gabions.

Traverse *Bay, Great,* lies on the N. E. corner of Lake Michigan. It has a narrow entrance, and ſets up into the land ſouth-eaſtward, and receives Traverſe river from the E.—*Morse.*

TRAVESTY, or burleſque tranſlation, is a ſpecies of writing which, as it partakes, in a great degree, of original compoſition, is not to be meaſured by the laws of ſerious tranſlation. It conveys neither a juſt picture of the ſentiments, nor a faithful repreſentation of the ſtyle and manner of the original; but pleaſes itſelf in exhibiting a ludicrous caricatura of both. It diſplays an overcharged and groteſque reſemblance, and excites our riſible emotions by the incongruous aſſociation of dignity and meanneſs, wiſdom and abſurdity. This aſſociation forms equally the baſis of traveſty and of ludicrous parody, from which it is no otherwiſe diſtinguiſhed than by its aſſuming a different language from the original. In order that the mimickry may be underſtood, it is neceſſary that the writer chooſe, for the exerciſe of his talents, a work that is well known, and of great reputation. Whether that reputation is deſerved or unjuſt, the work may be equally the ſubject of burleſque imitation. If it has been the ſubject of general, but undeſerved praiſe, a parody or a traveſty is then a fair ſatire on the falſe taſte of the original author and his admirers, and we are pleaſed to ſee both become the objects of a juſt caſtigation. The *Rehearſal, Tom Thumb,* and *Crononhotonthologos,* which exhibit ludicrous parodies of paſſages from the favourite dramatic writers of the times, convey a great deal of juſt and uſeful criticiſm. If the original is a work of real excellence, the traveſty or parody detracts nothing from its merit, nor robs the author of the ſmalleſt portion of his juſt praiſe. We laugh at the aſſociation of dignity and meanneſs; but the former remains the excluſive property of the original, the latter belongs ſolely to the copy. We give due praiſe to the mimical powers of the imitator, and are delighted to ſee how ingeniouſly he can elicit ſubjects of mirth and ridicule from what is grave, dignified, pathetic, or ſublime.

But this ſpecies of compoſition pleaſes only in a ſhort ſpecimen. We cannot bear a lengthened work in traveſty. The incongruous aſſociation of dignity and meanneſs excites riſibility chiefly from its being unexpected. Cotton's and Scarron's Virgil entertain but for a few pages: the compoſition ſoon becomes tedious, and at length diſguſting. We laugh at a ſhort exhibition of buffoonery; but we cannot endure a man who, with good talents, is conſtantly playing the fool.

TREACLE (ſee *Encycl.*) or Melasses, is a ſubſtance very wholeſome, but of a taſte diſagreeably ſweet. Methods have accordingly been propoſed for purifying it, ſo that it may, on many occaſions, ſupply the place of refined ſugar, which has long been at a price which a great number of poor perſons cannot afford to pay for what muſt now be conſidered as a neceſſary of life. The following is the proceſs for purifying treacle, given by the M. Cadet (Devaux) in the *Feuille du Cultivateur,* founded upon experiments made by Mr Lowitz of Peterſburgh:

Take of treacle 24 lbs. of water 24 lbs. of charcoal, thoroughly burnt, 6 lbs. Bruiſe the charcoal groſsly, mix the three ſubſtances in a caldron, and let the mixture boil gently upon a clear wood fire. After it has boiled for half an hour, pour the liquor through a ſtraining-bag, and then replace it upon the fire, that the ſuperfluous water may be evaporated, and that the treacle may be brought to its original conſiſtence. There is little or no loſs by this operation, as 24 lbs. of treacle give nearly the ſame quantity of ſyrup.

This proceſs has been repeated in the large way, and has ſucceeded: the treacle is ſenſibly ameliorated, ſo that it may be uſed for many diſhes; nevertheleſs, thoſe with milk, and the fine or aromatic *liqueurs,* are not near ſo good as with ſugar.

TREADHAVEN *Creek,* a ſmall branch of Choptank river.—*Morse.*

TREASURY *Iſlands,* form a part of Mr Shortland's *New-Georgia,* (Surville's Archipelago of the Arſacides) lying from 6 38 to 7 30 S. lat. and from 155 34 to 156 E. long. from Greenwich.—*ib.*

TREBISOND, a large, populous, and ſtrong town of Turkey in Aſia, in the province of Jenich, with a Greek archbiſhop's ſee, a harbour, and a caſtle. It is ſeated

ſeated at the foot of a very ſteep hill. The walls are ſquare and high, with battlements; and are built with the ruins of ancient ſtructures, on which are inſcriptions not legible. The town is not populous; for there are more woods and gardens in it than houſes, and theſe but one ſtory high. The caſtle is ſeated on a flat rock, with ditches cut therein. The harbour is at the eaſt end of the town, and the mole built by the Genoeſe is almoſt deſtroyed. It ſtands on the Black Sea, 104 miles north-weſt of Erzerum, and 440 eaſt of Conſtantinople. E. Lon. 40° 25′ N. lat. 40° 45′.

TREE. Under this title (*Encycl.*) we gave an account of the method recommended by Meſſrs Forſyth and Hitt for curing injuries and defects in trees. The actual cautery is employed in Cevennes, and in the department de l'Allier in France, for ſtopping the progreſs of rottenneſs in large trees. When they perceive that this very common and deſtructive diſeaſe begins to make ſome progreſs in the cheſnut tree, by excavating its trunk, they collect heath, and other combuſtible vegetables, and burn them in the very cavity, till the ſurface is completely converted into a coal. It ſeldom happens that the tree periſhes by the effect of this operation, and it is always found that this remedy ſuſpends the progreſs of the decay. It is practiſed in the ſame manner, and with ſimilar ſucceſs, on the white oak. When we compare the effects of the actual cautery on the animal ſyſtem, in ſimilar diſeaſes, a new reſemblance is ſeen between the diſeaſes which affect the organic beings of both kingdoms, as well as between the remedies by which they may be oppoſed.—*Nicholſon's Journal.*

TRENCHE MONT *River*, a ſmall river of the iſland of St John's, in the Gulf of St Lawrence. It empties into the ſea 3 or 4 leagues to the weſtward of the eaſtern extremity of the iſland.—*Morſe.*

TRECOTHIC, a townſhip in Grafton county, New-Hampſhire, incorporated in 1769.—*ib.*

TRENT, a ſmall river of N. Carolina, which falls into Neus river, at Newbern. It is navigable for ſea veſſels, 12 miles above the town, and for boats 20.—*ib.*

TRENTON, is one of the largeſt towns in New-Jerſey, and the metropolis of the ſtate, ſituated in Hunterdon county, on the E. ſide of Delaware river, oppoſite the falls, and nearly in the centre of the ſtate from N. to S. The river is not navigable above theſe falls, except for boats which will carry from 500 to 700 buſhels of wheat. This town, with Lamberton, which joins it on the ſouth, contains between 200 and 300 houſes, and about 2,000 inhabitants. Here the legiſlature ſtatedly meets, the ſupreme court ſits, and moſt of the public offices are kept. The inhabitants have lately erected a handſome court-houſe, 100 feet by 30, with a ſemi-hexagon at each end, over which is a baluſtrade. Here are alſo a church for Epiſcopalians, one for Preſbyterians, one for Methodiſts, and a Quaker meeting-houſe. In the neighbourhood of this pleaſant town, are a great many gentlemen's ſeats, finely ſituated on the banks of the Delaware, and ornamented with taſte and elegance. Here is a flouriſhing academy. It is 12 miles S. W. of Princeton, 30 from Brunſwick, and 30 N. E. of Philadelphia. N. lat. 40 15, W. long. 74 15.—*ib.*

TRENTON, a ſmall poſt-town of the Diſtrict of Maine, Hancock county, 12 miles W. by S. of Sullivan, 31 N. E. by E. of Penobſcot, 286 N. E. of Boſton, and 633 N. E. of Philadelphia. This town is near Deſert Iſland; and in a part of it called *The Narrows* were about 40 families in 1796.—*ib.*

TRENTON, the chief town of Jones' county, N. Carolina, ſituated on the S. ſide of Trent river. It contains but few houſes, beſides the court-houſe and gaol. It is 521 miles from Philadelphia.—*ib.*

TREPASSI *Bay*, or *Treſpaſſes Bay*, and *Harbour*, on the ſouth ſide of Newfoundland Iſland, near the S. E. part, and about 21 miles to the N. weſtward of Cape Race, the S. E. point of the iſland. The harbour is large, well ſecured, and the ground good to anchor in.—*ib.*

TRIANGLE, ARITHMETICAL, a kind of numeral triangle, or triangle of numbers, being a table of certain numbers diſpoſed in form of a triangle. It was ſo called by Paſcal; but he was not the inventor of this table, as ſome writers have imagined, its properties having been treated of by other authors ſome centuries before him, as is ſhewn in Dr Hutton's Mathematical Tracts, vol. i. p. 69. &c.

The form of the triangle is as follows:

1					
1	1				
1	2	1			
1	3	3	1		
1	4	6	4	1	
1	5	10	10	5	1
1	6	15	20	&c.	
1	7	21	&c.		
1	8	&c.			
1	9				

And it is conſtructed by adding always the laſt two numbers of the next two preceding columns together, to give the next ſucceeding column of numbers.

The firſt vertical column conſiſts of units; the ſecond, a ſeries of the natural numbers 1, 2, 3, 4, 5, &c.; the third, a ſeries of triangular numbers 1, 3, 6, 10, &c.; the fourth, a ſeries of pyramidal numbers, &c. The oblique diagonal rows, deſcending from left to right, are alſo the ſame as the vertical columns. And the numbers taken on the horizontal lines are the co-efficients of the different powers of a binomial. Many other properties and uſes of theſe numbers have been delivered by various authors, as may be ſeen in the Introduction to Hutton's Mathematical Tables, pages 7, 8, 75, 76, 77, 89, ſecond edition.

TRIANGLE *Iſland*, a ſmall iſland, one of the Bahamas. N. lat. 20 51, W. long. 69 53.—*Morſe.*

TRIANGLE *Shoals*, lie to the weſtward of the peninſula of Yucatan, near the E. ſhore of the Bay of Campeachy, nearly W. of Cape Condecedo. N. lat. 17 5, W. long. 111 59.—*ib.*

TRIANGULAR COMPASSES, are ſuch as have three legs or feet, by which any triangle or three points, may be taken off at once. Theſe are very uſeful in the conſtruction of maps, globes, &c.

Triangular Numbers, are a kind of polygonal numbers; being the ſums of arithmetical progreſſions, which have 1 for the common difference of their terms.

Thus, from theſe arithmeticals 1 2 3 4 5 6, are formed the triangular numbers 1 3 6 10 15 21, or the third column of the arithmetical triangle abovementioned.

The ſum of any number *n* of the terms of the triangular numbers, 1, 3, 6, 10, &c. is =

$$\frac{n^3}{6} + \frac{n^2}{2} + \frac{n}{3}, \text{ or } \frac{n}{1} \times \frac{n+1}{2} \times \frac{n+2}{3}$$

which is alſo equal to the number of ſhot in a triangular pile of balls, the number of rows, or the number in each ſide of the baſe, being *n*.

The ſum of the reciprocals of the triangular ſeries, infinitely continued, is equal to 2; viz.

$$1 + \tfrac{1}{3} + \tfrac{1}{6} + \tfrac{1}{10} + \tfrac{1}{15}, \text{ \&c.} = 2.$$

For the rationale and management of theſe numbers, ſee *Malcolm's Arith.* book 5. ch. 2.; and *Simpſon's Algeb.* ſec. 15.

TRIESTE, a ſmall, but ſtrong and ancient ſeaport of Italy, in Iſtria, on the gulph of Venice, with a biſhop's ſee. It is beautifully ſituated on the ſide of a hill, about which the vineyards form a ſemicircle. The ſtreets are narrow; but there is a large ſquare, where they keep the annual fair. The harbour is ſpacious, but not good; becauſe it is open to the W. and S. W. winds. The inhabitants have a good trade in ſalt, oil, almonds, iron, &c. brought from Laubach; and they make good wines. The cathedral, and the late Jeſuits church, are the two beſt buildings. It belongs to the Houſe of Auſtria, and is eight miles north of Capo d'Iſtria, and 80 north-eaſt of Venice. E. Long. 14 4. N. Lat. 45. 56.

Trieste *Bay*, on the coaſt of Terra Firma, is nearly due ſouth from Bonair Iſland, one of the Little Antilles, to the eaſt of Curaſſou Iſland.—*Morse.*

Trieste *Iſland*, a ſmall iſland at the bottom of the Gulf of Campeachy, weſtward of Port-Royal Iſland, about 3 leagues from E. to W. The creek which ſeparates it from Port-Royal Iſland is ſcarcely broad enough to admit a canoe. Good freſh water will be got by digging 5 or 6 feet deep in the ſalt ſand; at a leſs depth it is brackiſh and ſalt, and at a greater depth than 6 feet it is ſalt again.—*ib.*

TRINIDAD, a ſmall iſland in the S. Atlantic Ocean, due E off Spiritu Santo, in Brazil. S. lat. 20 30, W. long. 41 20. It is alſo called Trinity.—*ib.*

Trinadad, or *Trinidada Iſland*, near the coaſt of Terra Firma, at the north part of S. America. It partly forms the Gulf of Paria, or Bocca del Drago, and is much larger than any other upon the coaſt. It is 36 leagues in length, and 18 or 20 in breadth, but the climate is rather unhealthy, and little of it is cleared. The current ſets ſo ſtrong along the coaſt from E. to W. as to render moſt of its bays and harbours uſeleſs. It produces ſugar, fine tobacco, indigo, ginger, a variety of fruit, ſome cotton and Indian corn. It was taken by Sir Walter Raleigh, in 1595, and by the French in 1676, who plundered the iſland, and extorted money from the inhabitants. It was captured by the Britiſh in February, 1797. It is ſituated between 59 and 62 W. long. and in 10 N. lat. The N. E. point lies in lat. 10 28 N. and long. 59 37 W. The chief town is St Joſeph.—*ib.*

Trinidad, La, a town of Mexico, in the province of Guatimala, on the banks of the river Belen, 12 miles from the ſea; but the road is almoſt impaſſable by land. It is 70 miles S. E. of Guatimala, and 24 eaſt of La Conception. N. lat. 13, W. long. 91 40.—*ib.*

Trinidad, La, on the north coaſt of the Iſthmus of Darien, lies eaſtward of Bocca del Toro, and ſome cluſters of ſmall iſlands, and S. W. of Porto Bello and Fort Chagre. N. lat. 8 30, W. long. 81 30.—*ib.*

Trinidad, or *La Sonſonate Port*, a town on a bay of the Pacific Ocean, about 65 miles S. E. of Petapa, and 162 from the town of Guatimala. All the goods that are ſent from Peru and Mexico to Acaxatla, about 12 miles from it, are brought to this port. It is 9 miles from the town to the harbour which is much frequented, and is a place of great trade; being the neareſt landing to Guatimala for ſhips that come from Peru, Panama, and Mexico.—*ib.*

Trinidad, La, one of the ſea-ports on the ſouth part of the iſland of Cuba, in the Weſt-Indies; ſituated N. W. from the weſt end of the groupe of iſlands called Jardin de la Reyna. N. lat. 21 40, W. long. 80 50.—*ib.*

Trinidad, La, an open town of Veragua, and audience of Mexico, in N. America.—*ib.*

Trinidad *Channel*, has the iſland of Tobago on the N. W. and that of Trinidad on the ſouth.—*ib.*

Trinidad, or *Trinity*, a town of New-Granada, and Terra Firma, in S. America, about 23 miles N. E. of St Fe.—*ib.*

TRINITARIANS (Order of), was inſtituted at Rome in the year 1198, under the pontificate of Innocent III. the founders whereof were John de Matha and Felix de Valois. His Holineſs gave them permiſſion to eſtabliſh this order for the deliverance of captives, who groaned under the tyranny of the infidels: he gave them as a habit a white gown, ornamented with a red and blue croſs. After the death of the two founders, Pope Honorious III. continued the order; and their rule was approved by his ſucceſſor Clement IV. in 1367. At firſt they were not permitted to eat fleſh; and when they travelled, were to ride only upon aſſes. But their rule was corrected and mitigated by the biſhop of Paris, and the abbots of St Victor and St Genevieve, who allowed them to eat any kind of food, and to uſe horſes. This order poſſeſſed, at one time, about 250 convents in 13 different provinces: ſix of which were in France; namely, France, Normandy, Picardy, Champaine, Languedoc, and Provence; three in Spain, viz. New Caſtile, Old Caſtile, and Arragon; one in Italy, and one in Portugal. There was formerly the province of England, where this order had 43 houſes; that of Scotland, where it had nine; and that of Ireland, where it had 52; beſides a great number of monaſteries in Saxony, Hungary, Bohemia, and other countries. The convent of Cerfroy in France was head of the order. It is impoſſible for us to ſay what is now the ſtate of the order, which can have no viſible exiſtence in France, and is probably ſuppreſſed even in Italy.

TRINITY *Bay*, on the eaſt ſide of Newfoundland Iſland, between lat. 47 53 30, and 48 37 N.—*Morse.*

Trinity *Port*, a large bay of Martinico Iſland, in the Weſt-Indies, formed on the ſouth-eaſt by Point Caravelle.—*ib.*

Trinity *Iſle* lies near the coaſt of Patagonia, in S. America, eaſtward of York Iſlands. S. lat. 50 37.—*ib.*

Trinity *Iſle*, the north-eaſternmoſt of the ſmall iſlands on the ſouth-eaſt coaſt of the peninſula of Alaſka, on the N. W. coaſt of N. America, N. E. of Foggy Iſlands.—*ib.*

TRIO, a cape on the coaſt of Brazil, S. America.—*ib.*

TRIONES, in aſtronomy, a ſort of conſtellation, or aſſemblage

aſſemblage of ſeven ſtars in the Urſa Major, popularly called *Charles's Wain*.—From the *ſeptem triones* the north pole takes the denomination *ſeptentrio*.

TRIPOLI of Syria is, according to Mr Browne, by no means ſo populous a place as we were led to repreſent it in the *Encyclopædia*. It is indeed, he ſays, a city of ſome extent, ſituated about a mile and a half from the ſea; but inſtead of ſixty, he eſtimates its population at about ſixteen thouſand. The air is rendered unwholeſome by much ſtagnant water. The town is placed on a ſlight elevation, the length conſiderably exceeding the breadth. On the higheſt ground, to the ſouth, is the caſtle, formerly poſſeſſed by the earls of Tripoli; it is large and ſtrong. Hence is viſible a part of mount Libanus, the ſummit of which is covered with ſnow. The gardens in the vicinity are rich in mulberry and other fruit trees. The city is well built, and moſt of the ſtreets are paved.

Here is found a number of Mohammedan merchants, ſome of the richeſt and moſt reſpectable in the empire. Silk is the chief article of commerce.

The *miri*, or fixed public revenue paid by Tripoli to Conſtantinople, is only about L.1000 Sterling, 20 purſes, a-year. Syria at preſent contains only four Paſhaliks, Damaſcus, Aleppo, Acré, and Tripoli; the laſt of which is the ſmalleſt in territory and power. Our author obſerved no antiquities at Tripoli; but the country round it is noted for producing the beſt tobacco in Syria.

TRISECTION, the dividing a thing into three equal parts. The term is chiefly uſed in geometry, for the diviſion of an angle into three equal parts. The *triſection of an angle* geometrically, is one of thoſe great problems, whoſe ſolution has been ſo much ſought for by mathematicians for 2000 years paſt; being, in this reſpect, on a footing with the famous quadrature of the circle, and the duplicature of the cube.

TRISTAN d'Acunha, the largeſt of three iſlands which were viſited by Lord Macartney and his ſuit on the 31ſt of December 1792. The other two are diſtinguiſhed by the names of *Inacceſſible* and *Nightingale* iſlands. "Inacceſſible (as Sir Eraſmus Gower obſerved) ſeems to deſerve that name, being a high, bluff, as well as apparently barren plain, about nine miles in circumference, and has a very forbidding appearance. There is a high rock detached from it at the ſouth end. Its latitude is 37° 19′ ſouth; its longitude 11° 50′ weſt from Greenwich. This rude looking ſpot may be ſeen at 12 or 14 leagues diſtance. Nightingale iſland is irregular in its form, with a hollow in the middle, and is about ſeven or eight miles in circumference, with ſmall rocky iſles at its ſouthern extremity. It is deſcribed as having anchorage on the north-eaſt ſide. Its latitude is 37° 29′ ſouth; and longitude 11° 48′ weſt from Greenwich. It may be ſeen at ſeven or eight leagues diſtance. The largeſt of theſe three iſlands, which comparatively may be called the great iſle of *Triſtan d'Acunha*, is very high, and may be ſeen at 25 leagues diſtance. It ſeems not to exceed in circumference 15 miles. A part of the iſland towards the north riſes perpendicularly from the ſea to a height apparently of a thouſand feet or more. A level then commences, forming what among ſeamen is termed *table land*, and extending towards the centre of the iſland; from whence a conical mountain riſes, not unlike in appearance to the Peak of Teneriffe, as ſeen from the bay of Santa Cruz. Boats were ſent to ſound and to examine the ſhore for a convenient place to land and water. In conſequence of their report, the Lion (a ſhip of 64 guns) ſtood in, and came to anchor in the evening on the north ſide, in 30 fathoms water, one mile from the ſhore; the bottom black ſand with ſlime; a ſmall rock, off the weſt point, bearing ſouth-weſt by ſouth, juſt open with the weſtern extremity of the iſland; a caſcade, or fall of water, emptying itſelf upon the beach, ſouth by eaſt. All the ſhore, from the ſouthern point to the eaſtern extremity, appears to be clear of danger, and ſteep, except the weſt point, where there are breakers about two cables length, or near 500 yards from the ſhore. The ſhip, when anchored, was overſhadowed by the dark maſs of that portion of the iſland whoſe ſides ſeemed to riſe, like a moſs-grown wall, immediately from the ocean. On the right the elevation was leſs rapid, and between the riſing part and the ſea was left a flat, of ſome extent, covered with ſedge-graſs, interſperſed with ſmall ſhrubs, which, being perfectly green, looked from the ſhip like a pleaſant meadow, watered by a ſtream that fell, afterwards, from its banks upon the beach. The officers, who went aſhore, reported, that the caſks might be filled with freſh water by means of a long hoſe, without moving them from the boats. The landing place thereabouts was alſo deſcribed as being ſafe, and ſuperior to any other that had been examined. From the plain, the land roſe gradually towards the central mountain, in ridges covered with trees of a moderate ſize and height. The coaſt abounded with ſea lions and ſeals, penguins and albatroſſes. One of the latter was brought on board, his wings meaſuring ten feet from tip to tip; but others are ſaid to have been found much larger. The coaſt was covered with a broad ſea-weed, ſeveral fathoms long, and deſervedly by naturaliſts termed *gigantic fucus*. Some good fiſh was caught with the hook and line.

"The accident of a ſudden guſt, by which the anchor was in a few hours driven from its hold, and the ſhip forced out to ſea, prevented the iſland from being explored, as was intended. It is probable that had the Lion anchored in 20, inſtead of 30 fathoms water, the anchor would have held firmly. Some advantage was obtained, however, from coming to this place. The juſt poſition of thoſe iſlands, in reſpect to their longitude, was aſcertained, by the mean of ſeveral time-pieces, to be about two degrees to the eaſtward of the place where they are laid down in charts, taken from obſervations made at a period when the inſtruments for this purpoſe were leſs accurate than at preſent. The ſpot where the Lion anchored was determined, by good meridional obſervations, and by accurate time pieces, to be 37° 6′ ſouth latitude, and 11° 43′ weſt longitude from Greenwich. The compaſs had ſeven degrees of variation weſtward from the pole. Fahrenheit's thermometer ſtood at 67 degrees. It was uſeful alſo to have aſcertained, that a ſafe anchorage, and plenty of good water, were to be found here. Theſe iſlands are certainly worthy of a more particular inquiry; for they are not 50 leagues from the general track of veſſels bound to China, and to the coaſt of Coromandel, by the outer paſſage. In war time, an excellent rendezvous might be ſettled there, for ſhips that wanted no other ſupply but that of water. When circumſtances require particular diſpatch, it is practicable to come from England to Triſtan d'Acunha without ſtopping in the way, and afterwards to the end of the voyage to India or China."

Theſe iſlands are ſeparated by a ſpace of about fifteen hundred miles from any land to the weſtward or northward of them. They are ſituated in that part of the ſouthern hemiſphere, in the neighbourhood of which a continent, to balance the quantity of land in the northern hemiſphere, was once expected to be found, but where it has been ſince diſcovered that there is none. Of what extent, however, the baſes of theſe iſlands are under the ſurface of the ſea, cannot be aſcertained; or whether they may, or may not, be ſufficient to make up for the defect of land appearing above water. Navigators report, that to the eaſtward of them are other ſmall iſlands, differing not much in latitude, ſuch as Gough and Alvarez iſlands, and the Marſonines; as well as extenſive ſhoals, lying due ſouth of the moſt ſoutherly point of Africa, and extending eaſterly ſeveral degrees. That all theſe together form a chain, ſome of ſubaqueous, and ſome of ſuperaqueous mountains, but all connected by their roots, is perhaps a conjecture leſs improbable, than that they ſhould ſeparately ariſe, like tall columns, from the vaſt abyſs.

A ſettlement in Triſtan d'Acunha is known to have been twice in the contemplation of adventurers, but not as yet to have been carried into execution. One had the project of rendering it a mart for the change of the light manufactures of Hindoſtan, ſuited to hot climes, for the ſilver of the Spaniſh ſettlements in South America; in the route between which places it is conveniently ſituated. The other plan meant is only as a ſuitable ſpot for drying and preparing the furs of ſea lions and ſeals, and for extracting the ſpermaceti of the white or long noſed whale, and the whale bone and oil of the black ſpecies. Whales of every kind were ſeen ſporting about Triſtan d'Acunha, particularly near the ſetting of the ſun; and the ſword fiſh likewiſe made its appearance occaſionally.—*Sir George Staunton's Account of the Embaſſy to China.*

TRISTO, a bay on the north coaſt of S. America, is W. S. W. of the river Turiano. It has good anchorage and is well ſheltered from the ſwell of the ſea. —*Morse.*

TRITON, in zoology, a genus belonging to the order of vermes molluſca. The body is oblong; the tongue is ſpiral; it has twelve tentacula, ſix on each ſide, the hindmoſt ones having claws like a crab. There is but one ſpecies, found in holes of rocks about the ſhore.

TRIVIGILLO *Bay*, in the Gulf of Honduras, or ſouth ſhore of the Gulf of Mexico, is within the Iſland of Pines. Dulce river lies a little to the weſt.—*Morse.*

TROCADIE, a ſmall iſland on the N. coaſt of the Iſland of St John's, lying off the mouth of Shimene Port, and in the Gulf of St Lawrence.—*ib.*

TROIS *Rivieres*, a bay at the eaſt end of the abovementioned Iſland of St John's, and weſt of Cape Breton Iſland. Three ſtreams fall into it from different directions; hence its name. N. lat. 46 5, W. long. 62 15 —*ib.*

Trois *Rivieres*, or the *Three Rivers*, or *Treble River*, a town of Lower Canada, ſettled by the French in 1610; and is ſo called from the junction of three waters a little below the town where they fall into the river St Lawrence. The town ſtands on the northern bank of the St Lawrence, at that part of the river called Lake St Pierre. It is but thinly inhabited; is commodiouſly ſituated for the fur trade, and was formerly the ſeat of the French government, and the grand mart to which the natives reſorted. It is pleaſantly ſituated in a fertile country, about 50 miles ſouth-weſt of Quebec. The inhabitants are moſtly rich, and have elegant, well furniſhed houſes, and the country round wears a fine appearance. N. lat. 46 51, W. long. 75 15.—*ib.*

TROMPEAUR, *Cape, del Enganna*, or *Falſe Cape*, is the eaſternmoſt point, of the iſland of St Domingo. N. lat. 18 25, W. long. from Paris 71.—*ib.*

TROPIC *Keys*, are ſmall iſlands or rocks, on the north of Crab Iſland, and off the eaſt coaſt of Porto Rico Iſland. A number of tropic birds breed here, which are a ſpecies never ſeen but between the tropics. —*ib.*

TROQUOES, a bay at the ſouthern extremity of the eaſtern part of Lake Huron, ſeparated from Matchudoch Bay on the N. E. by a broad promontory.—*ib.*

TROQUQUA, an iſland on the north coaſt of S. America, in the mouth of a ſmall bay near Cape Seco, a ſhort way S. E. from the eaſt point of the bay or river Taratura.—*ib.*

TROTTER (Mrs Catharine), was the daughter of Captain David Trotter, a Scotch gentleman. He was a commander in the royal navy in the reign of Charles II. and at his death left two daughters, the youngeſt of whom, Catharine, our celebrated author, was born in London, Auguſt 1679. She gave early marks of her genius; and learned to write, and alſo made herſelf miſtreſs of the French language, by her own application and diligence, without any inſtructor; but ſhe had ſome aſſiſtance in the ſtudy of the Latin grammar and logic, of which latter ſhe drew up an abſtract for her own uſe. The moſt ſerious and important ſubjects, and eſpecially religion, ſoon engaged her attention.—But notwithſtanding her education, her intimacy with ſeveral families of diſtinction of the Romiſh perſuaſion, expoſed her, while very young, to impreſſions in favour of that church; which not being removed by her conferences with ſome eminent and learned members of the church of England, ſhe embraced the Romiſh communion, in which ſhe continued till the year 1707. In 1695, ſhe produced a tragedy called *Agnes de Caſtro*, which was acted at the theatre-royal when ſhe was only in her 17th year. The reputation of this performance, and the verſes which ſhe addreſſed to Mr Congreve upon his Mourning Bride, in 1697, were probably the foundation of her acquaintance with that celebrated writer. Her ſecond tragedy, *Fatal Friendſhip*, was acted in 1698, at the new theatre in Lincoln's-Inn-Fields. This tragedy met with great applauſe, and is ſtill thought the moſt perfect of her dramatic performances. Her dramatic talents not being confined to tragedy, ſhe brought upon the ſtage, in 1701, a comedy called *Love at a loſs*, or *Moſt votes carry it*. In the ſame year ſhe gave the public her third tragedy, entitled the *Unhappy Penitent*, acted at the theatre-royal in Drury-lane. But poetry and dramatic writing did not ſo far engroſs the thoughts of our author but that ſhe ſometimes turned them to ſubjects of a very different nature; and diſtinguiſhed herſelf in an extraordinary manner in defence of Mr Locke's writings; a female metaphyſician being a remarkable phenomenon in the republic of letters.

She returned to the exerciſe of her dramatic genius in 1703, and fixed upon the revolution of Sweden, under Guſtavus Erickſon, for the ſubject of a tragedy. This tragedy was acted, in 1706, at the Queen's theatre in the Hay-Market. In 1707, her doubts concerning the Romiſh religion, which ſhe had ſo many years profeſſed, having led her to a thorough examination of the grounds of it, by conſulting the beſt books on both ſides of the queſtion, and adviſing with men of the beſt judgment, the reſult was a conviction of the falſeneſs of the pretenſions of that church, and a return to that of England, to which ſhe adhered during the remainder of her life. In 1708, ſhe was married to the Rev. Mr Cockburn, then curate of St Dunſtan's in Fleet-ſtreet, but he afterwards obtained the living of Long-Horſeley, near Morpeth in Northumberland. He was a man of conſiderable abilities; and, among ſeveral other things, wrote an account of the Moſaic Deluge, which was much approved by the learned.

Mrs Cockburn's remarks upon ſome writers in the controverſy concerning the foundation of moral duty and moral obligation, were introduced to the world, in Auguſt 1743, in the Literary Journal, intitled *The Hiſtory of the Works of the Learned*. The ſtrength, clearneſs, and vivacity ſhewn in her remarks upon the moſt abſtract and perplexed queſtions, immediately raiſed the curioſity of all good judges about the concealed writer; and their admiration was greatly increaſed when her ſex and advanced age were known. Dr Rutherforth's Eſſay on the Nature and Obligations of Virtue, publiſhed in May 1744, ſoon engaged her thoughts; and notwithſtanding the aſthmatic diſorder which had ſeized her many years before, and now left her ſmall intervals of eaſe, ſhe applied herſelf to the confutation of that elaborate diſcourſe, and finiſhed it with a ſpirit, elegance, and perſpicuity equal, if not ſuperior, to all her former writings.

The loſs of her huſband in 1748, in the 71ſt year of his age, was a ſevere ſhock to her; and ſhe did not long ſurvive him, dying on the 11th of May 1749, in her 71ſt year, after having long ſupported a painful diſorder with a reſignation to the Divine will, which had been the governing principle of her whole life, and her ſupport under the various trials of it.

Her works are collected into two large volumes 8vo, by Dr Birch; who has prefixed to them an account of her life and writings.

TROU JACOB, on the ſouth ſide of the iſland of St Domingo. From this to Cape Beate, or Cape a Foux, the ſhore is rocky.—*Morse*.

TROU, LE, a ſettlement in the northern part of the French diviſion of the iſland of St Domingo. It is 5$\frac{1}{2}$ leagues E. of Ouanaminthe, and 2 S. E. of Limonade. N. lat. 19 35, W. long. from Paris 74 22.—*ib*.

TROY, a poſt-town of New-York, Ranſſelaer county, 6 miles north of Albany, 3 S. of Lanſingburg city, and 271 from Philadelphia. The townſhip of Troy is bounded E. by Peterſburg, and was taken from Renſſellaerwyck townſhip, and incorporated in 1791. In 1796, 550 of the inhabitants were electors. Seven years ago, the ſcite of the flouriſhing village of Troy was covered with flocks and herds, and the ſpot on which a ſchool, containing 160 ſcholars, is now erected, was then probably a ſheepfold. The ſchool is under the direction of three ſchoolmaſters, and is a very promiſing ſeminary.—*ib*.

Trumpet Marine.

TRUMPET MARINE, or MARIGNY. This is a ſtringed inſtrument, invented in the 16th century by an Italian artiſt Marino or Marigni, and called a *trumpet*, becauſe it takes only the notes of the trumpet, with all its omiſſions and imperfections, and can therefore execute only ſuch melodies as are fitted for that inſtrument. It is a very curious inſtrument, though of ſmall muſical powers, becauſe its mode of performance is totally unlike that of other ſtringed inſtruments; and it deſerves our very particular attention, becauſe it lays open the mechaniſm of muſical ſounds more than any thing we are acquainted with; and we ſhall therefore make uſe of it in order to communicate to our readers a philoſophical theory of muſic, which we have already treated in detail as a liberal or ſcientific art.

Plate XLV.

The trumpet marine is commonly made in the form of a long triangular pyramid, ABCD, fig. A. on which a ſingle ſtring EFG is ſtrained over a bridge F by means of the finger pin L. At the narrow end are ſeveral frets 1, 2, 3, 4, 5, &c. between E and K, which divide the length EF into aliquot parts. Thus E 1 is $\frac{1}{12}$ of EF, E 2 is $\frac{1}{11}$, and ſo on. The bow is drawn lightly acroſs the cord at H, and the ſtring is ſtopped by preſſing it with the finger immediately above the frets, but not ſo hard as to make it touch the fret. When the open ſtring is ſounded, it gives the fundamental note. If it be ſtopped, in the way now deſcribed, at $\frac{1}{3}$d of its length from E, it yields the 12th of the fundamental; if ſtopped at $\frac{1}{4}$th, it gives the double octave; if at $\frac{1}{5}$th, it gives the 17th major, &c. In ſhort, it always gives the note correſponding to the length of the part between the fret and the nut E. The ſounds reſemble thoſe of a pipe, and are indeed the ſame with thoſe known by the name *harmonics*, and now executed by every performer on inſtruments of the viol or violin ſpecies. But in order to increaſe the noiſe, the bridge F is conſtructed in a very particular manner. It does not reſt on the ſound-board of the inſtrument through its whole breadth, but only at the corner *a*, where it is firmly fixed. The other extremity is detached about $\frac{1}{100}$ of an inch from the ſound-board; and thus the bridge being made to tremble by the ſtrong vibration of the thick cord, rattles on the ſound-board, or on a bit of ivory glued to it. The uſual way in which this motion is procured, is to have another ſtring paſſing under the middle of the bridge in ſuch a manner that, by ſtraining it tight, we raiſe the corner *b* from the ſound-board to the proper height. This contrivance increaſes prodigiouſly the noiſe of the inſtrument, and gives it ſomewhat of the ſmart ſound of the trumpet, though very harſh and coarſe. But it merits the attention of every perſon who wiſhes to know any thing of the philoſophy of muſical ſounds, and we ſhall therefore ſay as much on the ſubject as will conduce to this effect.

Galileo, as we have obſerved in the article TEMPERAMENT, *Suppl.* was the firſt who diſcovered the real connection between mathematics and muſic, by demonſtrating that the times of the vibrations of elaſtic cords of the ſame matter and ſize, and ſtretched by equal weights, are proportional to the lengths of the ſtrings. He

He inferred from this that the muſical pitch of the ſound produced by a ſtretched cord depended ſolely on the frequency of the vibrations. Moreover, not being able to diſcover any other circumſtance in which thoſe ſounds phyſically reſembled each other, and reflecting that all ſounds are immediately produced by agitations of air acting on the ear, he concluded that each vibration of the cord produced a ſonorous pulſe in the air, and therefore that the pitch of *any* ſound whatever depended on the frequency of the aerial pulſes. In this way alone the ſound of a ſtring, of a bell, of an organ pipe, and the bellow of a bull, may have the ſame pitch. He could not, however, demonſtrate this in any caſe but the one above mentioned. But he was encouraged to hope that mathematicians would be able to demonſtrate it in all caſes, by his having obſerved that the ſame proportions obtained in organ pipes as in ſtrings ſtretched by equal weights. But it required a great progreſs in mechanical philoſophy, from the ſtate in which Galileo found it, before men could ſpeculate and reaſon concerning the pulſes of air, and diſcover any analogy between them and the vibrations of a ſtring. This analogy, however, was diſcovered, and its demonſtration completed, as we ſhall ſee by and by. In the mean time, Galileo's demonſtration of the vibrations of elaſtic cords became the foundation of all muſical philoſophy. It muſt be thoroughly underſtood before we can explain the performance of the trumpet marine.

The demonſtration of Galileo is remarkable for that beautiful ſimplicity and perſpicuity which diſtinguiſh all the writings of that great mechanician, and it is the elementary propoſition in all mechanical treatiſes of muſic. Few of them indeed contain any thing more; but it is extremely imperfect, and is juſt only on the ſuppoſition that all the matter of the ſtring is collected at its middle point, and that the reſt of it has elaſticity without *inertia*. This did not ſuit the accurate knowledge of the laſt century, after Huyghens and Newton had given the world a taſte of what might be done by proſecuting the Galilean mechanics. When a muſical cord has its middle point drawn aſide, and it is ſtrained into the ſhape of two ſtrait lines, if it be let go, it will be obſerved not to vibrate in this form. It may eaſily be ſeen in the extremity of its excurſions, where it reſts, before it return by its elaſticity. The reaſon is this (ſee fig. B.) When the middle point C of the cord is drawn aſide, and the cord has the form of two ſtraight lines AC, CB, this point C, being pulled in the directions CA, CB, at once, is really accelerated in the direction CD, which biſects the angle ACB; and if it were then detached from the reſt of the material cord, it would move in that direction. But any other point f between C and B has no accelerating force whatever acting on it. It is equally pulled in the directions fC and fB. The particle C therefore is obliged to drag along with it the inert matter of the reſt of the cord; and when it has come to any intermediate ſituation c, the cord cannot have the form of two ſtraight lines Ac, cB, with the particle f ſituated in $'f$. This particle will be left ſomewhat behind, as in e, and the cord will have a curved form A c e B; and in this form it will vibrate, going to the other ſide, and aſſuming, not the rectilineal form ADB, but the curved form A d B. That every particle of the curve A e c $'f$ B is now accelerated toward the axis AB is evident, becauſe every part is curved, and the whole is ſtrained toward A and B, which tends to ſtraighten every part of it. But in order that the whole may arrive at the axis in one moment, and conſtitute a ſtraight line AB, it is evidently neceſſary that the accelerating force on every particle be as the diſtance of the particle from that point of the axis at which it arrives. It is well known to the mathematician that the accelerating force by which any particle is urged towards a rectilineal poſition, with reſpect to the adjoining particles, is proportional to the curvature. Our readers who are not familiar with ſuch diſcuſſions, may ſee the truth of this fundamental propoſition by conſidering the whole of A c B as only a particle or minute portion of a curve, magnified by a microſcope. The force which ſtrains the curve may be repreſented by c A or AE. Now it is well known (and is the foundation of Galileo's demonſtration) that the ſtraining force is to the force with which c is accelerated in the direction c E as A c to c D, or as AE to c D, or as AE to twice c E. Now c E is the meaſure of the curvature of A c B, being its deflection from a right line. Therefore when the ſtraining force is the ſame all over the curve, the accelerating force, by which any portion of it tends to become ſtraight, is proportional to the curvature of that portion. And if r be the radius of a circle paſſing through A, c, and B, and coinciding with this element of a curve, it is plain that $c\mathrm{D} : c\mathrm{A} = c\mathrm{A} : r$, or that the radius of curvature is to the element c A as the extending force to the accelerating force; and $c\mathrm{D} = \frac{c\mathrm{A}^2}{r}$; and is inverſely as r, or directly as the curvature.

Hence we ſee the nature of that curve which a muſical chord muſt have, in order that all its parts may arrive at the axis at once. The curvature at c muſt be to the curvature at f as E c to g f. But this may not be enough. It is farther neceſſary that when c has got half way to E, the curvature in the different points of the new curve into which the cord has now arranged itſelf, be alſo, in every point, proportional to the diſtance from the axis. Now this *will* be the caſe if the extreme curve has been ſuch. For, taking the cord in any other ſucceſſive ſhape, the diſtance which each point has gone in the ſame moment muſt be proportional to the force which impelled it; therefore the remaining diſtances of all the points from the axis will have the ſame proportion as before. And the geometrical and evident conſequence of this is, that the curvatures will alſo be in the ſame proportion.

Therefore a cord that is once arranged in this form will always preſerve it, and will vibrate like a cycloidal pendulum, performing its oſcillations in equal times, whether they be wide or narrow. Therefore ſince this perfect iſochroniſm of vibrations is all that is wanted for preſerving the ſame muſical pitch or tone, this cord will always have the ſame note.

This propoſition was the diſcovery of Dr Brooke Taylor, one of the ornaments of our country*, and is publiſhed in his celebrated work *Methodus Incrementorum*. The inveſtigation, however, and the demonſtration in that work, are ſo obſcure and ſo tedious that few had patience to peruſe them. It was more elegantly treated afterwards by the Bernoullis and others. The curve got the name of the *Taylorean curve*; and is conſidered by many eminent mathematicians as a trochoid,

viz.

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* See life, E

viz. the curve deſcribed by a point in the nave or ſpoke of a wheel while the wheel rolls along a ſtraight line. But this is a miſtake, although it is allied to the trochoid in the ſame manner that the figure of ſines is allied to the cycloid. Its phyſical property intitles it to the name of the HARMONICAL CURVE. As this curve is not only the foundation of all our knowledge of the vibration of elaſtic cords, but alſo furniſhes an equation which will lead the mathematician through the whole labyrinth of aereal undulations, and be of uſe on many other occaſions; and as the firſt mathematicians have, through inattention, or through enmity to Dr Taylor, affected to conſider it as the trochoid already well known to themſelves—we ſhall give a ſhort account of its conſtruction and chief properties, ſimplified from the elegant deſcription given by Dr Smith in his Harmonics.

Let SDTV, QERP (fig. C.), be circles deſcribed round the centre C. Draw the diameters QCR, ECP, cutting each other at right angles. From any point G in the exterior circle draw the radius GC, cutting the interior circle in F, draw KHFI parallel to QCR, and make HI, HK, each equal to the arch EG. Let this be done for every point of the quadrantal arch EGR. The points I, K, are in the harmonic curve; that is, the curve AKDIB paſſing through the points K and I, determined by this conſtruction, has its curvature in every point K proportional to the diſtance KN from the baſe AB.

To demonſtrate this, draw FL perpendicular to the axis, and join EL. Take another point g in the outer circle indefinitely near to G. Draw $g\ c$, cutting the inner circle in f, and $f\ h$ and $f\ l$ perpendicular to DC, CT, and join E l. Then ſuppoſe two lines Km', Km' perpendicular to the curve in K and k. They muſt meet in m', the centre of the equicurve circle. Draw KNn' perpendicular to the baſe, and $m'\ n'$ parallel to it, and join $k\ n$. Laſtly, draw XL x perpendicular to EL.

It is plain that k O, the difference of HK and $h\ k$, is equal to G g, the difference of GE and g E, and that KO is equal to F r, and L l to $r\ f$. Alſo, becauſe ELX is a right angle, $\text{EX} = \frac{\text{EL}^2}{\text{EC}}$.

We have $\text{F}r : \text{F}f = \text{CL} : \text{CF}, = \text{CL} : \text{CD}.$
$\text{F}f : \text{G}g = \text{CD} : \text{CE}.$
Therefore $\text{F}r : \text{G}g$, or $\text{KO} : \text{O}k = \text{CL} : \text{CE}$.

The triangles ECL and kOK are therefore ſimilar, as are alſo kOK and K $n\ m$, and conſequently ECL and K $n\ m$; and becauſe EC is parallel to Kn, EL is parallel to K m. For the ſame reaſon km is parallel to El, and the triangles E $l\ x$ and m K k are ſimilar, and

$\text{L}x : \text{K}k = \text{LE} : \text{K}m,$
and $\text{L}x : \text{K}k = \text{EC} : \text{K}n$. But farther,
$\text{L}x : \text{L}l = \text{CE} : \text{CL}$
$\text{L}l : \text{F}f = \text{KN} : \text{CD}$, being $= \text{FL} : \text{FC}$
$\text{F}f : \text{G}g = \text{CD} : \text{CE}$, being $= \text{F}f : k\text{O}$
$\text{G}g : \text{K}k = \text{CE} : \text{CL}$. being $= \text{KO} : \text{K}k$.
Therefore $\text{L}x : \text{K}k = \text{KN} \times \text{CE} : \text{EL}^2, = \text{KN} : \text{EX}$.
Therefore $\text{KN} : \text{EX} = \text{LE} : \text{K}m$, and $\text{K}m = \frac{\text{EX}\cdot\text{LE}}{\text{KN}}$,
and $\text{KN} : \text{EX} = \text{CE} : \text{K}n$, and $\text{K}n = \frac{\text{EX}\cdot\text{CE}}{\text{KN}}$.

In the very narrow vibrations of muſical cords, CD is exceedingly ſmall in compariſon with CE, ſo that EX·EL, or EX CE, may, without ſenſible error, be taken for CE², and then we obtain Km or Kn (which hardly differ) $= \frac{\text{CE}^2}{\text{KN},}$ and therefore the curvature is proportional to KN. The ſmall deviation from this ratio would ſeem to ſhew that this conſtruction does not give the harmonic curve with accuracy. But it is not ſo. For it will be found that although the curvature is not as KN, it is ſtill proportional to the ſpace which any particle K muſt really deſcribe in order to arrive at the axis. Theſe paths are lines whoſe curvatures diminiſh as they approach to DC.

We ſee 1*ſt*, that the baſe ACB of the curve is equal to the ſemicircular arch QER.

2*d*, Alſo that the tangent KZ in any point K is perpendicular to EL.

3*d*, We learn that the curvature at A and B is nothing, for in theſe two points KN is nothing.

4*th*, The radius of curvature at D is preciſely $= \frac{\text{CE}^2}{\text{CD}}$.

Therefore as the ſtring approaches the axis, and CD diminiſhes, the curvature diminiſhes in the ſame proportion. The vibrations therefore are performed like thoſe of a pendulum in a cycloid, and are iſochronous, whether wide or narrow, and therefore the muſical pitch is conſtant.

This is not ſtrictly true, becauſe in the wide vibrations the extenſion or extending force is ſomewhat greater. Hence it is that a ſtring when violently twanged ſounds a little ſharper at the beginning. Dr Long made a harpſichord whoſe ſtrings were ſtretched by weights, by which this imperfection was removed.

It is proper to exhibit the curvature at D in terms of the length AB, and of the greateſt excurſion c D. Therefore let c be the circumference of a circle whoſe diameter is 1. Let AB the length of the cord be = L, and let CD the ½ breadth of the vibration be B.

We had a little ago $\text{D}m = \frac{\text{CE}^2}{\text{CD}}$, but $c : 1 = \text{AB} : \text{CE}$, and $\text{CE} = \frac{\text{AB}}{c}$, and $c\text{E}^2 = \frac{\text{AB}c}{c^2}$. Therefore $\text{D}m = \frac{\text{AB}^2}{c^2 \times \text{CD}}, = \frac{\text{L}^2}{9{,}87\text{CD}}$ nearly.

We can now tell the number of vibrations made in a ſecond by a ſtring. This we obtain by comparing its motion, when impelled by the accelerating force which acts on it, with its motion when acted on by its weight only. Therefore let L be the length of a ſtring, and W its weight, and let E be the ſtraining weight, or extending force. Let f be the force which accelerates the particle D d of the cord, and w the weight of that particle, while W is the weight of the whole cord. Let z be the ſpace which the particle D d would deſcribe during the time of one vibration by the uniform action of the force f, and let S be the ſpace which it would deſcribe in the ſame time by its weight w alone. Then (DYNAMICS, *Suppl.* n° 103. cor. 6) the time in which f would impel the particle D d along ½ DC, is to the time of one vibration as $1 : c$. And ½ DC is to z as the ſquare of the time of deſcribing ½ DC, is to the ſquare of the time of deſcribing z; that is, $1 : c^2 = \frac{1}{2}\text{DC} : 2z$, and $c^2.\text{DC} = 2\,z$.

Now, by the property of the harmonic curve,

$$\text{AB} : \text{D}m = 2\,z : \text{AB}$$

But

Trumpet Marine.

$$\text{But } \mathrm{D}m : \mathrm{D}d = \mathrm{E} : f$$
$$\text{And } \mathrm{D}d : \mathrm{AB} = w : \mathrm{W}$$
$$\text{Therefore } 2z \cdot \mathrm{E} \cdot w = \mathrm{AB}f \cdot \mathrm{W}$$
$$\text{And } f : w = 2z \times \mathrm{E} : \mathrm{AB} \times \mathrm{W}$$
$$\text{But } w : f = 2\,\mathrm{S} : 2z$$
$$\text{Therefore } 2\,\mathrm{S} \times \mathrm{E} = \mathrm{AB} \times \mathrm{W}$$
$$\text{And } 2\,\mathrm{E} : \mathrm{W} = \mathrm{AB} : \mathrm{S}.$$

That is, a muſical cord, extended by a force E, performs one vibration DCV in the time that a heavy body deſcribes a ſpace S, which is to the length of the cord as its weight is to twice the extending force.

Now let g be the ſpace through which a heavy body falls in one ſecond, and let the time of a vibration (eſtimated in parts of a ſecond) be T. We have

$$\mathrm{AB} : \mathrm{S} = 2\,\mathrm{E} : \mathrm{W}$$
$$\mathrm{S} : g = \mathrm{T}^2 : 1^2$$
$$\text{Therefore } \mathrm{AB} : g = 2\,\mathrm{E} \cdot \mathrm{T}^2 : \mathrm{W}$$
$$\text{And } \mathrm{AB} \times \mathrm{W} = \mathrm{T}^2 \times 2\,\mathrm{E} \times g$$
$$\text{Therefore } \mathrm{T}^2 = \frac{\mathrm{AB} \times \mathrm{W}}{2g.\,\mathrm{E}}, \text{ and } \mathrm{T} = \sqrt{\frac{\mathrm{AB} \times \mathrm{W}.}{2g.\,\mathrm{E}}}$$

Let n be the number of vibrations made in a ſecond.

$$n = \frac{1}{\mathrm{T}}, = \sqrt{\frac{2g.\,\mathrm{E}}{\mathrm{AB.W}}} = \sqrt{\frac{2g\,\mathrm{E}}{\mathrm{L\,W}}}.$$

If the length of the cord be meaſured in feet, $2\,g$ is very nearly 32. If in inches, $2\,g$ is 386, more nearly. Therefore $n = \sqrt{\frac{32\ \mathrm{E}}{\mathrm{L.W}}}$ or $\sqrt{\frac{386\ \mathrm{E}}{\mathrm{L.W}}}$. This may eaſily be compared with obſervation. Dr Smith hung a weight of 7 pounds, or 49,000 grains, on a braſs wire ſuſpended from a finger pin, and ſhortened it till it was in perfect uniſon with the double octave below the open ſtring D of a violin. In this ſtate the wire was 35,55 inches long, and it weighed 31 grains.

Now $\sqrt{\frac{384 \times 49000}{35{,}55 \times 31}} = 130{,}7 = n.$ This wire, therefore, ought to make 130,7 vibrations in a ſecond. Dr Smith proceeded to aſcertain the number of aereal pulſes made by this ſound, availing himſelf of the theory of the beats of tempered conſonances invented by himſelf. On his fine chamber organ he tuned upwards the perfect fifths DA, A *e*, *e b*, and then tuned downward the perfect 6th *e d*. Thus he obtained an octave to D, which was too ſharp by a comma, and he found that it beat 65 times in 20 ſeconds. Therefore the number of vibrations was $\frac{65}{20}81$, or 263,25. Theſe were complete pulſes or motions from D to V and back again, and therefore contained $526\frac{1}{2}$ ſuch vibrations as we have now been conſidering. The double octave below ſhould make $\frac{1}{4}$th of this, or 131,6, which is not a complete vibration more than the above theory requires: more accurate coincidence is needleſs.

This theory is therefore very completely eſtabliſhed, and it may be conſidered as one of the fineſt mechanical problems which has been ſolved in the 18th century. We mention it with the greater minuteneſs, becauſe the merit of Dr Taylor is not ſufficiently attended to. Mr Rameau, and the other great theoriſts in muſic, make no mention of him; and ſuch as have occaſion to ſpeak of the abſolute number of vibrations made by any muſical note, always quote Mr Sauveur of the French academy. This gentleman has written ſome very excellent diſſertations on the theory of muſic, and Sir Iſaac Newton in his *Principia* often quotes his authority. He has given the actual determination of the number of vibrations of the note C, obtained in a manner ſimilar to that practiſed by Dr Smith on his chamber organ, and which agrees extremely well with that meaſure. But Mr Sauveur has alſo given a mechanical inveſtigation of the problem, which gives the ſame number of vibrations that he obſerved. We preſume that Rameau and others took the demonſtration for good: and thus Mr Sauveur paſſes on the continent for the diſcoverer of this theorem. But it was not publiſhed till 1716, though read in 1713; whereas Dr Taylor's demonſtration was read to the Royal Society in May 1714. But this demonſtration of Mr Sauveur is a mere paralogiſm, where errors compenſate errors; and the aſſumption on which he proceeds is quite gratuitous, and has nothing to do with the ſubject. Yet John Bernoulli, from enmity to Taylor and the Engliſh mathematicians, takes not the leaſt notice of this ſophiſticated demonſtration, accommodated to the experiment, and ſo devoid of any pretenſions to argument that this ſevere critic could not but ſee its falſity.

Sauveur was one of the firſt who obſerved diſtinctly that remarkable fact which Mr Rameau made the foundation of his muſical theory, *viz.* that a full muſical note is accompanied by its octave, its twelfth, and its ſeventeenth major. It had been caſually obſerved before, by Merſennus, by Perrault, and others; but Sauveur tells diſtinctly how to make the obſervation, and affirms it to be true in all deep notes. Rameau aſſerts it to be univerſally and neceſſarily true in all notes, and the foundation of all muſical pleaſure.

It had been diſcovered before this time, that not only a full note cauſed its uniſon to reſound, but alſo that a 12th, being ſounded near any open ſtring, the ſtring *reſounded* to this 12th. It does the ſame to a 15th, a 17th major, a 22d, &c.

Dr Wallis added a very curious circumſtance to this obſervation. Two of his pupils, Mr Noble and Mr Pigot, in 1673, amuſing themſelves with theſe reſonances, obſerved, that if a ſmall bit of paper be laid on the ſtring of a violin which is made to reſound to its uniſon, the paper is thrown off: a proof that the ſtring reſounded by really vibrating, and that it is thrown into theſe vibrations by the pulſes of the air produced by the other ſtring. In like manner the paper is thrown off when the ſtring reſounds to its octave. But the young gentlemen obſerved, that when the paper was laid on the middle point of the ſtring, it remained without agitation, although the ſtring ſtill reſounded. They found the ſame thing when they made the ſtring reſound to its 12th: papers laid on the two points of diviſion lay ſtill, but were thrown off when laid on any other place. In ſhort, they found it a general rule, that papers laid on any points of diviſion correſponding to the note which was reſounded, were not agitated.

Dr Wallis (the greateſt theoriſt in muſic of the 17th century) juſtly concluded that theſe points of the reſounding ſtring were at reſt, and that the intermediate parts were vibrating, and producing the notes correſponding to their lengths.

From this Mr Sauveur, with great propriety, deduced the theory of the performance of the trumpet marine, the vielle, the clavichord, and ſome other inſtruments. When

mpet
rine.

When the ſtring of the trumpet marine is gently ſtopped at $\frac{1}{2}$, and the bow drawn lightly acroſs it at H (fig. A), the full vibration at the finger is ſtopped; but the ſtring is thrown into vibrations of ſome kind, which will either be deſtroyed or may go on. It is of importance to ſee what circumſtance will permit their continuance.

Suppoſe an elaſtic cord put into the ſituation ABCDE, (fig. D), ſuch that AB, BC, CD, DE, are all equal, and that BCD is a ſtraight line. Let the point C be made faſt, and the two points B and D be let go at once. It is evident that the two parts will immediately vibrate in two harmonical curves A*b*C and CDE, which will change to ABC and C*d*E, and ſo on alternately. It is alſo evident that if a line FCG be drawn touching the curve ABC, it will alſo touch the curve CDE; and the line which touches the curve A*b*C in C, will alſo touch the curve C*d*E. In every inſtant the two halves of the cord will be curves which have a common tangent in the point C. The undoubted conſequence of this is, that the point C will not be affected by theſe vibrations, and its fixure may be taken away. The cord will continue to vibrate, and will give the ſound of the octave to its fundamental note.

The condition, then, which muſt be implemented, in order that a ſtring may reſound to its octave, or take the ſound of its octave, is ſimply this, that its two parts may vibrate equally in oppoſite directions. This is evidently poſſible; and when the bow is drawn acroſs the ſtring of the trumpet marine at H, and irregular vibrations are produced in the whole ſtring, thoſe which happen to be in one direction on both ſides of the middle point, where it is gently ſtopped by the finger, will deſtroy each other, and the conſpiring ones will be inſtantly produced, and then every ſucceeding action of the bow will increaſe them.

The ſame thing muſt happen if a ſtring is gently ſtopped at one-third of its length; for there will be the ſame equilibrium of forces at the two points of diviſion, ſo that the fixures of theſe points may be removed, and the ſtring will vibrate in three parts, ſounding the 12th of the fundamental.

We may obſerve, by the way, that if the bow be drawn acroſs the ſtring at one of the points of diviſion, correſponding to the ſtopping at the other end of the ſtring, it will hardly give any diſtinct note. It rattles, and is intolerably harſh. The reaſon is plain: The bow takes ſome hold of the point C, and drags it along with it. The cord on each ſide of C is left behind, and therefore the two curves cannot have a common tangent at C. The vibrations into which it is thus jogged by the bow deſtroy each other.

We now ſee why the trumpet marine will not ſound every note. It will ſound none but ſuch as correſpond to a diviſion of the ſtring into a number of equal parts, and its note will be in uniſon with a ſtring equal to one of thoſe parts. Therefore it will *firſt* of all ſound the fundamental, by its whole length;

2. Its octave, correſponding to - $\frac{1}{2}$ its length
3. The 12th, - - - $\frac{1}{3}$
4. The 15th, or double octave, - $\frac{1}{4}$
5. The 17th, - - - $\frac{1}{5}$
6. The 19th, - - - $\frac{1}{6}$
7. The 21ſt, which is not in the diatonic ſcale of our muſic, - $\frac{1}{7}$
8. The triple octave or 22d, $\frac{1}{8}$ its length
9. The 23d, or 2d in the ſcale of the triple octave, . - - $\frac{1}{9}$
10. The 24th or 3d in this ſcale, $\frac{1}{10}$
11. The 25th, a falſe 4th of this ſcale, $\frac{1}{11}$
12. The 26th, a perfect 5th of this ſcale, $\frac{1}{12}$
13. The 27th, a falſe 6th of ditto, $\frac{1}{13} = \frac{3}{39}$ or $\frac{4}{52}$
14. The 28th, a falſe 7th minor, - $\frac{1}{14}$
15. The 28th, a perfect 7th major, $\frac{1}{15}$
16 The quadruple octave, . $\frac{1}{16}$

Thus we ſee that this inſtrument will not execute all muſic, and indeed will not complete any octave, becauſe it will neither give a perfect 4th nor 6th. We ſhall preſently ſee that theſe are the very defects of the trumpet.

This ſingular ſtringed inſtrument has been deſcribed in this detail, chiefly with the view of preparing us for underſtanding the real trumpet. The VIELLE, SAVOYARDE, or HURDYGURDY, performs in the ſame manner. While the wheel rubs one part of the ſtring like a bow, the keys gently preſs the ſtrings, in points of aliquot diviſion, and produce the harmonic notes.

It is to prevent ſuch notes that the part of harpſichord wires, lying between the bridge and the pins, are wrapped round with liſt. Theſe notes would frequently diſturb the muſic.

Laſtly on this head, the Æolian harp derives its vaſt variety of fine ſounds from this mode of vibration. Seldom do the cords perform their fundamental or ſimple vibrations. They are generally ſounding ſome of the harmonies of their fundamentals, and give us all this variety from ſtrings tuned in uniſon.

Muſical Trumpet

TRUMPET, Muſical, is a wind inſtrument which ſounds by preſſing the cloſed lips to the ſmall end, and forcing the wind through a very narrow aperture between the lips. This is one of the moſt ancient of muſical inſtruments, and has appeared in all nations in a vaſt variety of forms. The conch of the ſavage, the horn of the cowherd and of the poſtman, the bugle horn, the lituus and tuba of the Romans, the military trumpet, and the trombone, the *cor de chaſſe* or French horn—are all inſtruments winded in the ſame manner, producing their variety of tones by varying the manner and force of blowing. The ſerpent is another inſtrument of the ſame kind, but producing part of its notes by means of holes in the ſides.

Although the trumpet is the ſimpleſt of all muſical inſtruments, being nothing but a long tube, narrow at one end and wide at the other, it is the moſt difficult to be explained. To underſtand how ſonorous and regulated undulations can be excited in a tube without any previous vibration of reeds to form the waves at the entry, or of holes to vary the notes, requires a very nice attention to the mechaniſm of aereal undulations, and we are by no means certain that we have as yet hit on the true explanation. We are certain, however, that theſe aereal undulations do not differ from thoſe produced by the vibration of ſtrings; for they make ſtrings reſound in the ſame manner as vibrating cords do. Galileo, however, did not know this argument for his aſſertion that the muſical pitch of a pipe, like that of a cord, depended on the frequency alone of the aereal undulations; but he thought it highly probable, from his obſervations on the ſtructure of organs, that the notes of pipes were related to their lengths in the ſame manner as thoſe of wires, and he expreſsly makes this remark. Newton having diſcovered that ſound moved at the rate of about 960 feet per ſecond, obſerved that, according to the experiments of Mr Sauveur, the length of an open pipe is half the length of an aereal pulſe. This he could eaſily aſcertain by dividing the ſpace deſcribed by ſound in a ſecond by the number of pulſes.

Daniel Bernoulli, the celebrated promoter of the Newtonian mechanics, diſcovered, or at leaſt was the firſt who attentively marked, ſome other circumſtances of reſemblance between the undulations of the air in pipes and the vibrations of wires. As a wire can be made, not only to vibrate in its full length, ſounding its fundamental note, but can alſo be made to ſubdivide itſelf, and vibrate like a portion of the whole, with points of reſt between the vibrating portions, when it gives one of its harmonic notes; ſo a pipe cannot only have ſuch undulations of air going on within it as are competent to the production of its fundamental note, but alſo thoſe which produce one of its harmonic notes. Every one knows that when we force a flute by blowing too ſtrongly, it quits its proper note, and gives the octave above. Forcing ſtill more, produces the 12th. Then we can produce the double octave or 15th, and the 17th major, &c. In ſhort, by attending to ſeveral circumſtances in the manner of blowing, all the notes may be produced from one very long pipe that we produce from the trumpet marine, and in preciſely the ſame order, and with the ſame omiſſions and imperfections. This alone is almoſt equivalent to a proof that the mechaniſm of the undulations of air in a pipe are analogous to that of the vibrations of an elaſtic cord. Having with ſo great ſucceſs inveſtigated the mechaniſm of the partial vibrations of wires, and alſo another kind of vibrations which we ſhall mention afterwards, incomparably more curious and more important in the philoſophy of muſical ſounds, Mr Bernoulli undertook the inveſtigation of thoſe more myſterious motions of air which are produced in pipes; and in a very ingenious diſſertation, publiſhed in the Memoirs of the Academy of Paris for 1762, &c. he gives a theory of them, which tallies in a wonderful manner with the chief phenomena which we obſerve in the wind inſtruments of the flute and trumpet kind. We are not, however, ſo well ſatisfied with the truth of his *aſſumptions* reſpecting the ſtate of the air, and the preciſe form of the undulations which he aſſigns to it; but we ſee that, notwithſtanding a probability of his being miſtaken in theſe circumſtances (it is with great deference that we preſume to ſuppoſe him miſtaken), the chief propoſitions are ſtill true; and that the changes from note to note muſt be produced in the order, though perhaps not in the preciſe manner, aſſigned by him.

It is by no means eaſy to conceive, with clearneſs, the way in which muſical undulations are excited in the various kinds of trumpets. Many who have reputation as mechanicians, ſuppoſe that it is by means of vibrations of the lips, in the ſame manner as in the hautboy, clarionette, and reed pipes of the organ, where the air, ſay they, is put in motion by the trembling reed. But this explanation is wrong in all its parts; even in the reed-pipes of an organ, the air is *not* put in motion by the reeds. They are indeed the *occaſions* of its muſical undulation, but they do not *immediately impel* it into thoſe waves. This method (and indeed all methods but the vibrations of wires, bells, &c.) of producing ſound is little underſtood, though it is highly worthy of notice, being the origin of animal voice, and becauſe a knowledge of it would enable the artiſts to entertain us with ſounds hitherto unknown, and thus add conſiderably to this gift of our Bountiful Father, who has ſhewn in the ſtructure of the larynx of the human ſpecies, that he intended that we ſhould enjoy the pleaſures of muſic as a *laborum dulce lenimen*. He has there placed a micrometer apparatus, by which, *after* the other muſcles have done their part in bringing the glottis nearly to the tenſion which the intended note requires, we can eaſily, and inſtantly, adjuſt it with the utmoſt nicety.

We truſt, therefore, that our readers will indulge us while we give a very curſory view of the manner in which the tremulous motion of the glottis, or of a reed in an organ pipe, produces the ſonorous undulations with a conſtant or uniform frequency, ſo as to yield a muſical note.

If we blow through a ſmall pipe or quill, we produce only a whizzing or hiſſing noiſe. If, in blowing, we ſhut the entry with our tongue, we hear ſomething like a ſolid blow or tap, and it is accompanied with ſome faint perception of a muſical pitch, juſt as when we tap with the finger on one of the holes of a flute when all the reſt are ſhut. We are then ſenſible of a difference of pitch according to the length of the pipe; a longer pipe or quill giving a graver ſound. Here, then, is like the beginning of a ſonorous undulation. Let us conſider the ſtate of the air in the pipe: It was filled by a column of air, which was moving forward, and would have been ſucceeded by other air in the ſame ſtate. This air was therefore nearly in its ſtate of natural denſity. When the entry is ſuddenly ſtopped by the tongue, the included air already in motion, continues its motion. This it cannot do without growing rarer, and then it is no longer a balance for the preſſure of the atmoſphere. It is therefore retarded in its motion, totally ſtopped (being in a rarefied ſtate), and is then preſſed back again. It comes back with an accelerated motion, and recovers its natural denſity, while the ſtate of rarefaction goes forward through the open air like any other aereal pulſe. Its motions are ſomewhat, but not altogether, like that of a ſpiral wire, which has been in like manner moving uniformly along the pipe, and has been ſtopped by ſomething catching hold of its hindermoſt extremity. This ſpring, when thus catched behind, ſtretches itſelf a little, then contracts *beyond* its natural ſtate, and than expands again, quivering ſeveral times. It can be demonſtrated that the column of air will make but one quiver. Suppoſe this accompliſhed in the hundredth part of a ſecond, and that at that inſtant the tongue is removed for the hundredth part of a ſecond, and again applied to the entry of the pipe. It is plain that this will produce ſuch another pulſe, which will join to the former one, and force it out into the air, and the two pulſes together will be like two pulſes produced by the vibration of a cord. If, inſtead of the tongue we ſuppoſe the flat plate of an organ-reed to be thus alternately applied to the hole and removed, at the exact moments that the renewals of air are wanted, it is plain that we ſhall have *ſonorous* undulations of *uniform* frequency, and therefore a muſical note. This is the way in which reeds produce their effect, not by *impelling* the air into alternate ſtates of motion to and fro, and alternate ſtrata of rarefied and condenſed air, but by giving them time to acquire this ſtate by the combination of the air's elaſticity with its progreſſive motion.

The adjuſtment of the ſucceeding puff of air to the pulſe which precedes it, ſo that they may make one ſmooth and regular pulſe, is more exact than we have yet remarked; for the ſtoppage of the hole not only *occaſions* a rarefaction *before it*, but by checking the air which was juſt going to enter, makes a condenſation *behind the door* (ſo to ſpeak); ſo that, when the paſſage is again opened, the two parcels of air are fitted for ſupporting each other, and forming one pulſe.

Suppoſe, in the next place, that the reed, inſtead of completely ſhutting the hole each time, only half ſhuts it. The ſame thing muſt ſtill happen, although not in ſo remarkable a degree. When the paſſage is contracted, the ſupply is diminiſhed, and the air now in the pipe muſt rarefy, by advancing with its former velocity. It muſt therefore retard; by retarding regain its former denſity; and the air not yet got into the pipe, muſt condenſe, &c. And if the paſſage be again opened or enlarged in the proper time, we ſhall have a complete pulſe of condenſed and rarefied air; and this muſt be accompanied by the beginning of a muſical note, which may be continued like the former.

This will be a ſofter or more mellow note than the other; for the condenſed and rarefied air will not be ſo ſuddenly changed in their denſities. The difference will be like the difference of the notes produced by drawing a quill along the teeth of a comb, and that produced by the equally rapid vibrations of a wire. For let it be remarked here, that muſical notes are by no means confined, as theoriſts commonly ſuppoſe, to the regular cycloidal agitations of air, ſuch as are produced by the vibrations of an elaſtic cord; but that any crack, ſnap, or noiſe whatever, when repeated with ſufficient frequency, becomes *ipſo facto* a muſical ſound, of which we can tell the pitch or note. What can be leſs muſical than the ſolitary cracks of ſnaps made by a ſtiff door when very ſlowly opened? Do this briſkly, and the creak changes to a chirp, of which we can tell the note. The ſounds will be harſh or ſmooth, according as the ſnaps of which they are compoſed are abrupt or gradual.

This diſtinction of ſounds is moſt ſatisfactorily confirmed by experiment. If the tongue of the organ reed is quite flat, and if, in its vibrations, it apply itſelf to the whole margin of the hole at once, ſo as completely to ſhut it (as is the caſe in the oldfaſhioned regal ſtop of the organ), the note is clear, ſmart, and harſh or hard: but if the lips of the reed are curved, or the tongue properly bent backward, ſo that it applies itſelf to the edges of the hole *gradatim*, and never completely ſhuts the paſſage, the note may have any degree of mellow ſweetneſs. This remark is worth the attention of the inſtrument-makers or organ builders, and enables them to vary the VOICE of the organ at pleaſure. We only mention it here as introductory to the explanation of the ſounds of the trumpet.

We truſt that the reader now perceives how the air, proceeding along a pipe, may be put in the ſtate of alternate ſtrata of condenſed and rarefied air, the particles, in the mean time, proceeding along the pipe with a very moderate velocity; while the *ſtate of undulation* is propagated at the rate of eleven or twelve hundred feet in a ſecond; juſt as we may ſometimes ſee a ſtream of water gliding gently down a canal, while a wave runs along its ſurface with much greater rapidity.

It will greatly aſſiſt the imagination, if we compare theſe aëreal undulations with the undulations of water in an open canal. While the water is flowing ſmoothly along, ſuppoſe a ſluice to be thruſt up from the bottom quite to the ſurface, or beyond it. This will immediately cauſe a depreſſion on the lower ſide of the ſluice, by the water's going along the canal, and a heaping up of the water on the other ſide. By properly timing the motion of this ſluice up and down, we can produce a ſeries of connected waves. If the ſluice be not puſhed up to the ſurface but only one-half way, there will be the ſame ſucceſſion of waves, but much ſmoother, &c. &c.

It is in this ſtate, though not by ſuch means, that the air is contained in a ſounding trumpet. It is not brought into this ſtate by any tremor of the lips. The trumpeter ſometimes feels ſuch a tremor; but whenever he feels it, he can no longer ſound his note. His lips are painfully tickled, and he muſt change his manner of winding.

When blowing with great delicacy and care, the deepeſt notes of a French horn, or trombone, we ſometimes can feel the undulations of the air in the pipe diſtinctly fluttering and beating againſt the lips; and it is difficult to hinder the lips from being affected by it; but we feel plainly that it is not the lips which are fluttering, but the air before them. We feel a curious inſtance of this when we attempt to whiſtle in concert. If our accompanier intonates with a certain degree of incorrectneſs, we feel ſomething at our own lips which makes it impoſſible to utter the intended note. This happens very frequently to the perſon who is whiſtling the upper note of a greater third. In like manner, the undulations in a pipe react on the reed, and check its vibrations. For if the dimenſions of a pipe are ſuch that the undulations formed by the reed cannot be kept up in the pipe, or do not ſuit the length of the pipe, the reed will either not play at all, or will vibrate only in ſtarts. This is finely illuſtrated by a beautiful and inſtructive experiment. Take a ſmall reed of the *vox humana* ſtop of an organ, and ſet it in a glaſs foot, adapted to the windbox of the organ. Inſtead of the common pipe above it, fix on it the ſliding tube of a ſmall teleſcope. When all the joints are thruſt down, touch the key, and look attentively to the play of the reed. While it is ſounding, draw out the joints, making the pipe continually longer. We ſhall obſerve the reed thrown into ſtrange fits of quivering, and ſometimes quite motionleſs, and then thrown into wide ſonorous vibrations, according as the *maintainable* pulſe is commenſurate or not with the vibrations of the reed. This plainly ſhews that the air is not impelled into its undulations by the reed, but that the reed accommodates itſelf to the undulations in the pipe.

We acknowledge that we cannot explain with diſtinctneſs in what manner the air in a trumpet is firſt put into muſical undulations. We ſee that it is only in very long and ſlender tubes that this can be done. In ſhort tubes, of conſiderable diameter, like the cowherd's horn, we obtain only one or two very indiſtinct notes, of which it is difficult to name the pitch; and this requires great force of blaſt; whereas, to bring out the deep notes of the French horn, a very gentle and well regulated blaſt is neceſſary. The form of the lips, combined with the force of the blaſt, form all the notes. But this is in a way that cannot be taught by any deſcription. The performer learns it by habit, and *feels* that the inſtrument leaps into its note without him, when he gradually varies his blaſt, and continues ſounding the ſame note; although he, in the mean time, makes ſome ſmall change in his manner of blowing. This is owing to what Mr Bernoulli obſerved. The tube is ſuited only to ſuch pulſes, and can only maintain ſuch pulſes as correſpond to aliquot parts of its length; and when the embouchure is very nearly, but not accurately, ſuited to a particular note, that note *forms itſelf* in the tube, and, reacting on the lips, brings them into the form which can maintain it with eaſe. We have a proof of this when we attempt to ſound the note correſponding to one-ſeventh of the length. Not having a diſtinct notion of this note, which makes no part of our ſcale of melody, we cannot eaſily prepare for it in the way that habit teaches us to prepare for the others: whereas, from what we ſhall ſee preſently, the notes *one-ſixth* and *one-eighth* are both familiar to the mind, and eaſily produced. When, therefore, we attempt to produce the note *one-ſeventh*, we ſlide, againſt our will, into the *one-ſixth* or *one eighth*.

Nor can we completely illuſtrate the formation of muſical pulſes by waves in water. A canal is equally ſuſceptible of every height and length of progreſſive waves; whereas we ſee that a certain length of tube will maintain only certain determined pulſes of air.

We muſt therefore content ourſelves for the preſent with having learned, by means of the reed pipes, how the air may exiſt progreſſively in a tube, in an alternate ſtate of condenſation and rarefaction; and we ſhall now proceed to conſider how this ſtate of the air is related to the length of the tube. And here we can do no more than give an outline of Mr Bernoulli's beautiful theory of flutes and trumpets, but without a mathematical examination of the particular motions. We can, however, ſhew, with ſufficient evidence, how the different notes are produced from the ſame tube. It requires, however, a very ſteady attention from the reader to enable him to perceive how the different portions of this air act on each other. We truſt that this will now be given.

The conditions which muſt be implemented, in order to maintain a muſical pulſe, are two: 1. That the vibrations of the different plates of air be performed in equal times, otherwiſe they would all mix and confound each other. 2. That they move all together, all beginning and all ending at the ſame inſtant. It does not appear that any other ſtate of vibration can exiſt and be maintained.

The column of air in a tube may be conſidered as a material ſpring (having weight and inertia). This ſpring is compreſſed and coiled up by the preſſure of the atmoſphere. But in this coiled ſtate it can vibrate in its different parts, as a long ſpiral wire may do, though preſſed a little together at the ends. It is evident that the air within a pipe, ſhut at both ends, may be placed in ſuch a ſituation, *in a variety of ways*, that it will vibrate in every part, in the ſame manner as a chord of the ſame length and weight, ſtrained by a force equal to the preſſure of the atmoſphere. Thus, in the ſhut pipe AB (fig. 1.), ſuppoſe a harmonic curve ACB, or a wire of the ſame weight with the air, throwing itſelf into the form of this curve. The force which impels the point C to the axis is to that which impels the point c as CE to ce. Now, ſuppoſe the air in this pipe divided into parallel ſtrata or plates, croſſing the tube like diaphragms. In order that theſe may vibrate in the ſame manner (not acroſs the tube, but in the direction of its axis), all that is neceſſary for the moment is, that the exceſs of the preſſure of the ſtratum dd above that of the ſtratum ff may be to the exceſs of the preſſure of DD above that of FF as ce to CE. In this caſe, the ſtratum ce will be accelerated in the direction ef, and the ſtratum EE is accelerated in the ſame direction, and in the due proportion. Now this may be done in an infinite variety of ways for a ſingle moment. It depends, not on the abſolute denſity, but on the *variation* of denſity; becauſe the preſſure by which a particle of air is urged in any direction ariſes from the *difference* of the diſtances of the adjoining particles on each ſide of it. But in order to *continue* this vibration, or in order that it may obtain at once in the whole pipe, this variation of denſity muſt continue, and be according to ſome connected law. This circumſtance greatly limits the ways in which the vibration may be kept up. Mr Bernoulli finds that the iſochroniſm and ſynchroniſm can be maintained in the following manner, and in no other that he could think of:

Let AB (fig. 2.) be a cylindrical pipe, ſhut at A, and open at B. Then, in whatever manner the ſound is produced in the pipe, the undulations of the contained air muſt be performed as follows: Let aa be a plate of air. This plate will approach to, and recede from, the ſhut end A, vibrating between the ſituations bb and cc, the whole vibration being bc, and the plate will vibrate like a pendulum in a cycloid. The greater we ſuppoſe the excurſions ab, ac, the louder will the ſound be; but the duration of them all muſt be the ſame, to agree with the fact that the tone remains the ſame. The motion will be accelerated in approaching to aa from either ſide, and retarded in the receſs from it. Let us next conſider a plate $\alpha\alpha$, more remote from A. It muſt make ſimilar vibrations from the ſituation $\beta\beta$ to the ſituation $\gamma\gamma$. But theſe vibrations muſt be greater in proportion as the plate is farther from A. It cannot be conceived otherwiſe: For ſuppoſe the plate $\alpha\alpha$ to make the *ſame* excurſions with aa, and that the reſt do the ſame. Then they will all retain the ſame diſtances from each other; and thus there will be no force whatever acting on any particles to make them vibrate. But if every particle make excurſions proportional to its diſtance from A, the *variation* of denſity will, in any inſtant, be the ſame through the whole pipe, and each particle in the vibrating plate $\beta\beta$ will be accelerated or retarded in proportion to its diſtance from A; while the accelerations and retardations over all will, in any inſtant, be proportional to the diſtance of each particle from its place of reſt. All this will appear to the mathematician, who attentively conſiders any momentary ſituation of the particles. In this manner all the particles will ſupport each other in their vibrations.

It follows from this deſcription that the air in the tube is alternately rarefied and condenſed. But theſe changes are very different in different parts of the tube. They muſt be greateſt of all at A; becauſe, while all the

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the plates approach to A, they concur in condenſing the air immediately adjoining to A; while the air in *a a* and *α α* is leſs condenſed by the action of the plates beyond it. The air at B is always of its natural denſity, being in equilibrio with the ſurrounding air. At B, therefore, there is a ſmall parcel of air, of its natural denſity, which is alternately going in and out.

This account is confirmed by many facts. If the bottom of the pipe be ſhut by a fine membrane, ſtretched acroſs it like a drumhead, with a wire ſtretched over it, either externally or internally, in the ſame manner as the catgut is ſtretched acroſs the bottom of a drum, it will be thrown into ſtrong vibrations, making a very loud noiſe, by rattling againſt the croſs wire. The ſame thing happens if the membrane be paſted over a hole cloſe to the bottom, leaving a ſmall ſpace round the edge of the hole without paſte, ſo that the membrane may play out and in, and rattle on the margin of the hole. This alſo makes a prodigious noiſe. Now, if the membrane be paſted on a hole far from the bottom, the agitations will be much fainter; and when the hole is near the mouth of the pipe, there will be none.— When a pipe has its air agitated in this manner, it is giving the loweſt note of which it is ſuſceptible.

Let us next conſider a pipe open at both ends. Let CB (fig. 3.) be this pipe. It is plain that, if there be a partition A in the middle, we ſhall have two pipes AB, AC, each of which may undulate in the manner now deſcribed, if the undulations in each be in oppoſite directions. It is evidently poſſible, alſo, that theſe undulations may be the ſame in point of ſtrength in both, and that they may begin in the ſame inſtant. In this caſe, the air on each ſide of the partition will be in the ſame ſtate, whether of condenſation or rarefaction, and the partition A itſelf will always be in equilibrio. It will perfectly reſemble the point C of the muſical cord BFCGH (fig. 6.), which is in equilibrio between the vibrating forces of its two parts. In the pipe, the plates of air on each ſide are either both approaching it, or both receding from it, and the partition is either equally ſqueezed from both ſides, or equally drawn outwards. Conſequently this partition may be removed, and the parcels of air on each ſide will, in any inſtant, ſupport each other. There ſeems no other way of conceiving theſe vibrations in open pipes which will admit of an explanation by mechanical laws. The vibrations of all the plates muſt be obtained without any mutual hinderance, in order to produce the tone which we really hear; and therefore ſuch vibrations are impreſſed by Nature on each plate of air.

But if this explanation be juſt, it is plain that this pipe CB muſt give the ſame note with the pipe AB (fig. 2.) of half the length, ſhut at one end. But the ſound, being doubled, with perfect conſonance, muſt be clear, ſtrong, and mellow. Now this is perfectly agreeable to obſervation; and this fact is an unequivocal confirmation of the juſtneſs of the theory. If we take a ſlender pipe, about ſix inches long and one half of an inch wide, ſhut at one end, and ſound it by blowing acroſs its mouth, as we whiſtle on the pipe of a key, or acroſs a hole that is cloſe to the mouth, and formed with an edge like the ſound-hole of a German flute, we ſhall get a very diſtinct and clear tone from it. If we now take a pipe of double the length, open at both ends, and blow acroſs its mouth, we obtain the ſame note, but more clear and ſtrong. And the note produced by blowing acroſs the mouth is not changed by a hole made exactly in the middle, in reſpect of its muſical pitch, although it is greatly hurt in point of clearneſs and ſtrength. Alſo a membrane at this hole is ſtrongly agitated. All this is in perfect conformity to this mechaniſm.

Muſical
Trumpet.

Thus we have, in a great meaſure, explained the effect of an open and a ſhut pipe. The ſhut pipe is always an octave, graver than an open pipe of the ſame length; becauſe the open pipe is in uniſon with the ſhut pipe of half the length.

Let AC (fig. 4.) be a pipe ſhut at both ends. We may conſider it as compoſed of two pipes AB, BC, ſtopped at A and C, and open at B. Undulations may be performed in each half preciſely as in the pipe AB of fig. 2.; and they will not, in the ſmalleſt degree obſtruct each other, if we only ſuppoſe that the plates in each half are vibrating at once in the *ſame* direction. The condenſation in AB will correſpond with the rarefaction in BC, and the middle parcel B will maintain its natural denſity, vibrating to, and again acroſs the middle; and two plates *a a*, *α α*, which are equally diſtant from B, will make equal excurſions in the ſame direction.

We may produce ſound in this pipe by making an opening at B. Its note will be found to be the ſame with that of BC of fig. 2. or of AB of fig. 2.

In the next place, let a pipe, ſhut at one end, be conſidered as divided into any odd number of equal parts, and let them be taken in pairs, beginning at the ſtopped end, ſo that there may be an odd one left at the open end. It is plain that each of theſe pairs may be conſidered as a pipe ſtopped at both ends, as in fig. 4.

For the partitions will, of themſelves, be in equilibrio, and may be removed, and vibrations may be maintained in the whole, conſiſtent with the vibration of the odd part at the open end; and theſe vibrations will all ſupport each other, and the plates of air which are at the point of diviſion will remain at reſt. Conceive the pipe AB of fig. 2. to be added to the pipe AC of fig. 4. the part A of the firſt being joined to A of the other. Now, ſuppoſe the vibrations to be performed in both, in ſuch a manner that the ſimultaneous undulations on each ſide of the junction may be in oppoſite directions. It is plain that the partition will be in equilibrio, and may be removed; and the plate of air will perform the ſame office, being alternately the middle plate of a condenſed and of a rarefied parcel of air. The two pipes CA, AB will together give the ſame note that AB would have given alone, but louder.

In like manner may another pipe, equal to AC, be joined to the ſhut end of this compound pipe, as in fig. 5. and the three will ſtill give the ſame note that AB would have done alone.

And in the ſame manner may any number of pipes, each equal to AC, be added, and the whole will give ſtill the ſame note that AB would have given alone.

Hence it legitimately follows, that if the undulations can be once begun in this manner in a pipe, it may give either the ſound competent to it, as a ſingle pipe AB (fig. 2.); or it may give the ſound competent to a pipe of $\frac{1}{3}$d, $\frac{1}{5}$th, $\frac{1}{7}$th, &c. of its length; the undulations in each part AB, BC, CD, maintaining themſelves in the

the manner already deſcribed. This ſeems the only way in which they can be preſerved, both iſochronous and ſynchronous.

It is known that the graveſt tones of pipes are as the lengths of the pipes, or the frequency of the undulations are inverſely as their lengths. (This will be *demonſtrated* preſently). Therefore theſe acceſſory tones ſhould be as the odd numbers 3, 5, 7, &c. and the whole tones, including the fundamental, ſhould form the progreſſion of the odd numbers 1, 3, 5, 7, &c.

This is abundantly confirmed by experiment. Take a German flute, and ſtop all the finger holes. The flute, by gradually forcing the blaſt, will give the fundamental, the 12th, the 17th, the 21ſt, &c. (A).

Again, let AD (fig. 6.) repreſent the length of a pipe. Conſtruct on AD an harmonic curve AEBFCGHD, in ſuch a manner that HD may be $\frac{1}{2}$ AB, = $\frac{1}{2}$ BC, = $\frac{1}{2}$ CH. The ſmall ordinates *m n* will expreſs the total excurſion of the plates of air at the points *m*, *n*, &c. and thoſe ordinates which are above the axis will expreſs excurſions on one ſide of the place of reſt, and the ordinates below will mark the excurſions in the oppoſite directions, in the ſame manner as if this harmonic curve were really a vibrating cord. Theſe excurſions are nothing in the points A, B, C, H, and are greateſt at the points E, F, G, D, where the little maſs of air retains its natural denſity, and travels to and again, condenſing the air at B, or rarefying it, according as the parcels E and F are approaching to or receding from each other. The points A, B, C, H, may be called NODES, and the parts E, F, G, D, may be called BIGHTS or LOOPS. This repreſents very well to the eye the motion of the plates of air. The denſity and velocity need not be minutely conſidered at preſent. It is enough that we ſee that when the denſity is increaſing at A, by the approach of the parcel E, it is diminiſhing at B by the receſs of E and F; and increaſing at C, by the approach of F and G, and diminiſhing at H, by the receſs of G. In the next vibration it will be diminiſhing at A and C, and increaſing at B and H. And thus the alternate nodes will be in the ſame ſtate, and the adjoining nodes in oppoſite ſtates.

The reader muſt carefully diſtinguiſh this motion from the undulatory motion of a pulſe, inveſtigated by Newton, and deſcribed in the article ACOUSTICS, *Encycl.* That undulation is going on at the ſame time, and is *a reſult* of what we are now conſidering, and the cauſe of our hearing this undulation. The undulation we are now conſidering is the original agitation, or rather it is the SOUNDING BODY, as much as a vibrating ſtring or bell is; for it is not the trumpet that we hear, but the air trembling in the trumpet. The trumpet is performing the office, not of the ſtring, but of the pin and bridge on which the ſtring is ſtrained. This is an important remark in the philoſophy of muſical ſounds.

There is yet another ſet of notes producible from a pipe beſides thoſe which follow in the order of frequency 1, 3, 5, 7, &c.

Suppoſe a pipe open at both ends, ſounding by blowing acroſs the end, and undulating, as already deſcribed, with a node in the middle A (fig. 3.) If we ſtill expreſs the fundamental note of the pipe AB of fig. 2. by 1, it is plain that the fundamental of an open pipe of the ſame length will have the frequency of its undulations expreſſed by 2; becauſe an open pipe of twice the length of AB (fig 2.) will be 1, the two pipes AB (fig. 2.), and CB (fig. 3.), being in uniſon.

But this open pipe may be made to undulate in another manner; for we have ſeen that AB of fig. 2. joined to CA of fig. 4. may ſound altogether when the partition A is removed, ſtill giving the note of AB (fig. 2.) Let ſuch another as AB (fig 2.) be added to the end C, and let the partition be removed. The whole may ſtill undulate, and ſtill produce the ſame note; that is, a pipe open at both ends may ſound a note which is the fundamental of a pipe like AB (fig. 2.), but only one-fourth of its length. The pipe CB of fig. 3. may thus be ſuppoſed to be divided into four equal parts, CE, EA, AF, FB, of which the extreme parts EC and FB contain undulations ſimilar to thoſe in AB (fig. 2.); and the two middle parts contain undulations like thoſe in CA (fig. 4.) The partitions at E and F may be removed, becauſe the undulations in EC and EA will ſupport each other, if they are in oppoſite directions; and thoſe in FB and FA may ſupport each other in the ſame manner.

It muſt here be remarked, that in this ſtate of undulation the direction of the agitations at the two extremities is the ſame; for in the middle piece EF the particles are moving one way, condenſing the air at E, while they rareſy it at F. Therefore, while the middle parcel is moving from E towards F, the air at B muſt be moving towards F, and the air at C muſt be moving from E. In ſhort, the air at the two extremities muſt, in every inſtant, be moving in the oppoſite direction to that of the air in the middle.

In like manner, if the pipe CB of fig. 3. be divided into ſix parts, the two extreme parts may undulate like AB of fig. 2. and the four inner parts may undulate like two pipes, ſuch as CA of fig. 4. and the whole will give the ſound which makes the fundamental of a pipe, of one-ſixth of the length, or having the frequency 6.

We may remark here, that the ſimultaneous motion of

(A) A little reflection will teach us that theſe tones will not be perfectly in the ſcale. A certain proportion between the diameter and length of the pipe produces a certain tone. Making the pipe wider or ſmaller flattens or ſharpens this tone a little, and alſo greatly changes its clearneſs. Organ builders, who have tried every proportion, have adopted what they found beſt. This requires the diameter to be about $\frac{1}{11}$th or $\frac{1}{12}$th of the length. Therefore, when we cauſe the ſame pipe to ſound different notes, we neglect this proportion; and the notes are falſe, and even very coarſe, when we produce one correſponding to a very ſmall portion of the pipe. For a ſimilar reaſon, Mr Lambert found that, in order to make his pitch-pipe ſound the octave to any of its notes, it was not ſufficient to ſhorten its capacity one-half by puſhing down the piſton; he found that the part remaining muſt be leſs than the part taken off by a fixed quantity $1\frac{5}{12}$ inches. Or, the length which gave any note being x, the length for its octave muſt be $\frac{x - 1\frac{5}{12}}{2}$.

of the air at the extremities is in oppoſite directions, whereas in the laſt caſe it was in the ſame direction. This is eaſily ſeen; for as the partition which is between the two middle pieces muſt always be in equilibrio, the air muſt be coming in or going out at the extremities together. This circumſtance muſt give ſome ſenſible difference of character to the ſounds 4 and 6. In the one, the agitations at each end of the tube are in the ſame direction, and in the other they are in the oppoſite. Both produce pulſes of ſound which are conveyed to the ear. Thus we ſee that the air in a pipe open at both ends may undulate in two ways. It may undulate with a node in the middle, giving the note of AB (fig. 2.), or of its 3d, 5th, 7th, &c. paſt; and it may undulate with a loop or bight in the middle, ſounding like $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{6}$, &c. of AB, fig. 2.

In like manner may this pipe produce ſounds whoſe frequency are expreſſed by 8, 10, &c. and proceed as the even numbers.

This ſtate of agitation may be repreſented in the ſame way that we repreſented the ſounds 1, 3, 5, &c. by conſtructing on AM (fig. 7,) an harmonic curve, with any number of nodes and loops. Divide the parts AF, FD, DE, EM, equally in C, O, P, B. CB will correſpond to the pipe, and the ordinates to the curve GFHDLEN will expreſs the excurſions of the plates of air.

If the pipe gives its fundamental note, its length muſt be repreſented by CO, and the undulations in it will reſemble the vibrations of part CO of a cord, whoſe length AD is equal to 2CO, and which has a node in F.

If the pipe is ſounding its octave, it will be repreſented by CP, and its undulations will reſemble the vibrations of a cord CP, whoſe length AE is $\frac{3}{2}$ of CP, having nodes at F and D, &c. &c.

We can now ſee the poſſibility of ſuch undulations exiſting in a pipe as will be permanent, and produce all the variety of notes by a mere change in the manner of blowing, and why theſe notes are in the order of the natural numbers, preciſely as we obſerve to happen in winding the trumpet or French horn. We have, *1ſt*, the fundamental expreſſed by 1; then the octave 2: then the 12th, 3; the double octave 4; then the third major of that octave 5, or 17th of the fundamental; then the octave of the 12th, or the 5th of this double octave = 6. We then jump to the triple octave 8, without producing the intermediate ſound correſponding to $\frac{1}{7}$th of the pipe. With much attention we can hit it; and it is a fact that a perſon void of muſical ear ſtumbles on it as eaſily as on any other. But the muſician, finding this ſound begin with hum, and his ear being grated with it, perhaps thinks that he is miſtaking his embouchure, and he ſlides into the octave. After the triple octave, we eaſily hit the ſounds correſponding to $\frac{1}{9}$ and $\frac{1}{10}$, which are the 2d and 3d of this octave. The next note $\frac{1}{11}$ is ſharper than a juſt 4th. We eaſily produce the note 12, which is a juſt 5th; 13 is a falſe 6th; 14 is a ſound of no uſe in our muſic, but eaſily hit; 15 and 16 give the exact 7th and 8th of this octave.

Thus, as we aſcend, we introduce more notes into every octave, till at laſt we can nearly complete a very high octave; but in order to do this with ſucceſs, and tolerable readineſs, we muſt take an inſtrument of a very low pitch, that we may be able nearly to fill up the ſteps of the octave in which our melody lies. Few players can make the French horn or trombone ſound its real fundamental, and the octave is generally miſtaken for it. The proof of this is, that moſt players can give the 5th of the loweſt note that they are able to produce; whereas the 5th of the real fundamental cannot be uttered. Therefore that loweſt note is not the fundamental, but the octave to the fundamental.

Few performers can ſound even this ſecond octave on a ſhort inſtrument, ſuch as the ordinary military trumpet; and what they imagine to be the fundamental ſound of this inſtrument is the double octave above it. This appears very ſtrange; and it may be aſked, how we know what is really the fundamental note of a trumpet? The anſwer to this is to be obtained only by demonſtrating, on mechanical principles, what is the frequency of undulation correſponding to a given length of pipe. This is a propoſition equally fundamental with its correſponding one in the theory of muſical cords; but we have reſerved it till now, becauſe many readers would ſtop ſhort at ſuch an inveſtigation, who are able to underſtand completely what we have now delivered concerning the muſic of the trumpet.

Suppoſe therefore a pipe ſhut at both ends, and that the whole weight of the contained air is concentrated in its middle point, the reſt retaining its elaſticity without inertia: or (which is a more accurate conception), let the middle point be conceived as extending its elaſticity to the two extremities of the pipe, being repelled from each by a force inverſely as the diſtance. Let the length of this pipe be L. This may alſo expreſs the weight of the middle plate of air, which will always be proportional to the length of the pipe, becauſe all is ſuppoſed to be concentrated there. Let E be the elaſticity of the air. This muſt be meaſured by the preſſure of the atmoſphere, or by the weight of the column of mercury in the barometer. Perhaps the rationale of this will be better conceived by ſome readers by conſidering E as the height of a homogeneous atmoſphere. Then it is plain that E is to L as the weight of this atmoſpheric column to the weight of the column of the ſame air which fills the pipe whoſe length is L. Then it is alſo plain that E is to L as the external preſſure; and conſequently, as the elaſticity which ſupports that preſſure is to the weight or inertia of the matter to be moved. Let this middle plate or diaphragm be withdrawn from its place of reſt to the very ſmall diſtance *a*. The elaſticity or repulſion will be augmented on one ſide and diminiſhed on the other; and the difference between them is the only force which impels the diaphragm toward the middle point, and cauſes it to vibrate, or produces the undulation. It is plain that the repulſion on one ſide is $\frac{\frac{1}{2}L}{\frac{1}{2}L-a} \times E$, or $\frac{L}{L-2a}E$ $\left(\text{for } \frac{1}{2}L - a : \frac{1}{2}L = E : \frac{\frac{1}{2}LE}{\frac{1}{2}L-a}\right)$, and the repulſion on the other ſide is $\frac{\frac{1}{2}L}{\frac{1}{2}L+a} \times E$, or $\frac{L}{L+2a}E$. The difference of theſe repulſions is $E \times L \times \frac{4a}{L^2-4^2}$. But as we ſuppoſe *a* exceedingly ſmall in compariſon with

L,

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L, this difference, or the accelerating force, may ſafely be expreſſed by E $\frac{4a}{L}$, or $4a\frac{E}{L}$.

Hence we deduce, in the firſt place, that the undulations will be iſochronous, whether wide or narrow; becauſe the accelerating force is always proportional to the diſtance *a* from the middle point.

Now, let a pendulum, whoſe quantity of matter is L, and length *a*, be ſuppoſed to vibrate in a cycloid by the force $\frac{4a}{L}$ E, or $\frac{4E}{L}a$. It muſt perform its vibrations in the ſame time with the plate of air; becauſe the moving force, the matter to be moved, and the ſpace along which they are to be ſimilarly impelled, are the ſame in both caſes. Let another pendulum, having the ſame quantity of matter L, vibrate by its weight L alone. In order that theſe two pendulums may vibrate in equal times, their lengths muſt be as the accelerating forces. Therefore we muſt have $\frac{4E}{L}a : L = a : \frac{aL^2}{4Ea}, = \frac{L^2}{4E}$, which is therefore the length of the ſynchronous pendulum.

Now, a cord without weight and inertia, but loaded with the weight L at its middle point, and ſtrained by a weight E, and drawn from the axis to the diſtance *a*, is preciſely ſimilar in its motion to the diaphragm we are now conſidering, and muſt make its oſcillations in the ſame time.

This is applicable to any number of plates of air, by ſubſtituting in the cord a loaded point for each of the plates; for when the caſe is thus changed, both in the pipe and the cord, the ſpace to be paſſed over by the plate of air bears the ſame proportion to *a*, which is paſſed over by the whole air concentrated in the middle point, which the ſpace to be paſſed over by the correſponding loaded point of the cord bears to that paſſed over by the whole matter of the cord concentrated in the middle point; and the ſame equality of ratios obtains in the accelerating forces of the plate of air and the correſponding loaded point of the cord. Suppoſe, then, a pipe divided into 2, 3, 4, &c. equal parts, by 1, 2, 3, diaphragms, each of which contains the air of the intervening portions of the pipe, the whole weight L being equally divided among them. If there be but one diaphragm, its weight muſt be L; if two, the weight of each muſt be $\frac{1}{2}$ L; if three, the weight of each muſt be $\frac{1}{3}$ L; and ſo on for any number.

By conſidering this attentively, we may infer, without farther inveſtigation, what will be the undulations of all the different plates of air in a pipe ſtopped at both ends. We have only to compare it with a cord ſimilarly divided and loaded. Increaſe the number of loaded points, and diminiſh the load on each, continually—it is evident that this terminates in the caſe of a ſimple cord, with its matter uniformly diffuſed; and a ſimple pipe, with its air alſo uniformly diffuſed over its whole length.

Therefore, if we take an elaſtic cord, and ſtretch it by ſuch a weight that the extending weight may bear the ſame proportion to the accelerating force acting on the whole matter concentrated in its middle point, which the elaſticity of the air bears to its accelerating force acting on the whole matter concentrated at the mouth of an open pipe, ſounding its fundamental note, the cord and the air will vibrate in the ſame time. Moreover, ſince the proportion between the vibrations of a cord ſo conſtituted, and thoſe of a cord having its matter uniformly diffuſed, is the ſame with the proportion between the undulations in a pipe ſo conſtituted, and thoſe of a pipe in which the air is uniformly diffuſed—it is plain that the vibrations of the cord and of the pipe in their natural ſtate will alſo be performed in equal times.

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We look on this as the eaſieſt way of obtaining a diſtinct perception of the authority on which we reſt our knowledge of the abſolute number of undulations of the air in a pipe of given length. It may be obtained directly; and Daniel Bernoulli, Euler, and others, have given very elegant ſolutions of this problem, without having recourſe to the analogy of the vibrations of cords and undulations of a column of air. But it requires more mathematical knowledge than many readers are poſſeſſed of who are fully able to follow out this analogical inveſtigation.

Let us therefore compare this theory with experiment. What we call an open pipe of an organ is the ſame which we, in this theory, have conſidered as a pipe open at both ends; for the opening at the foot, which the organ builders call the VOICE of the pipe, is equivalent to a complete opening. The aperture, and the ſharp edge which divides the wind, may be continued all round, and the wind admitted by a circular ſlit, as is repreſented in fig. 10. We have tried this, and it gives the moſt brilliant and clear tones we ever heard, far exceeding the tones of the organ. An open organ pipe, therefore, when ſounding its fundamental note, undulates with one node in its middle, and its undulations are analogous, in reſpect of their mechaniſm, with the vibrations of a wire of the ſame length, and the ſame weight, with the column of air in the pipe, and ſtretched by a weight equal to that of a column of the ſame air, reaching to the top of a homogeneous atmoſphere, or equal to the weight of a column of mercury as high as that in the barometer.

Dr Smith (ſee *Harmonics*, 2d edit. p. 193.) found that a braſs wire whoſe length was 35,55 inches, and weight 31 troy grains, and ſtretched by 7 pounds avoirdupois or 49000 grains, was in perfect uniſon with an open organ pipe whoſe length was 86,4 inches.

Now 86,4 inches of this wire weighs 75,34 grains. When the barometer ſtands at 30 inches, and the thermometer at 55° (the temperature at the time of the experiment), the height of a homogeneous atmoſphere is 332640 inches. This has the ſame proportion to the length of the pipe which the preſſure of the atmoſphere has to the weight of the column of air contained in the pipe.

Now $86{,}4 : 332640 = 75{,}34 : 290060$. This wire, therefore, ſhould be ſtretched (if the theory be juſt) by 290060 grains, in order to be uniſon with the other wire, and we ſhould have $35{,}55^2 : 86{,}4^2 = 49000 : 290060$

But, in truth, - $35{,}55^2 : 86{,}4^2 = 49000 : 289430$

The difference is - - - - - 630

The error ſcarcely exceeds $\frac{1}{500}$, and does not amount to an error of one vibration in a ſecond.

We muſt therefore account this theory as accurate, ſeeing that it agrees with experiment with all deſirable exactneſs.

We

We may alſo deduce from it a very compendious rule for determining the abſolute number of aereal pulſes made by an open pipe of any given length. When conſidering the vibrations of cords, we found that the number of vibrations made in a ſecond is $\sqrt{\frac{386\,E}{LW}}$, where E is the extending weight, W the weight of the cord, and L its length. Let H be the height of a homogeneous atmoſphere. We have its weight $= \frac{HW}{L}, = E$. Therefore ſubſtituting $\frac{HW}{L}$ for E in the above formula, we have the number of aereal pulſes made per ſecond $= \sqrt{\frac{386\,H}{L^2}}$, or $= \frac{\sqrt{386\,H}}{L}$. Now $\sqrt{386}\,H$, computed in inches, is 11331. Therefore, if we alſo meaſure the length of the pipe L in inches, the pulſes in a ſecond are $= \frac{11331}{L}$. Thus, in the caſe before us, $\frac{11331}{86,4} = 131,12$, or this pipe produces 131 pulſes in a ſecond. Dr Smith found by experiment that it produced 130,9, differing only about $\frac{1}{5}$th of a pulſe.

We ſee that the pitch of a pipe depends on the height of the homogeneous atmoſphere. This may vary by a change of temperature. When the air is warmer it expands, and the weight of the induced column is leſſened, while it ſtill carries the ſame preſſure. Therefore the pitch muſt riſe. Dr Smith found his organ a full quarter tone higher in ſummer than in winter. The effect of this is often felt in concerts of wind inſtruments with ſtringed inſtruments. The heat which ſharpens the tone of the firſt flattens the laſt. The harpſichord ſoon gets out of tune with the horns and flutes.

Sir Iſaac Newton, comparing the velocity of ſound with the number of pulſes made by a pipe of given length, obſerved that the length of a pulſe was twice the length of the open pipe which produced it. Divide the ſpace paſſed over in a ſecond by the number of pulſes, and we obtain the length of each pulſe. Now it was found that a pipe of 21,9 inches produced 262 pulſes. The velocity of ſound (as computed by the theory on which our inveſtigation of the undulations in pipes proceeds) is 960 feet. Now $\frac{960 \times 12}{262} = 44$ inches very nearly, the half of which is 22, which hardly differs from 21,9. The difference of this theoretical velocity of ſound, and its real velocity 1142 feet per ſecond, remains ſtill to be accounted for. We may juſt obſerve here, that when a pipe is meaſured, and its length called 21,9 we do really allow it too little. The voice hole is equivalent to a portion, not inconſiderable of its length, as appears very clearly from the experiments of Mr Lambert on a variable pitch pipe, and on the German flute, recorded in the Berlin Memoirs for 1775. He found it equivalent to $\frac{1}{5}$th; and this is ſufficient for reconciling theſe meaſures of a pulſe with the real velocity of ſound.

The determination which we have given of the undulations of air in an organ pipe is indirect, and is but a ſketch of the beautiful theory of Daniel Bernoulli, in which he ſtates with accuracy the preciſe undulation of each plate of air, both in reſpect of poſition, denſity, velocity, and direction of its motion. It is a pleaſure to obſerve how the different equations coincide with thoſe which expreſs the vibrations of an elaſtic cord. But this would have taken up much room, and would not have been ſuited to the information of many curious readers, who can eaſily follow the train of reaſoning which we have employed.

Mr Bernoulli applies the ſame theory to the explanation of the undulations in flutes, or inſtruments whoſe ſounds are modified by holes in the ſides of the pipe. But this is foreign to our purpoſe of explaining the muſic of the trumpet. We ſhall only obſerve, that a hole made in that part of a pipe where a node ſhould form itſelf, in order to render practicable the undulations competent to a particular note, prevents its formation, and in its place we only get ſuch undulations (and their correſponding ſounds) as have a loop in that place. The intelligent reader will perceive that this ſingle circumſtance will explain almoſt every phenomenon of flutes with holes; and alſo the effects of holes in inſtruments with a reed voice, ſuch as the hautboy or clarionette.

We now ſee that the ſound or muſical pitch of a pipe is inverſely as its length, in the ſame manner as in ſtrings. And we learn, by comparing them, that the ſound of a trumpet has the ſame pitch with an open organ pipe of the ſame length. A French horn, 16 feet long, has the ſound C *fa ut*, which is alſo the ſound of an open flute-pipe of that length.

The TROMBONE, great trumpet, or SACKBUT, is an old inſtrument deſcribed by Merſennus, and other authors of the laſt century. It has a part which ſlides (air-tight) within the other. By this contrivance the pitch can be altered by the performer as he plays. This is a great improvement when in good hands; becauſe we can thus correct all the falſe notes of the trumpet, which are very offenſive, when they occur in an emphatical or holding note of a piece of muſic. We can even employ this contrivance for filling up the blanks in the lower octaves.

We muſt not take leave of this ſubject without taking notice of another diſcovery of Mr Bernoulli's, which is exceedingly curious, and of the greateſt importance in the philoſophy of muſic.

Artiſts had long ago obſerved that the deep notes of muſical inſtruments are ſometimes accompanied by their harmonic ſounds. This is moſt clearly perceived in bells, ſome of which give theſe harmonics, particularly the 12th, almoſt as ſtrong as the fundamental. Muſicians, by attending more carefully to the thing, ſeem now to think that this accompaniment is univerſal. If one of the fineſt ſounding ſtrings of the baſes of a harpſichord be ſtruck, we can hear the 12th very plainly as the ſound is dying away, and the 17th major is the laſt ſound that dies away on the ear. This will be rendered much more ſenſible, if we divide the wire into five parts, and at the points of diviſion tie round it a thread with a faſt knot, and cut the ends off very ſhort. This makes the ſtring falſe indeed by the unequal loading; but, by rendering thoſe parts ſomewhat leſs moveable by this additional matter, the portions of the wire between theſe points are thus jogged, as it were, into ſecondary vibrations, which have a more ſenſible proportion to the fundamental vibration. This is ſtill more

ſenſible

ſenſible in the ſound of the ſtrings of a violincello when ſo loaded; but we muſt be careful not to load them too much, becauſe this would ſo much retard the fundamental vibration, without retarding the ſecondary vibrations, that both cannot be maintained together. (*N. B.* This experiment always produces a beat in the ſound)—Liſtening to a fine ſounding flute pipe of the organ, we can alſo very often perceive the ſame thing. Mr Rameau, and moſt other theoriſts in muſic, now aſſert that this is the eſſence of a muſical ſound, and *neceſſarily* exiſts in all of them, diſtinguiſhing them from harſh noiſes. Rameau has made this the foundation of his ſyſtem of muſic, aſſerting that the pleaſure of harmony reſults from the ſucceſsful imitation of this harmony of Nature, (ſee Music, *Encycl.*). But a little logic ſhould convince theſe theoriſts that they muſt be miſtaken. If a note is muſical becauſe it has theſe accompaniments, and by this compoſition alone is a muſical note, what are theſe harmonics? Are they muſical notes? This is granted. Therefore they have the ſame compoſition; and a muſical note muſt conſiſt at once of every poſſible ſound; yet we know that this would be a jarring noiſe. A little mathematics, too, or mechanics, would have convinced them. A ſimple vibration is ſurely a moſt poſſible thing, and therefore a ſimple ſound. No, ſay the theoriſts; for though the vibration of the cord may be ſimple, it produces ſuch undulations in the air as excite in us the perception of the harmonics. But this is a mere aſſertion, and leaves the queſtion undecided. Is not a ſimple undulation of the air as poſſible as the ſimple vibration of a cord?

It is, however, a very curious thing, that almoſt all muſical ſounds really have this accompaniment of the octave, 12th, double octave, and 17th major; for theſe are the harmonics that we hear.

The jealouſy of Leibnitz and of John Bernoulli, and their unfriendly thoughts reſpecting all the Britiſh mathematicians, made John Bernoulli do every thing in his power to leſſen the value of Dr Taylor's inveſtigation of the vibration of a muſical cord. Taylor gave him a good opportunity. Perhaps a little vain of his inveſtigation of this abſtruſe matter, he thought too much of it. He affirmed that the harmonic curve was the eſſential form of a ſtring giving a muſical note. This was denied without knowing at firſt whether it was true or falſe. But as the analytic mathematics improved, it was at length found that there are an infinity of forms into which an elaſtic cord can be thrown, which are conſiſtent both with iſochronous vibrations, whether wide or narrow, and alſo with the condition of the whole cord becoming a ſtraight line at once. Euler, D'Alembert, and De la Grange, have proſecuted this matter with great ingenuity, and it is one of the fineſt problems of the preſent day.

Daniel Bernoulli, of a very different caſt of mind from his illuſtrious friends, admired both Newton and Taylor; and ſo far from wiſhing to eclipſe Dr Taylor by the additions he had made to his theory, tried whether he could not extend Taylor's doctrine as far as the author had ſaid. When he took a review of what he had done while explaining the partial vibrations of muſical cords, he thought it very poſſible that while a cord is vibrating in three portions, with two nodes or points of reſt, and ſounding the 12th to its fundamental, it might at the ſame time be alſo vibrating as a ſimple cord, and ſounding its fundamental note. It was poſſible, he thought, that the three portions might be vibrating between the four points with a triple frequency, while the two middle nodes were vibrating acroſs the ſtraight line between the two pins; and thus the vibrating cord might be a moveable axis, to which the rapid vibrations of the three parts might always be referred. This was very ſpecious, and when a little more attentively conſidered, became more probable; for if the cord $ApBqCrD$ (fig. 8.) be vibrating as a 12th to its fundamental AD, the points B and C are in equilibrio. If therefore theſe two points be laid hold of by hooks, and be drawn aſide to β and γ, while the ſtring is yet vibrating, this ſhould not hinder the vibrations. If the hooks be annihilated in an inſtant, the whole ſhould vibrate between A and D; and this ſhould be in a way very different from the ſimple vibration. The queſtion now is, will the cord *continue* to vibrate with the loops $\beta s \gamma$, $\beta q \gamma$, &c. in the 900th part of a ſecond (for inſtance), while the whole ſtring vibrates from $A \beta \gamma D$ to $A \beta' \gamma' D$ in the 300th part of a ſecond? or will it at once acquire the form of the ſimple harmonic curve? The caſe in which it is moſt likely to take the latter mode of vibration is when the points β and γ are let go at the inſtant that each portion of the ſtring is in the middle of its vibration, and therefore forms the line $A \beta \gamma D$. But a moment's conſideration will ſhew us that it cannot do this; for at that inſtant the point v, for inſtance, which had come from q, is moving outwards with a moſt rapid motion, and therefore will continue to go outward, while β and γ are approaching the axis. The point w, on the contrary, is at this moment approaching the axis with a motion equally rapid. They cannot therefore all come to the axis at once, and the vibration muſt differ greatly from a ſimple one. On the other hand, let it be ſuppoſed that both ſpecies of vibrations can be preſerved, and that, at the moment of letting go the points β and γ, the cord has the form $A m \beta q \gamma n D$. Then, when β and γ have come to B and C, having made ½ a vibration, the point m will be in the axis, having made a vibration downward, and a half vibration upwards, q, in like manner, is in the axis, having made a whole vibration upwards, and half a vibration downwards. n is like m. Thus the whole comes to the axis at once; and in ſuch a manner, that if the points B and C were inſtantly ſtopped, the three portions would continue their partial vibrations without any new effort. The reſult of this compound vibration muſt be a compound pulſe of air, which will excite in us the perception of the fundamental ſound and of its 12th. The conſequence will be the ſame if the points β and γ are ſtopped any where ſhort of the axis; and therefore (ſaid Bernoulli) the ſtring will really vibrate ſo if not ſtopped at all.

But this was refuſed by Euler, who obſerved that in the points β and γ of contrary flexure, having no curvature, there can be no accelerating force. This cauſed Bernoulli to attempt a direct inveſtigation, examining minutely the curvatures and accelerating forces in the different points.

He had the pleaſure of finding that the accelerating forces ariſing from the curvature in every point, were preciſely ſuch as would produce the accelerations neceſſary in thoſe points for performing the motion that was

was required. And he exhibited the equations expreſſive of the ſtate of the cord in all theſe points. And, on the faith of theſe equations, he reſtored the Taylorean curve to the rank which its inventor had given it; and he aſſerted that in every muſical vibration the cord was diſpoſed in a harmonical curve either ſimple or compound. He farther ſhewed that the equations which Euler and D'Alembert had given for the muſical cord (at leaſt in the caſes which they had publiſhed) were included in his equations, and that their equations only exhibited its momentary ſtates, while his own equations ſhewed the phyſical connection of them all; which is, that the whole cord forms a harmonic curve between the two fixed pins, while its different portions form ſubordinate harmonic curves on the firſt as an axis. Euler and D'Alembert, although they acknowledge this in the particular caſes which they had taken as examples, on account of their ſimplicity, ſtill inſiſt that no ſubordinate harmonic vibrations can correſpond to all the ſtates of an elaſtic cord which their equations exhibit as iſochronous and permanent. Mr Bernoulli's death put an end to the controverſy, and the queſtion (conſidered as a general theory) is perhaps ſtill undecided. It may very probably be true, that as a ſimple vibration may be permanent which never has the form of the ſimple harmonic deſcribed by Dr Taylor, ſo a vibration may exiſt compounded of ſuch vibrations, and therefore not expreſſible by any equation deduced from the Taylorean curve.

But, in the mean time, Mr Bernoulli has made the moſt beautiful diſcovery in mechanics which has appeared in the courſe of the laſt century, and has explained the moſt curious phenomenon of continued ſounds, *viz.* the *almoſt univerſal* accompaniment of the harmonic notes of any fundamental ſound. For this *ſuſceptibility* of compounded variation is not confined to a 12th, but is equally demonſtrable of every other harmonic. Nay, it is evident that the ſame ſimple vibration of a cord may furniſh a moveable axis to more than one harmonic. For as the ſimple vibration can have a ſubordinate harmonic vibration ſuperinduced upon it, ſo may this compounded vibration have another ſuperinduced on it, and ſo on to any degree of compoſition. And farther, as Mr Bernoulli has ſhewn the complete analogy between the accelerations of the different points of an elaſtic cord and of the correſponding plates of a column of air, it legitimately follows that all the conſequences which we can eaſily deduce, reſpecting the vibrations of an elaſtic cord, may be affirmed reſpecting the undulations of a column of air in a pipe. Therefore this accompaniment of the harmonics muſt not be confined to the muſic of ſtrings and bells, but equally obtains in the muſic of wind inſtruments. And thus the doctrine becomes univerſal.

Mr Bernoulli did not think it enough to ſhew that theſe compound vibrations are poſſible. He endeavours to ſhew that this accompaniment muſt be frequent. He illuſtrates this very prettily, by ſuppoſing that a toothed wheel is turned round, and rubs with its teeth on an elaſtic cord. If the ſucceſſive dropping of the teeth keep exactly pace with ſuch vibrations as the cord can take and maintain by its elaſticity, theſe will certainly be formed on it. If the intervals do not *exactly* correſpond, a little reflection will ſhew that the agitation which the cord acquires will approximate to thoſe which it can maintain: and if when they are exactly ſo in any place of it, and the wheel be in that inſtant removed, this vibration will remain and diffuſe itſelf through the reſt of the cord; ſo that the very laſt dying quiver (ſo to ſpeak) will be harmonic. Every *harmonic* agitation tends, by the very nature of the thing, to continue, while thoſe that are incompatible really *do* deſtroy each other; and the very laſt muſt be the remainder or ſuperplus of ſuch as could continue, over thoſe which deſtroyed each other. Accordingly, the harmonic notes of wires are always moſt diſtinctly heard as the ſound is dying away.

There is no occaſion now to ſay any thing about the fallacy of Rameau's *Generation Harmonique* as a theory of muſical pleaſure. Our harmonies pleaſe us, not becauſe a ſound is accompanied by its harmonics, but becauſe harmonics pleaſe. His principle is therefore a tautology, and gives no inſtruction whatever. His theory is a very *forced* accommodation of this principle to the practice of muſicians, and taſte of the Public. He is exceedingly puzzled in the caſe of the *ſousdominante*, or 4th of the ſcale, and the 6th where there is no reſonance. He ſays that theſe notes, "fremiſſent, quoiqu'elles ne reſonnent pas." But this miſleads us. They do not reſound; becauſe a 4th and a 6th cannot be produced at all by dividing the chord. They tremble; becauſe the falſe 4th and falſe 6th are very near the true ones, and the true 4th and 6th would both tremble and reſound, if they were made falſe. A ſtring will both tremble and reſound, if very nearly true, as any one obſerves the 12th and 17th on a harpſichord tremble and reſound very ſtrongly, though they are tempered notes. The whole theory is overturned at once by tuning the 4th falſe, ſo as to correſpond to an aliquot diviſion of the cord. It will then reſound; and if this had happened to be agreeable, it would have been catched at as the ſouſdominant.

The phyſical cauſe of the pleaſure of harmonic ſounds is yet to ſeek, as much as our choice of thoſe notes for melody which give us the beſt harmony (ſee Temperament, *Suppl.*). We have no heſitation in ſaying that, with reſpect to our choice, the two are quite independent. Thouſands enjoy the higheſt pleaſure from melody who never heard a harmonious ſound. All the untaught ſingers, and all ſimple nations, are examples. They not only fix on certain intervals as the ſteps of their tunes, but are diſguſted when other ſteps are taken. Nor do we heſitate, for the very ſame reaſons, to ſay that the rules of accompaniment are dependent on the cantus or air, and by no means on the fundamental baſs of Rameau. The dependence aſſumed by him, as the rule of accompaniment, would, if properly adhered to, according to his own notions of the comparative values of the harmonics, lead to the moſt fantaſtic airs imaginable, always jumping by large intervals, and altogether incompatible with graceful muſic. The rules of modulation which he has ſqueezed out of his principle, are nothing but forced, very forced, accommodations of a very vague principle to the current practice of his contemporaries. They do not ſuit the primitive melodies of many nations, and they have cauſed theſe national muſics to degenerate. This is acknowledged by all who are not perverted by the prevailing habits. We have heard, and could write down, ſome moſt enchanting lullabies of ſimple peaſant women,

men, poſſeſſed of muſical ſenſibility, but far removed, in the cool ſequeſtered vale of life, from all opportunities of ſtealing from our great compoſers. Some of theſe lullabies never fail to charm, even the moſt erudite muſician, when ſung by a fine flexible voice: but it would puzzle Mr Rameau to accompany them *ſecundum artem*.

We conclude this ſubject by deſcribing a moſt beautiful and inſtructive experiment.

Mr Watt, the celebrated engineer, was amuſing himſelf (about the year 1765) with organ building, and invented a monochord of continued ſound, by which he could tune an organ with mathematical preciſion, according to any propoſed ſyſtem of temperament. It conſiſted of a covered ſtring of a violincello, ſounding by the friction of an ivory wheel. The inſtrument did not anſwer Mr Watt's purpoſe, by reaſon of the dead harſhneſs of its tone, and a flutter in the ſtring by the unequal action of the wheel. But Mr Watt was amuſed by obſerving the ſtring frequently taking, of its own accord, points of diviſion, which remained fixed, while the reſt was in a ſtate of ſtrong vibration. The inſtrument came into the poſſeſſion of the writer of this article. He ſoon ſaw that it gave him an opportunity of making all the experiments which Bernoulli could only relate. When the ſtring was kept in a ſtate of ſimple vibration, by a very uniform and gentle motion of the wheel, if its middle point was then gently touched with a quill, this point immediately ſtopped, but the ſtring continued to vibrate in two parts, ſounding the octave: And this it continued to do, however ſtrong the vibrations were rendered afterwards by increaſing the preſſure and velocity of the wheel. The ſame thing happened if the ſtring was gently touched at one-third. It inſtantly divided itſelf into three parts, with two nodes, and ſounded the 12th. In the ſame manner the double octave, the 17th, and all other harmonics, were produced and maintained.

But the prettieſt experiment was to put ſomething ſoft, ſuch as a lock of cotton, in the way of the wide vibrations of the cord, at one-third and two-thirds of its length, ſo as to diſturb them when they became very wide. When this was done, the ſtring inſtantly put on the appearance of fig. 8. performing at once the full vibration competent to its whole length, and the three ſubordinate vibrations, correſponding to one-third of its length, and ſounding the fundamental and the 12th with equal ſtrength. In this manner all the different accompaniments were produced at pleaſure, and could be continued, even with ſtrong ſounds. And it was amuſing to obſerve, when the wheel was ſtrongly preſſed to the ſtring, and the motion violent, the nodes would form themſelves on various parts of the ſtring, running from one part to another. This was always accompanied with all the jarring ſounds which correſponded to them.

When the ſtring was making very gentle, ſimple vibrations, and the wheel hardly touching it, if a violincello was made to ſound the 12th very ſtrongly in its neighbourhood, the ſtring inſtantly divided itſelf, and vibrated in uniſon, frequently retaining its ſimple vibration and fundamental tone. We recommend this experiment to every perſon who wiſhes to make himſelf well acquainted with the mechaniſm of muſical ſounds. He will ſee, in a moſt ſenſible and convincing manner, how a ſingle ſtring of the Æolian harp gives us all the changes of harmony, ſliding from one ſound to another, according as it is affected in its different parts by an irregular breeze of wind. The writer of this article has attempted to regulate theſe ſweet harmonic notes, and to introduce them into the organ. His ſucceſs has been very encouraging, and the ſounds far exceed in pathetic ſweetneſs any that have yet been produced by that noble inſtrument. But he has not yet brought them fully under command, nor made them ſtrong enough for any thing but the ſofteſt chamber muſic. Other neceſſary occupations prevent him from giving the attention to this ſubject that it deſerves. He recommends it therefore to the muſical inſtrument makers as richly deſerving their notice. His general method was this: A wooden pipe is made, whoſe ſection is a double ſquare. A partition in the middle divides it into two pipes, along ſide of each other. One of them communicates with the foot and wind cheſt, and is ſhut at the upper end. The other is open at the upper, and ſhut at the lower end. In the partition there is a ſlit almoſt the whole length, and the ſides of this ſlit are brought to a very ſmooth chamfered or feather edge. A fine catgut is ſtrained in this ſlit, ſo as almoſt to touch the ſides. It is evident that when the wind enters one pipe by the foot, it paſſes through the ſlit into the other, and eſcapes at the top, which is open. In its paſſage it forces the catgut into motion, and produces a muſical note, having all the ſweetneſs of the Æolian harp. The ſtrength of ſound may be increaſed by increaſing the body of air which is made to undulate. This was done by uſing, inſtead of catgut, very narrow ſilk tape or ribband varniſhed: but the unavoidable raggedneſs of the edges made the ſounds coarſe and wheeſing. Flat ſilver wire was not ſufficiently elaſtic; flat wire, uſed for watch balance ſprings, was better, but ſtill very weak ſounded. Other methods were tried, which promiſed better. A thin round plate of metal, properly ſupported by a ſpring, was ſet in a round hole, made in another plate not ſo thin, ſo as juſt not to touch the ſides. The air forced through this hole made the ſpring plate tremble, dancing in and out, and produced a very bold and mellow ſound.—This, and ſimilar experiments, are richly worth attention, and promiſe great additions to our inſtrumental muſic.

TRURO, a town of Nova-Scotia, ſituated in Halifax county, at the head of the Baſin of Minas, oppoſite to, and 3 miles ſoutherly of, Onſlow; 40 miles N. by W. of Halifax, and 40 from Pictou. It was ſettled by the North-Iriſh, ſome Scotch, and the deſcendants of North-Iriſh. Through this town runs the river called by the Indians Shubbenacadie, navigable for boats to within 9 miles of Port Sackville.—*Morſe.*

Truro, a townſhip of Maſſachuſetts, ſituated in Barnſtable county, lies between lat. 41 57, and 42 4 N. and between long. 70 4 and 70 13 W. It is on the eaſternmoſt part of the peninſula of Cape Cod, 57 miles S. E. of Boſton, in a ſtraight line, but as the road runs it is 112, and 40 from the court-houſe of Barnſtable. It is the *Pamet* of the Indians, and after its ſettlement in 1700 was ſome time called *Dangerfield*; it was incorporated under its preſent name in 1709, and contains 1,193 inhabitants. Only one family of Indians remained a few years ſince, and lived on *Pamet Point*. In the valley called *Great Hollow*, a creek ſets up from the bay, at the mouth of which is a tide harbour. The other landing-places are of ſmall note.

PLATE XLV.

Fig. 1

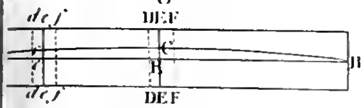


Fig. 3

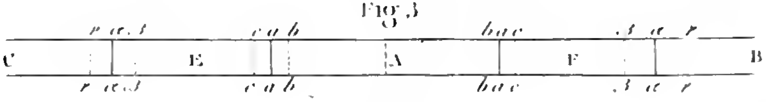


Fig. 2

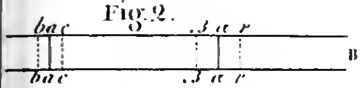


Fig. 4.

Fig. 5.

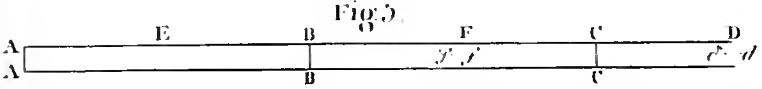


Fig. 6.

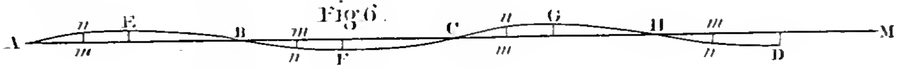


Fig. 7.

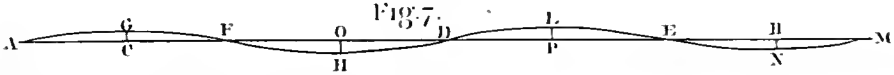


Fig. 8.

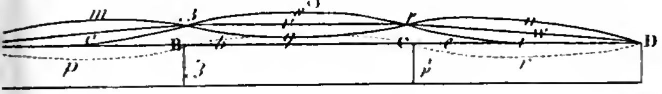


Fig. 10.

Fig. 9.

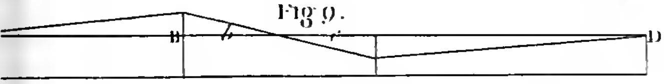
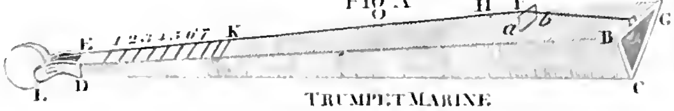


Fig. A



TRUMPET MARINE

Fig. C.

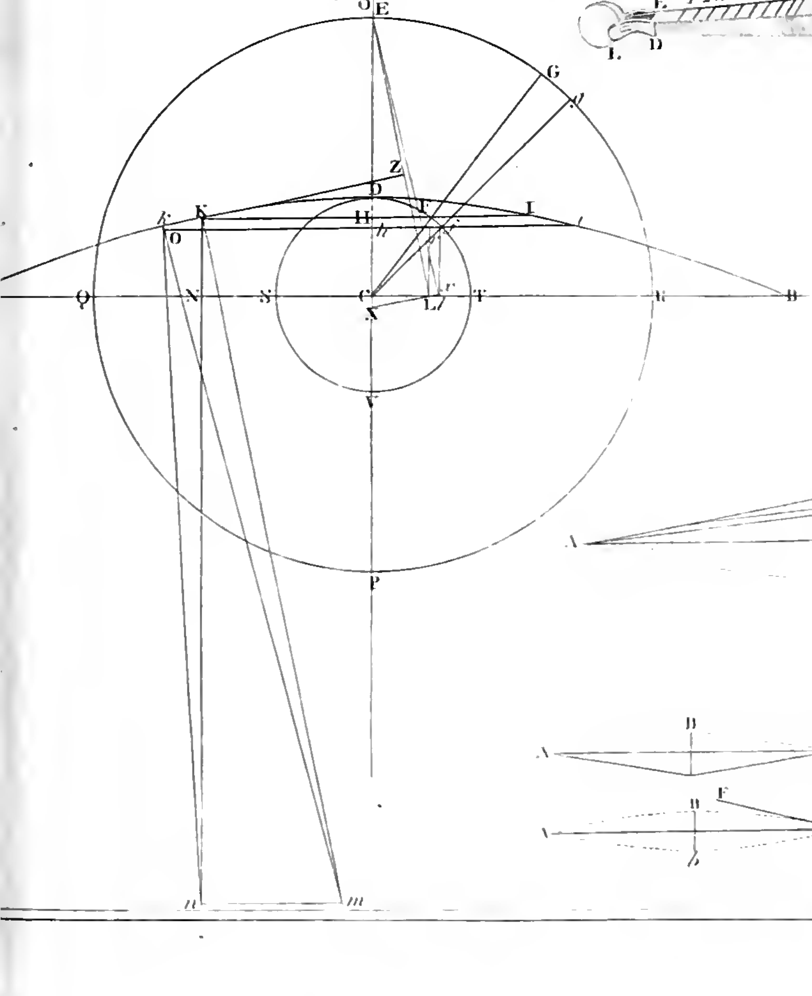


Fig. B.

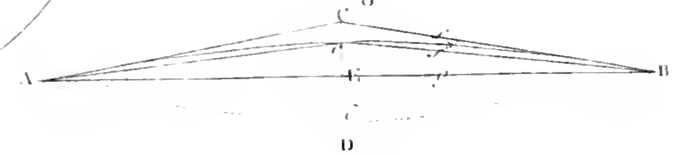
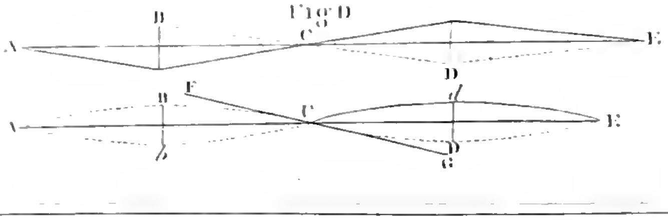


Fig. D



Pamet Harbour is about 100 yards wide at the mouth, but is wider within; and if repaired would be of public utility. It lies above 3 leagues S. E. of Cape Cod harbour. The hill on which the meeting-houſe ſtands branches from the high land of Cape-Cod, well known to ſeamen. The mountain of clay in Truro, in the midſt of ſandy hills, ſeems to have been placed there by the God of Nature, to ſerve as a foundation for a light-houſe, which if erected might ſave the lives of thouſands, and millions of property. The ſoil of Truro is, in moſt places, ſandy, like Provincetown; and the inhabitants derive their principal ſubſiſtence from the ſea, which here abounds with vaſt variety of fiſh. Great part of their corn and vegetables are procured from Boſton and the neighbouring towns. Two inhabitants of Truro, Captains David Smith and Gamaliel Collings, were the firſt who adventured to Falkland Iſlands in purſuit of whales. This voyage, which was crowned with ſucceſs, was undertaken in 1774, by the advice of Admiral Montague of the Britiſh navy. The whalemen of Truro now viſit the coaſt of Guinea and Brazil. Many of the maſters of ſhips employed from Boſton and other ports, are natives of Truro. The elderly men and ſmall boys remain at home to cultivate the ground; the reſt are at ſea two-thirds of the year. The women are generally employed in ſpinning, weaving, knitting, &c.—*ib.*

TRUXILLO, a bay, harbour, and town, at the bottom of St Giles's Bay, on the coaſt of Honduras, in the gulf of that name. The bay is about 6 miles broad, being deep and ſecure, and defended by a caſtle; but it has little trade. The town ſtands about a league from the North Sea, between two rivers, the mouths of which, with ſome iſlands before them, form the harbour. The country is exceedingly fruitful in corn and grapes, and notwithſtanding the heat of the climate, very populous. The city is defended by a thick wall towards the ſea, and is inacceſſible but by a narrow, ſteep aſcent. The caſtle joins to the wall, and ſtands on a hill. Behind the city are high mountains. It lies 300 miles N. E. of Amapalla. N. lat. 15 20, W. long. 85 56.—*ib.*

TRUXILLO, the firſt dioceſe in the audience of Lima, in Peru.—*ib.*

TRUXILLO, a bay or harbour, and one of the principal cities of the province of the ſame name in Peru, is 11 leagues from Chocope, and 80 N. W. of Lima; and according to Ulloa, the city lies in lat. 8 6 3 S. and long. 77 30 W. It ſtands in the valley of Chimo, on a ſmall river, about half a league from the ſea; is ſurrounded with a brick wall, and from its circuit may be claſſed among cities of the third order. Two leagues to the northward is the port of Guanchaco, the channel of its trade. The houſes make an elegant appearance, being generally of brick, with ſtately balconies and ſuperb porticos.—*ib.*

TRUXILLO, or *Noſtra Seniora de la Paz*, a town of New-Granada (Venezuela) and Terra Firma, in S. America, 125 miles ſouth of Maracaibo Lake; on the ſouthernmoſt bank of which lake is a village, called Truxillo, dependent on this city. The city is in lat. 9 21 N. and long. 69 15 W.—*ib.*

TRYON *Mountains*, in N. Carolina, lie N. W. of the town of Saliſbury, on the borders of the State of Tenneſſee.—*ib.*

Tſchirnhaus.

TSCHIRNHAUS, (Ehrenfred Walther Von), a name well known in the republic of letters, and one of the ornaments of the 17th century, was born April 10, 1651, at Kiſlingſwald near Gorlitz in Upper Luſatia. His father was Erneſt Chriſtopher Von Tſchirnhaus, Baron Kiſlingſwald and Stolzberg, and Obernſchonfeld, privy counſellor, and in various offices of rank under the Electors George I, and II. of Saxony, the firſt of whom honoured him with the diſtinction of the gold chain and portrait, as a mark of his ſenſe of his merits and ſervices. The mother of the young Von Tſchirnhaus was Maria Stirling, daughter of *Baron Stirling et Achil*, Stirling of Achil, or Achyle, in Scotland, an old and reſpectable family, as appears by an epitaph which the Duke Chriſtian, brother of the Elector George II. inſcribed on the tomb of Johan Albert Stirling of Achil, in the cathedral of Marckſpurg. This gentleman had been preſident of the ſenate of the electorate, privy counſellor, director of the impoſts, and maſter of horſe to the Prince, and had, by his faithful and uſeful ſervices, acquired his higheſt eſteem.

E. W. Von Tſchirnhaus was born, as has been obſerved, at Kiſlingſwald, the uſual reſidence of the family, and poſſeſſed by it during more than 300 years. The family came originally from Bohemia, and appears to have been conſiderable, ſeeing that, from the earlieſt accounts of it in Luſatia, the Barons of Kiſlingſwald are generally found in the moſt reſpectable civil offices.

The figure which Baron Von Tſchirnhaus, the ſubject of this relation, has made in the ſcientific and political world, makes it ſuperfluous to ſay that his early years were well employed. Quick apprehenſion, a clear perception of the ſubject of his thoughts, and the moſt ardent and inſatiable thirſt for knowledge, diſtinguiſhed him during his academical education. When 17 years of age, he was ſent to Leyden. In 1672 all ſtudy was interrupted in Holland by the din of war; and Mr Van Tſchirnhaus left the univerſity for the camp. His knowledge in mathematics, mechanics, and all phyſical ſcience, found ample room in the military ſervice for ſhewing the importance of thoſe ſciences; and Tſchirnhaus ſo diſtinguiſhed himſelf by his ſervice in this way, that Baron Nieuland, a general officer of great merit, and at the ſame time an accompliſhed ſcholar, took delight in puſhing him into every ſervice where he could ſhew himſelf and his talents.

After two years ſervice, he returned to his father's; but finding little to intereſt him in the life of a mere country gentleman, and ſtill burning with the ſame thirſt of knowledge, he prevailed on his father to allow him to travel. His younger brother George Albrecht Von Tſchirnhaus, Baron Obernſchonfeld, which he inherited from his grandfather Stirling, loved him with the warmeſt affection, and ſupplied him liberally with what was required for his appearance every where in a manner becoming his rank, and for fully gratifying his curioſity. He uſed often to ſay, "Sorry was I to loſe the company of my dear brother, and I ſometimes wiſhed to accompany him; but not having his thirſt for knowledge, I knew that his love for me would debar him of much happineſs, which I ſhould thus have obſtructed." *Felices animæ!* He went to Holland, from thence into England, France, Italy, Sicily, Malta, Greece.—Returning through the Tyrol, he met his brother at Vienna, where both were in great favour at the court of

Leopold. Wherever he went, he made himſelf acquainted with the moſt eminent in all departments of ſcience, living with them all in the mutual exchange of diſcoveries and of kind offices. In Holland he was intimate with Huyghens and Hudde; in England with Newton, Wallis, Halley, and Oldenburgh; in France, among a people who more ſpeedily contract acquaintance, there was not a man of note with whom he did not cultivate an active acquaintance—and, fortunately, Leibnitz then lived at Paris: in Italy, he was particularly careſſed by Michaeli, ſoon after Cardinal; and was in the cloſeſt correſpondence with Kircher. His enjoyments, however, were derived ſolely from the communications of the moſt eminent; his curioſity was directed to every thing, and wherever he ſaw an ingenious artiſan, he was eager to learn from him ſomething uſeful. In 1682, when at Paris for the third time, he communicated to his friends his celebrated theory of the cauſtic curves, which marked him out as a valuable acquiſition, and he was elected a member of the Royal Academy of Sciences, which was then reformed by the great miniſter Colbert, and the moſt illuſtrious in all nations were picked out for its ornaments. There he found himſelf ſeated with Leibnitz, Huyghens, John Bernoulli, &c.

After twelve years employed in viſiting Europe, he returned home: but after a ſhort ſtay, went to Flanders, and prepared to publiſh his work, intitled *Medicina Mentis;* of which the ſubject may almoſt be gueſſed, from the way in which he had exerciſed his own mind. Having the moſt exalted notions of the intellectual and moral nature of man, he thought that the continual ſupply of information was as neceſſary as the continual ſupply of food. And his great principle was TO ENLIGHTEN. This work was committed to the care of ſome friends, and did not appear till 1687, at Amſterdam. A ſecond edition appeared at Leipſic in 1695.

Finding now that his moderate fortune was inſufficient for the great public projects he had in view, he ſought for aſſiſtance, and endeavoured to make friends by frequenting the court of the Elector at Dreſden. He ſoon became a favourite of his Princes, George the II. and III. and was appointed to active offices of great reſponſibility. By the orders and encouragement of the Elector, then king of Poland, he introduced into his native country the firſt manufacture of glaſs; and his project ſoon throve to ſuch a degree, that not only Saxony was ſupplied, but they even began to export the finer kinds of white glaſs for windows; in which manufacture Saxony ſtill excels. It was in the courſe of experiments for improving this manufacture that Tſchirnhaus made the celebrated great burning glaſſes which ſtill bear his name. He made two of theſe lenſes, and gave one to the Emperor, and the other to the Academy of Paris. He was eager to improve the art of forming and poliſhing optical glaſſes; and in the proſecution of the theory on which their performance depends, he made ſome beautiful diſcoveries in the department of pure geometry. It is well known that all the ſciences are allied, and of a family, and that eminence in one is ſeldom attainable without the aſſiſtance of others. His preſent purſuits led him to the ſtudy of chemiſtry, which he proſecuted with the ſame ardour which he exhibited in every thing he undertook. But all the while, mathematics, and eſpecially geometry, was his favourite ſtudy; and he was anxious to make the ſame advances in the general paths of mathematical inveſtigation which he thought he had made in the general laws of material nature. He apprehended that only bye paths were yet known, and that many things were yet inacceſſible; becauſe we had not yet found out the great roads from which theſe branches were derived. He was of Des Cartes's opinion, that the true road in mathematics muſt be an eaſy one, except in caſes which were, in their own nature, complicated. Very early, therefore, he began writing on mathematical ſubjects, always continuing his general views of the ſcience, and his endeavours to ſyſtematiſe the ſtudy; but, at the ſame time, beſtowing a very particular attention on any branch which chanced to intereſt him; each of theſe his epiſodical ſtudies in mathematics deſerves the name of a department of the ſcience. This is the caſe with his theory of cauſtic curves, with his method of tangents, and his attempt to free Leibnitz's calculus from all conſideration of infiniteſimal quantities. Mr Tſchirnhaus ſeldom gave himſelf any trouble with a particular problem. In all his mathematical performances, there is an evident connection with ſomething which he conſidered as the great whole of the ſcience; and the manner of treating the different queſtions is plainly accommodated to a ſyſtem in his thoughts. This he intended as the third part of the Medicina Mentis; and, having nearly completed the ſecond, he had propoſed theſe as the occupation of the enſuing winter (1708-9). But his death, which may be called premature, has deprived the world of theſe, and other beneficent and uſeful labours.

Mr Von Tſchirnhaus was of the moſt mild and gentle diſpoſition, as was well known to all who enjoyed his acquaintance. This diſpoſition was ſo eminent in him, that ſcarcely any perſon ever ſaw him angry, or even much ruffled in his temper. He forgave injuries frankly and heartily, and often ſtood the friend (unknown) of thoſe who had wronged him. By ſuch conduct, he changed ſome enmities into the moſt ſteady and affectionate friendſhips. As an inquirer and an inventor, he had contentions with other claimants, and ſome diſputes about the legitimacy of his methods; as, for example, with Nicholas Fatio Duiller, who attacked Tſchirnhaus's method of tangents; and Preſtet and Rolle, who found fault with his expreſſion of equations of the third degree. But theſe were all friendly debates, and never carried him beyond the limits of gentlemanly behaviour. He began to diſpute with Ozanam about a quadratrix; but on being merely told that he was miſtaken, by P. Souciet, he immediately acknowledged his error, and corrected it.

Many original and important mathematical performances of Mr Von Tſchirnhaus are to be ſeen in the Leipſic Acts, in the Memoirs of the Academy of Sciences at Paris, and other literary journals. His happy generaliſation of Dr Barrow's theorem for the focus of a ſlender pencil of rays after reflection or refraction, and the theory of cauſtic curves, in which this terminates, both conſtitute one of the moſt elegant branches of optical ſcience, and affords a rich harveſt of very curious and unexpected geometrical truths. The manner in which he notices the rough way in which his firſt and ſole miſtake in this theory was pointed out, is perhaps incomparable as an example of gentlemanlike reprehenſion, Tſchirnhaus.

reprehenſion, and is a leſſon for literati of all deſcriptions, highly valuable on account of the ſoft way in which it falls, while it is convincing as a mathematical theorem.

Tſchirnhaus was the diſcoverer of the ſubſtance of which the celebrated Saxon porcelain is made, and of the manner of working it up; by which he eſtabliſhed a manufacture highly profitable to his country, and has given us the fineſt pottery in the world. He never wearied in ſpreading uſeful knowledge; and the ſhops of our artiſans of almoſt all kinds were ſupplied with books of inſtructions and patterns, many of them written by Mr Von Tſchirnhaus, or under his inſpection. Uſeful books of all kinds were tranſlated out of foreign languages at his expenſe. Men of genius in the arts were enabled, through the encouragement of himſelf and his friends, and often by his pecuniary aſſiſtance, to bring their talents before the public eye. In ſhort, he ſeemed at all times to prefer the public good to his own; and never felt ſo much pleaſure as when he could promote ſcience or the uſeful arts. He was as it were ſtimulated to this by an innate propenſity. And as he was more deſirous of *being* than of *appearing* the accompliſhed man, he was in no concern what notice others took of his ſervices to the public. He even repreſents the deſire of fame as hoſtile to the improvement either of ſcience or morality, in his *Medicina Mentis*; a work which is acknowledged by all who knew him to be a picture of his own amiable mind. He lightly eſteemed riches; and knew not what uſe they were of, except for providing the neceſſaries of life, and the means of acquiring knowledge. In perfect conformity to this maxim, he modeſtly, and with elegant reſpect, refuſed the ample preſents made him by his affectionate ſovereign; and when he was added to his cabinet council, he received the diploma, but begged and obtained to be free from the title. And when he preſented his great burning glaſs to the Emperor, and got from him the dignity and inſignia of Baron of the Empire, he pleaded for leave to decline it, requeſting to keep the chain and portrait, which he always wore under his veſt. He expended a very great portion of the ample revenue left him by his father in the ſervice of his country, by promoting the uſeful arts and ſciences.

Mr Von Tſchirnhaus venerated truth above all things; ſaying, that thoſe who thought any thing comparable with it were not the ſons of God, but ſtep children, and that the love of truth is the ruling affection in every man of a worthy heart. In a letter to an intimate friend, he ſaid that, by the age of five-and-twenty, he had completely ſubdued the love of glory, of riches, and of worldly pleaſures; and that at no time he had found it difficult to repreſs vanity, becauſe he was every day conſcious of having acted worſe than he was certain that he might and ſhould have done. He felt himſelf humbled in the ſight of the All-perfect Judge.

Nor was all this the vain boaſt of a man averſe to buſineſs, and poſſeſſed of an ample fortune, which permitted him, without inconvenience, to pleaſe his fancy in ſtudy, and in helping others with what to himſelf was ſuperfluous. Such a character, though rare, may exiſt, without being the object of much reſpect. No: Mr Tſchirnhaus was really a philoſopher of the true ſtoic ſect, in reſpect of fortitude of mind, while a good Chriſtian in modeſty and diffidence. In the laſt five years of his life he bore up under troubles, and embarraſſments, and misfortunes in his family, which would have tried the mind of Cato himſelf. But in the midſt of theſe ſtorms he was unſhaken, and preſerved his ſerenity of mind. He was even ſenſible of this being a rare gift of Providence, and uſed frequently to expreſs his thankfulneſs for a treaſure ſo precious. He felt deeply his relation to the Author of Nature, and rejoiced in thinking himſelf ſubject to the providence of God. He ſaid that he was fully perſuaded that he would meet with perfect juſtice, and would therefore ſtrive to perform his own part to the utmoſt of his power, that his future condition might be the more happy, and that he might in the mean time enjoy more ſatiſfactioo on reflecting on his own conduct. His lot, he ſaid, was peculiarly fortunate: having ſuch thirſt for novelty, he would have been unhappy without an affluent fortune; and his own enjoyments encouraged neither vice nor idleneſs in himſelf or in the miniſters to his pleaſures.

This amiable perſon was of a conſtitution not puny, but not robuſt, and he had hurt it by too conſtant ſtudy. He feared no diſeaſe; thinking that he had a cure or an alleviation for all but one, namely, the ſtone and gravel. He had a dread of this, and laboured to find a preventative or a remedy. He thought that he had alſo done a great deal here; and deſcribes in his *Medicina Corporis* a preparation of whey, which he ſaid he uſed with great advantage to his health. But his precautions were in vain: He was attacked with the gravel, which, after three months ſuffering, brought on a ſuppreſſion of urine. The phyſicians ſaw that his end approached; and finding him diſregard their preſcriptions, they quitted him. He treated himſelf (it is ſaid judiciouſly) for ſome time, and with ſome appearance of ſucceſs; but at laſt he ſaw death not far off. He dictated a letter to his Sovereign, thanking him for all his favours and kindneſs, and recommended his children to his protection. He never fretted nor complained; but frequently, with gliſtening eyes, expreſſed his warmeſt thanks to Providence for the wonderful track of good fortune and of happineſs that he had enjoyed; and ſaid that he alſo felt ſome ſatiſfaction in the conſciouſneſs that ſome of this was owing to his own prudent conduct. He poſſeſſed his entire faculties to the laſt moment, and when he felt his ſpirit juſt about to depart, his laſt words were, "*Jö triumphé—Victoria!*" No longer able to ſpeak, he made ſigns for what he wanted; and a little after, ſhutting his eyes, as if to ſleep, he gently, and without a groan, yielded up his ſpirit, about four o'clock in the morning of the 11th of October 1708, aged 56.

His funeral was performed in a manner becoming his rank, and the body conveyed to the family vault. The Elector (King of Poland) defrayed the expenſe; for he would not allow his family to have any thing to do with the funeral of a man of ſo public a character, and ſo univerſally beloved.

The account of ſuch a life as that of Baron Von Tſchirnhaus would, at all times, make a pleaſant and uſeful impreſſion. In theſe our times, in the beginning of the 19th century, after ſociety has availed itſelf of all the acquiſitions in ſcience and art, furniſhed by that ardent age of the world which this gentleman contributed to adorn; in an age when we boaſt of illumination unparalleled in hiſtory, and of improvements almoſt amounting to perfection; and in particular, of an emancipation from the prejudices which had obſcured our view of the chief good, and ſtifled public ſpirit—now, when we are ſo full of knowledge that it is running over on all hands, in volumes of inſtruction, how to make the world one happy family; in theſe bright days of philanthropiſm, can the public records of Europe exhibit a ſuperior character to that of Mr Von Tſchirnhaus, either in reſpect of wiſdom or of diſpoſition? Was he not a philanthropiſt, a ſincere lover of mankind? Was he not wiſe, in employing his great acquired knowledge as the means of direct and active beneficence, by limiting his exertions to the extent of thoſe circles where his own efforts would be effective? He did not write books, teaching others how to do good: he taught it by example; being determined that his own wiſhes to ſee men happier ſhould not fail by the want of ſuch wiſhes in others, even after he ſhould inſtruct them. He never allowed his inſatiable curioſity for freſh diſcoveries to interfere with the immediate turning to the good of his own country the knowledge he had already acquired. He probably never thought of improving the ſituation of the Chineſe or the Mexicans, finding that it required all his ample fortune, and all the intereſt and influence he could acquire, to do the good he wiſhed in Saxony. We doubt not but that he was equally attentive to the ſtill narrower circle of duties formed by his own family. We ſee that he was a dearly beloved brother; which could hardly be without his alſo being a loving brother and a dutiful ſon. The nature of the diſtreſſes which he experienced in his family, and the manner in which he behaved under them, ſhew him to have been an eminent Chriſtian moraliſt. With a modeſty that is unmatched by any one of the thouſands who have poured out inſtructions upon us during the laſt ten years, and a gracefulneſs which characteriſes the gentleman, his *Medicina Mentis* is offered to public notice, merely as an experimental proof that a certain way of thinking and acting is productive of internal quiet of mind; of great mental enjoyment, both moral and intellectual; and of peace, and the good will of thoſe around us: and that it did, in fact, produce a dutiful and comfortable reſignation to the unavoidable trials of human life. He pretends not to be greatly ſuperior in wiſdom to his neighbours, but merely tells how things ſucceeded with himſelf. He did not ſcruple, however, to publiſh to the world diſcoveries in ſcience, in which he had got the ſtart of others during that buſy period of ſcientific occupation: and theſe diſcoveries in mathematics were highly prized by the firſt men of the age; nor will the name of Tſchirnhaus, or his cauſtic curves, ever be forgotten.

We felt ourſelves obliged to the friend who took notice of the omiſſion of this gentleman's name, ſo eminent in the mathematical world, in the courſe of our alphabet; but when we looked into the memoirs of the Academy of Paris for 1709 for ſome account of him, what we there ſaw appeared ſuch a continual panegyric, that we could not take it as a fair picture of any real character. Looking about for more impartial information, we found in the *Acta Eruditorum*, Leipſ. 1709, the account of which the foregoing is an abſtract, except a particular or two which we have copied from an account in the Literary Journal of Breſlaw, by Count Herberſtein, whom we can ſcarcely ſuſpect of undue partiality, becauſe he had ſome diſputes with Mr Von Tſchirnhaus on mathematical ſubjects. May we not ſay, "the memory of this man is ſweet!"

TSHAMIE, the Indian name of a tree in the Northern Circars of Hindoſtan. It grows, ſays Dr Roxburgh, to be a pretty large tree, is a native of moſt parts of the coaſt, chiefly of low lands at a conſiderable diſtance from the ſea, and may be only a variety of *proſopis ſpicigera*, for the thorns are in this ſometimes wanting; flowers during the cold and beginning of the hot ſeaſons. *Trunk* tolerably erect, bark deeply cracked, dirty aſh colour. *Branches* irregular, very numerous, forming a pretty large ſhady head. *Prickles* ſcattered over the ſmall branches; in ſome trees wanting. *Leaves* alternate, generally bipinnate, from two to three inches long; pinnæ from one to four, when in pairs oppoſite, and have a gland between their inſertions. *Leaflets* oppoſite, from ſeven to ten pair, obliquely lanced, ſmooth, entire, about half an inch long, and one-ſixth broad. *Stipules* none. *Spikes* ſeveral axillary, filiform, nearly erect. *Bracts* minute, one-flowered, falling. *Flowers* numerous, ſmall, yellow, ſingle, approximated. *Calyx* below, five-toothed. *Filaments* united at the baſe. *Anthers* incumbent, a white gland on the apex of each, which falls off ſoon after the flower expands. *Style* crooked. *Stigma* ſimple. *Legume* long, pendulous, not inflated. *Seeds* many, lodged in a brown meally ſubſtance.

The pod of this tree is the only part uſed. It is about an inch in circumference, and from ſix to twelve long; when ripe, brown, ſmooth, and contains, beſides the ſeeds, a large quantity of brown meally ſubſtance, which the natives eat; its taſte is ſweetiſh and agreeable; it may therefore be compared to the Spaniſh *algaroba*, or locuſt tree. (*Ceratonia ſiliqua*, Linn.)

In compliance with Dr Kœnig's opinion, Dr Roxburgh calls this tree a *proſopis;* but as he thinks the antheral glands give it a claim to the genus *adenanthera*, we have retained the Indian name till its botanical claſſification ſhall be aſcertained by thoſe who have greater authority in the ſcience than we lay claim to.

TUAPE, the chief town of the diviſion of Senora, in New Mexico.—*Morſe.*

TUBAI, a ſmall iſland, one of the Society Iſlands, in the S. Pacific Ocean, is about 4 or 5 leagues to the N. by W. or N. N. W. from Bolabola. S. lat. 16 12, W. long. 151 44.—*ib.*

TUCAPEE, on the coaſt of Chili, and the W. ſide of S. America, is on the S. Atlantic Ocean, 10 leagues N. N. E. from Rio Imperial, and 10 to the iſland of Santa Maria, or St Mary.—*ib.*

TUCKABATCHEES, a town of the Creek nation of Indians.—*ib.*

TUCKAHOE *Creek*, in Maryland, Talbot county, a branch of Choptank river.—*ib.*

TUCKER (Abraham), Eſq; a curious and original thinker, was a gentleman of affluent fortune, and author of "The Light of Nature purſued," 9 vols 8vo; of which the five firſt volumes were publiſhed by himſelf in 1768, under the aſſumed name of "Edward Search, Eſq;" and the four laſt after his death, in 1777, as "The poſthumous Work of Abraham Tucker, Eſq; publiſhed from his manuſcript as intended for the preſs by the author." Mr Tucker lived at Betchworth-caſtle, near Dorking, in Surry; an eſtate which he purchaſed

purchaſed in the early part of his life. He married the daughter of Edward Barker, Eſq; by whom he had two daughters; one of whom married Sir Henry St John, and died in his lifetime; the other ſurvived, and now lives at Betchworth-caſtle. He loſt his eyeſight a few years before his death, which happened in 1775. To deſcribe him as a neighbour, landlord, father, and magiſtrate, it would be neceſſary to mention the moſt amiable qualities in each. It is unneceſſary to add that he was very ſincerely regretted by all who had the pleaſure of his acquaintance, and who ſtood connected with him in any of thoſe relations.

Tucker (Joſiah, D. D.) well known as a political and commercial writer, was born at Langhorn, in Caermarthenſhire, in the year 1712. His father was a farmer, and having a ſmall eſtate left him at or near Aberyſtwith, in Cardiganſhire, he removed thither; and perceiving that his ſon had a turn for learning, he ſent him to Ruthin ſchool, in Denbighſhire, where he made ſo reſpectable a progreſs in the claſſics, that he obtained an exhibition at Jeſus College, Oxford. It is generally underſtood that ſeveral of his journeys to and from Oxford were performed on foot, with a ſtick on his ſhoulder, and bundle at the end of it. Thus it might be ſaid by him, as by Simonides, "*Omnia mea mecum porto.*"

At the age of 23 he entered into holy orders, and ſerved a curacy for ſome time in Glouceſterſhire. About 1737 he became curate of St Stephen's church in Briſtol, and was appointed minor-canon in the cathedral of that city. Here he attracted the notice of Dr Joſeph Butler, then Biſhop of Briſtol, and afterwards of Durham, who appointed Mr Tucker his domeſtic chaplain. By the intereſt of this prelate Mr Tucker obtained a probendal ſtall in the cathedral of Briſtol; and on the death of Mr Catcott, well known by his treatiſe on the Deluge, and a volume of excellent ſermons, he became rector of St Stephen. The inhabitants of that pariſh conſiſt chiefly of merchants and tradeſmen; a circumſtance which greatly aided his natural inclination for commercial and political ſtudies.

When the famous bill was brought into the Houſe of Commons for the naturalization of the Jews, Mr Tucker, conſidering the meaſure rather as a merchant or politician than as a Chriſtian divine, wrote in defence of it with a degree of zeal which, to ſay no more, was at leaſt indecent in a man of his profeſſion. As ſuch it was viewed by his brethren of the clergy, and by his pariſhioners; for, while the former attacked him in pamphlets, newſpapers, and magazines, the latter burnt his effigy dreſſed in canonicals, together with the letters which he had written in defence of the naturalization.

In the year 1753 he publiſhed an able pamphlet on the "Turkey Trade;" in which he demonſtrates the evils that reſult to trade in general from chartered companies. At this period Lord Clare (afterwards Earl Nugent) was returned to Parliament for Briſtol; which honour he obtained chiefly through the ſtrenuous exertions of Mr Tucker, whoſe influence in his large and wealthy pariſh was almoſt deciſive on ſuch an occaſion. In return for this favour the earl procured for him the deanery of Glouceſter, in 1758, at which time he took his degree of doctor in divinity. So great was his reputation for commercial knowledge, that Dr Thomas Hayter, afterwards Biſhop of London, who was then tutor to his preſent majeſty, applied to Dr Tucker to draw up a diſſertation on this ſubject for the peruſal of his royal pupil. It was accordingly done, and gave great ſatisfaction. This work, under the title of "The Elements of Commerce," was printed in quarto, but never publiſhed.

Dr Warburton, who became Biſhop of Glouceſter in the year 1760, thinking very differently from Dr Tucker of the proper ſtudies of a clergyman, as well as of the project for naturalizing the Jews, ſaid once to a perſon who was praiſing the Elements of Commerce, that "his Dean's trade was religion, and religion his trade." This ſarcaſm, though not perhaps groundleſs, was certainly too ſevere; for ſome of the Dean's publications evince him to have devoted part of his time at leaſt to the ſtudy of theology, and to have been a man of genuine benevolence.

In the year 1771, when a ſtrong attempt was made to procure an abolition of ſubſcription to the 39 articles, Dr Tucker came forward as an able and moderate advocate of the church of England. About this time he publiſhed "Directions for travellers;" in which he lays down excellent rules, by which gentlemen who viſit foreign countries may not only improve their own minds, but turn their obſervations to the benefit of their native country.

The Dean was an attentive obſerver of the American conteſt. He examined the affair with a very different eye from that of a party-man, or an intereſted merchant; and he diſcovered, as he conceived, that both ſides would be better off by an abſolute ſeparation. Mr Burke's language in the Houſe of Commons, in conſequence of his publiſhing this opinion, was harſh, if not illiberal. In his famous ſpeech on the American taxation bill, April the 13th, 1774, he called the Dean of Glouceſter the advocate of the court faction, though it is well known that the court diſapproved of the propoſal as much as the oppoſition. This attack rouſed the Dean to reſentment; and he publiſhed a letter to Mr Burke; in which he not only vindicates the purity of his own principles, but retorts upon his adverſary in very forcible and ſarcaſtic terms. He afterwards ſupported Lord Nugent's intereſt in Briſtol againſt that of Mr Burke, and was certainly very inſtrumental in making the latter loſe his election.

When the terrors of an invaſion were very prevalent in 1779, Dr Tucker circulated, in a variety of periodical publications, ſome of the moſt ſenſible obſervations that were ever made on the ſubject, in order to quiet the fears of the people. In 1781 he publiſhed, what he had printed long before, "A Treatiſe on Civil Government," in which his principal deſign is to counteract the doctrines of Locke and his followers. The book made a conſiderable noiſe, and was very ſharply attacked by ſeveral writers on the democratic ſide of the queſtion, particularly by Dr Towers and Dr Dunbar of Aberdeen. This laſt gentleman acted a part which, if not diſhonourable, was at leaſt uncommon. The Dean had thrown off thirty copies of his work long before he publiſhed it; and theſe he ſent to different men of eminence, that he might avail himſelf of their animadverſions before he ſhould ſubmit it to the public at large. Principal Campbell of Aberdeen received one copy for this purpoſe; and Dr Dunbar having by him been favoured with a peruſal of it, inſtead of ſending his objections privately to the author, publiſhed ſevere remarks on it in a work which he had then in the preſs. Thus was the anſwer to the Dean of Glouceſter's Treatiſe on Government publiſhed before that treatiſe itſelf; but Dr Dunbar was no match for Dr Tucker.

In the year 1782 our author cloſed his political career with a pamphlet intitled "*Cui Bono?*" in which he balances the profit and loſs of each of the belligerent powers and recapitulates all his former poſitions on the ſubject of war and colonial poſſeſſions. His publications ſince that period conſiſted of ſome tracts on the commercial regulations of Ireland, on the exportation of woollens, and on the iron trade. In 1777 he publiſhed ſeventeen practical ſermons, in one volume octavo. In the year 1778, one of his pariſhioners, Miſs Pelloquin, a maiden lady of large fortune and moſt exemplary piety, bequeathed to the Dean her dwelling houſe in Queen-Square, Briſtol, with a very handſome legacy, as a teſtimony of her great eſteem for his worth and talents. In the year 1781 the Dean married a lady of the name of Crowe, who reſided at Glouceſter.

It ſhould be recorded to his praiſe, that though enjoying but very moderate preferment (for to a man of no paternal eſtate, or other eccleſiaſtical dignity, the Deanery of Glouceſter is no very advantageous ſituation), he was notwithſtanding a liberal benefactor to ſeveral public inſtitutions, and a diſtinguiſhed patron of merit. The celebrated John Henderſon of Pembroke-College, Oxford, was ſent to the univerſity, and ſupported there, at the Dean's expenſe, when he had no means whatever of gratifying his ardent deſire for ſtudy. We ſhall mention another inſtance of generoſity in this place, which reflects the greateſt honour upon the Dean. About the year 1790 he thought of reſigning his rectory in Briſtol, and, without communicating his deſign to any other perſon, he applied to the Chancellor, in whoſe gift it is, for leave to quit it in favour of his curate, a moſt deſerving man, with a large family. His Lordſhip was willing enough that he ſhould give up the living, but he refuſed him the liberty of nominating his ſucceſſor. On this the Dean reſolved to hold the living himſelf till he could find a fit opportunity to ſucceed in his object. After weighing the matter more deliberately, he communicated his wiſh to his pariſhioners, and adviſed them to draw up a petition to the Chancellor in favour of the curate. This was accordingly done, and ſigned by all of them, without any exception, either on the part of the diſſenters or others. The Chancellor being touched with this teſtimony of love between a clergyman and his people, yielded at laſt to the application; in conſequence of which the Dean cheerfully reſigned the living to a ſucceſſor well qualified to tread in his ſteps. Since that time he reſided chiefly at Glouceſter, viewing his approaching diſſolution with the placid mind of a Chriſtian, conſcious of having done his duty both to God and man. He died in November 1799. The following we believe to be a tolerably correct liſt of his works.

Theological and Controverſial.—1. A Sermon, preached before the Governors of the Infirmary of Briſtol, 1745. 2. Letters in behalf of the Naturalization of the Jews. 3. Apology for the Church of England, 1772. 4. Six Sermons, 12mo, 1773. 5. Letter to Dr Kippis on his Vindication of the Proteſtant Diſſenting Miniſters. 6. Two Sermons and Four Tracts. 7. View of the Difficulties of the Trinitarian, Arian, and Socinian Syſtems, and Seventeen Sermons, 1777.

Political and Commercial.—8. A pamphlet on the Turkey Trade. 9. A brief View of the Advantages and Diſadvantages which attend a Trade with France. 10. Reflections on the Expediency of Naturalizing foreign Proteſtants, and a Letter to a Friend on the ſame Subject. 11. The Pleas and Arguments of the Mother Country and the Colonies ſtated. 12. A Letter to Mr Burke. 13. Quere, Whether a Connection with, or Separation from, America, would be for national Advantage? 14. Anſwers to Objections againſt the Separation from America. 15. A Treatiſe on Civil Government. 16. *Cui Bono?* 17. Four Letters on national Subjects. 18. Sequel to Sir William Jones on Government. 19. On the Diſpute between Great Britain and Ireland. 20. Several Papers under the Signature of Caſſandra, &c. on the Difficulties attendant on an Invaſion. 21. A Treatiſe on Commerce (Mr Coxe, in his Life of Sir Robert Walpole, ſays that this was printed, but never publiſhed).

Miſcellaneous.—22. Directions for Travellers. 23. Cautions againſt the Uſe of Spirituous Liquors. 24. A Tract againſt the Diverſions of Cock-fighting, &c.

TUCKERTON, the port of entry for the diſtrict of Little Egg-Harbour, in the State of New-Jerſey. —*Morſe.*

TUCUYO, a town of New-Granada, and Terra Firma, in N. America. It ſtands in a valley of the ſame name, every where ſurrounded by mountains. The air is very healthy, and the ſoil fruitful, and a river divides the place. It is 200 miles S. of Maracaibo city. N. lat. 7 10, W. long. 68 36.—*ib.*

TUFTONBOROUGH, a town of New-Hampſhire, in Strafford county, ſituated on the N. E. ſide of Lake Winipiſeogee, adjoining Wolfborough, containing 109 inhabitants.—*ib.*

TUGELO *River*, in Georgia, is the main branch of Savannah river. The other great branch is Keowee, which joining with the other, 15 miles N. W. of the northern boundary of Wilke's county, form the Savannah. Some branches of the Tugelo riſe in the State of Tenneſſee. A reſpectable traveller relates that in ten minutes, having walked his horſe moderately, he taſted of Tugelo, Apalachicola, and Hiwaſſee rivers. —*ib.*

TUICHTENOONA *Creek*, in the State of New-York, is 16 miles above Schenectady. E. of the creek is a curious Indian inſcription.—*ib.*

TULIPOMANIA, the very proper name given to a kind of gambling traffic in *tulip-roots*, which prevailed in Holland and the Netherlands during ſome part of the 17th century. It was carried on to the greateſt extent in Amſterdam, Haerlem, Utrecht, Alkmaar, Leyden, Rotterdam, Hoorn, Enkhuyſen, and Meedenbliek; and roſe to the greateſt height in the years 1634, 1635, 1636, and 1637. Munting, who, in 1696, wrote a book of 1000 pages folio on the ſubject, has given a few of the moſt extravagant prices, of which we ſhall preſent the reader with the following. For a root of that ſpecies called the *Viceroy*, the after-mentioned articles, valued as below, were agreed to be delivered.

		Florins.
2	laſts of wheat	448
4	ditto rye	558
4	fat oxen	480
8	fat ſwine	240
12	fat ſheep	120
2	hogſheads of wine	70
4	tons beer	32
2	ditto butter	192
1000	pounds of cheeſe	120
	a complete bed	100
	a ſuit of clothes	80
	a ſilver beaker	60
	Sum	2500

Theſe tulips afterwards were ſold according to the weight of the roots. Four hundred perits* of Admiral Lieſken coſt 4400 florins; 446 ditto of Admiral Von der Eyk, 1620 florins; 106 perits Schilder coſt 1615 florins; 200 ditto Semper Auguſtus, 5500 florins; 410 ditto Viceroy, 3000 florins, &c. The ſpecies Semper Auguſtus has been often ſold for 2000 florins; and it once happened that there were only two roots of it to be had, the one at Amſterdam and the other at Haerlem. For a root of this ſpecies, one agreed to give 4600 florins, together with a new carriage, two grey horſes, and a complete harneſs. Another agreed to give twelve acres of land for a root: for thoſe who had not ready money, promiſed their moveable and immoveable goods, houſe and lands, cattle and clothes. A man, whoſe name Munting once knew, but could not recollect, won by this trade more than 60,000 florins in the courſe of four months. It was followed not only by mercantile people, but alſo by the firſt noblemen, citizens of every deſcription, mechanics, ſeamen, farmers, turf-diggers, chimney-ſweeps, footmen, maid-ſervants, and old clothes-women, &c. At firſt, every one won and no one loſt. Some of the pooreſt people gained in a few months houſes, coaches, and horſes, and figured away like the firſt characters in the land. In every town ſome tavern was ſelected which ſerved as a change, where high and low traded in flowers, and confirmed their bargains with the moſt ſumptuous entertainments. They formed laws for themſelves, and had their notaries and clerks.

To get poſſeſſion of fine flowers was by no means the real object of this trade, though many have ſaid that it was, and though we have known ſome individuals in Scotland, who, led away by what they thought the faſhion, have given ten guineas for a tulip root. During the time of the tulipomania, a ſpeculator often offered and paid large ſums for a root which he never received, and never wiſhed to receive. Another ſold roots which he never poſſeſſed or delivered. Oft did a nobleman purchaſe of a chimney-ſweep tulips to the amount of 2000 florins, and ſold them at the ſame time to a farmer; and neither the nobleman, chimney-ſweep, or farmer, had roots in their poſſeſſion, or wiſhed to poſſeſs them. Before the tulip ſeaſon was over, more roots were ſold and purchaſed, beſpoke, and promiſed to be delivered, than in all probability were to be found in the gardens of Holland; and when Semper Auguſtus was not to be had, which happened twice, no ſpecies perhaps was oftener purchaſed and ſold. In the ſpace of three years, as Munting tells us, more than ten millions were expended in this trade in only one town of Holland.

To underſtand this gambling traffic, it may be neceſſary to make the following ſuppoſition. A nobleman beſpoke of a merchant a tulip root, to be delivered in ſix months, at the price of 1000 florins. During theſe ſix months the price of that ſpecies of tulip muſt have riſen or fallen, or remained as it was. We ſhall ſuppoſe that, at the expiration of that time, the price was 1500 florins; in that caſe, the nobleman did not wiſh to have the tulip, and the merchant paid him 500 florins, which the latter loſt and the former won. If the price was fallen when the ſix months were expired, ſo that a root could be purchaſed for 800 florins, the nobleman then paid to the merchant 200 florins, which he received as ſo much gain; but if the price continued the ſame, that is, 1000 florins, neither party gained or loſt. In all theſe circumſtances, however, no one ever thought of delivering the roots or of receiving them. Henry Munting, in 1636, ſold to a merchant at Alkmaar, a tulip root for 7000 florins, to be delivered in ſix months; but as the price during that time had fallen, the merchant paid, according to agreement, only 10 *per cent.* "So that my father (ſays the ſon) received 700 florins for nothing; but he would much rather have delivered the root itſelf for 7000." The term of theſe contracts was often much ſhorter, and on that account the trade became briſker. In proportion as more gained by this traffic, more engaged in it; and thoſe who had money to pay to one, had ſoon money to receive of another; as at faro, one loſes upon one card, and at the ſame time wins on another. The tulip dealers often diſcounted ſums alſo, and transferred their debts to one another; ſo that large ſums were paid without caſh, without bills, and without goods, as by the Virements at Lyons. The whole of this trade was a game at hazard, as the Miſſiſſippi trade was afterwards, and as ſtock-jobbing is at preſent. The only difference between the tulip trade and ſtock-jobbing is, that at the end of the contract the price in the latter is determined by the Stock Exchange; whereas in the former it was determined by that at which moſt bargains were made. High and low priced kinds of tulips were procured, in order that both the rich and the poor might gamble with them; and the roots were weighed by perits, that an imagined whole might be divided, and that people might not only have whole, but half and quarter lots. Whoever is ſurpriſed that ſuch a traffic ſhould become general, needs only to reflect upon what is done where lotteries are eſtabliſhed, by which trades are often neglected, and even abandoned, becauſe a ſpeedier mode of getting fortunes is pointed out to the lower claſſes.

At length, however, this trade fell all of a ſudden. Among ſuch a number of contracts many were broken; many had engaged to pay more than they were able; the whole ſtock of the adventurers was conſumed by the extravagance of the winners; new adventurers no more engaged in it; and many becoming ſenſible of the odious traffic in which they had been concerned, returned to their former occupations. By theſe means, as the value of tulips ſtill fell, and never roſe, the ſellers wiſhed to deliver the roots *in natura* to the purchaſers at the prices agreed on; but as the latter had no deſire

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for tulips at even ſuch a low rate, they refuſed to take them or to pay for them. To end this diſpute, the tulip-dealers of Alkmaar ſent, in the year 1637, deputies to Amſterdam; and a reſolution was paſſed on the 24th of February, that all contracts made prior to the laſt of November 1636 ſhould be null and void; and that, in thoſe made after that date, purchaſers ſhould be free on paying ten *per cent.* to the vender.

The more diſguſted people became with this trade, the more did complaints increaſe to the magiſtrates of the different towns; but as the courts there would take no cognizance of it, the complainants applied to the States of Holland and Weſt Frieſland. Theſe referred the buſineſs to the determination of the provincial council at the Hague; which, on the 27th of April 1637, declared that it would not deliver its opinion on this traffic until it had received more information on the ſubject; that in the mean time every vender ſhould offer his tulips to the purchaſer; and, in caſe he refuſed to receive them, the vender ſhould either keep them, or ſell them to another, and have recourſe on the purchaſer for any loſs he might ſuſtain. It was ordered alſo, that all contracts ſhould remain in force till farther enquiry was made. But as no one could foreſee what judgment would be given reſpecting the validity of each contract, the buyers were more obſtinate in refuſing payment than before; and venders, thinking it much ſafer to accommodate matters amicably, were at length ſatisfied with a ſmall profit inſtead of exorbitant gain: and thus ended this extraordinary traffick, or rather gambling. *Beckmann's Hiſtory of Inventions*, vol. i.

TULLY, one of the military townſhips of Onondago county, New-York, having Sempronius on the weſt, and Fabius on the eaſt. It is within the juriſdiction of Pompey, and lies 29 miles S. E. of the ferry on Cayuga Lake.—*Morſe.*

TULPEHOCKEN, a branch of the Schuylkill, which empties into that river at Reading. Alſo, the name of a town of Pennſylvania, in Lancaſter county, 6 miles weſt of Middletown, and 65 north-weſt of Philadelphia. Tulpehocken creek or river, and Quitapahilla, lead within 4 miles of each other. The water communication between Schuylkill and Suſquehannah muſt be formed over a tract of country of about 40 miles in extent, from river to river, in a ſtraight line; but about 60 miles as the navigation muſt go. This tract is cut by the above 2 creeks. The bottom of the canal, through which the navigation muſt paſs, will not here riſe more than 30 feet above the level of the head waters of the above 2 creeks; nor ſo much as 200 feet above the level of the waters of Suſquehannah or Schuylkill.—*ib.*

TUMAR, in Bengal, rent-roll or aſſeſſment.

TUMBEZ, a town in the road to Lima and Peru, in South-America, 7 leagues from Salto, a place for landing of goods conſigned to this place, and in lat. 3 12 16 S. Near this town is a river of the ſame name, which empties into the bay of Guayaquil. It has near 70 cane houſes.—*Morſe.*

TUMBLING *Dam*, on Delaware river, is about 22 miles above Trenton.—*ib.*

TUMBREL, is a kind of carriage with two wheels, uſed either in huſbandry for dung, or in artillery to carry the tools of the pioneers, &c. and ſometimes likewiſe the money of an army.

TUNBRIDGE, a townſhip of Vermont, Orange county, 12 miles weſt of Thetford. It contains 487 inhabitants.—*Morſe.*

TUNGSTEN (See Chemiſtry, n° 178, &c. in this *Suppl.*) when well fuſed, is, according to Guyton *alias* Morveau, of no higher ſpecific gravity than 8.3406. This is very different from the ſpecific gravity which has hitherto been aſſigned to it. The ſame eminent chemiſt concludes, from its extreme brittleneſs and difficulty of fuſion, that it affords little promiſe of utility in the arts, except in metallic alloys, or by virtue of the property which its oxyd poſſeſſes, of affording fixed colours, or giving fixity to the colours of vegetables.

TUNIA, a city of New-Granada, in Terra Firma. —*Morſe.*

TUNJA, a town of New-Granada and Terra Firma, in South-America. Near it are mines of gold and emeralds. The air is temperate, and the ſoil fruitful. It is about 30 miles ſouth-weſt of Truxillo. N. lat. 4 51, W. long. 72 10.—*ib.*

TUNKHANNOCK, a townſhip and creek in Luzerne county, Pennſylvania. The creek is a water of Suſquehannah.—*ib.*

TUPINAMBAS, the name of a famous nation who inhabited Brazil on its firſt diſcovery by the Portugueſe. They left their chief abode about Rio de Janeiro, and wandered up to the parts near the Amazon, where the Tapayos are now the deſcendants of that brave people. Their migration and hiſtory are fully deſcribed by Father Dacunha.—*ib.*

TURA *Bamba*, a ſpacious plain of Peru, in South-America, at the extremity of which ſtands the city of Quito. To this plain there is a road from Guayaquil. —*ib.*

TURBET, a townſhip of Pennſylvania, on Suſquehannah river.—*ib.*

TURIANO, a river on the north coaſt of South-America, 3 leagues to the eaſt of the iſlands Barbarata. Near it is a ſalt pond which furniſhes all the coaſt with ſalt, and there is harbour and road for ſhips to ride in. —*ib.*

TURKEY, a ſmall town of New-Jerſey, Eſſex county, 14 miles north-weſterly of Elizabeth-Town, and 179 north-eaſt of Philadelphia.—*ib.*

Turkey *Foot*, in Youghiogany river, is the point of junction of the great S. Branch, Little Croſſings from the ſouth-eaſt, and N. Branch from the northward. It is 35 miles from the mouth of the river, 22 miles S. S. W. of Berlin, in Pennſylvania, and 36 north-eaſt of Morgantown. N. lat. 39 44.—*ib.*

Turkey *Point*, a promontory on the north ſide of Lake Erie, lies oppoſite to Preſque Iſle, on the ſouth ſide, about 50 miles acroſs.—*ib.*

Turkey *Point*, at the head of Cheſapeak Bay, is a point of land formed by the waters of the bay on the north-weſt, and thoſe of Elk river on the ſouth eaſt. It is about 15½ miles ſouth-weſt of Elkton, and 44 north-eaſt of Annapolis. Here the Britiſh army landed, in Auguſt, 1777, before they advanced to Philadelphia.—*ib.*

TURKISH *Iſlands*, a group of little iſlands, called alſo *Ananas*, ſince they are the iſlands of *Don Diego Luengo*, thus called by him who diſcovered them. They are more than 30 leagues north of Point Iſabelique, on the north coaſt of the iſland of St Domingo.—*ib.*

TURKS *Iſlands*, ſeveral ſmall iſlands in the Weſt-Indies, about 35 leagues north-eaſt of the iſland of St Domingo, and about 60 to the ſouth-eaſt of Crooked Iſland. The Bermudians frequently come hither and make a great quantity of ſalt, and the ſhips which ſail from St Domingo commonly paſs within ſight of them. N. lat. 21 18, W. long. 71 5.—*ib.*

TURNER, a townſhip of the Diſtrict of Maine, Cumberland county, on the weſt bank of Androſcoggin river, which divides it from Green in Lincoln county. It was incorporated in 1786, contains 349 inhabitants. and lies 172 miles north of Boſton, and 31 ſouth-weſt of Hallowell.—*ib.*

TURNSOL, a dye-ſtuff manufactured in Holland, the preparation of which was long kept a profound ſecret. In order to miſlead foreigners, the Dutch pretended that turnſol was made from rags dyed with the juice of the ſun-flower (*Helianthus*), from which it obtained its name. Since the late revolution, however, in Holland, the true method employed by the Dutch for preparing this colour has been diſcovered, and the proceſs is as follows:—That kind of lichen called orchil (LICHEN-*Rocella*. See that article in this *Suppl.*), or, when that cannot be procured, the large oak-moſs, after being dried and cleaned, is reduced to powder, and by means of a kind of oil-preſs the powder is forced through a braſs ſieve, the holes of which are ſmall. The ſifted powder is then thrown into a trough, and mixed with an alkali called *vetas*, which is nothing elſe than the aſhes of wine lees, in the proportion of half a pound of aſhes to one pound of powder. This mixture is moiſtened with a little human urine, for that of other animals contains leſs ammonia, by which a fermentation is produced; and the moiſtneſs is ſtill kept up by the addition of more urine. As ſoon as the mixture aſſumes a red colour, it is poured into another trough; is again moiſtened with urine, and then ſtirred round in order that the fermentation may be renewed. In the courſe of a few days it acquires a bluiſh colour, and is then carefully mixed with a third part of very pure pulveriſed potaſh; after which the mixture is put into wooden pails, three feet in height, and about half a foot broad. When the third fermentation takes place, and the paſte has acquired a conſiderably dark blue colour, it is mixed with chalk or pulveriſed marble, and ſtirred well round that the whole may be completely united. This laſt ſubſtance gives the colour no higher quality, and is intended merely to add to the weight. The blue, prepared in this manner, is poured into oblong ſquare iron moulds; and the cakes, when formed, are placed upon fir boards on an airy floor in order to dry, after which they are packed up for ſale.

TURPENTINE, a well known ſubſtance extracted from the pine. Under the article PINUS (*Encycl.*), we have given an account of one proceſs by which this extract is made; but the following, which is taken from the 31ſt volume of the *Journal de Phyſique*, is very different, and probably better. The pine from which turpentine is extracted, is never fit for this operation till it be thirty years of age. The extraction is begun in February and continued to the end of October. Inciſions are made with an hatchet, beginning at the foot of the tree on one ſide, and riſing ſucceſſively: they are repeated once or twice a week, the ſize about one finger's breadth acroſs, and three or four inches long. During the four years in which it is continued, the inciſions have riſen to about eight or nine feet. Then the inciſions are begun on the other ſide; and during this time the old ones fill up, and may be again opened after ſome years, ſo that a tree on a good ſoil, and well managed, may yield turpentine for a century. At the bottom of the tree, under the inciſion, a hole is dug in the ground to receive the reſin which flows from the tree. This reſin is called *terebinthine brut*, is of a milky colour, and is that which flows during the three ſummer months; it requires further purification.

The winter crop is called *barras galipot*, or white reſin: it ſticks to the bark of the tree, when the heat has not been ſtrong enough to let it flow into the trough in the ground. It is ſcraped off with iron knives.

Two methods are practiſed for purifying theſe reſins. That which is followed at Bayonne is to have a copper cauldron which will hold 300 lb. of materials fixed over a fire, and the flame circulating at the bottom of the copper. The turpentine is put in, melted with a gentle heat, and, when liquid, it is ſtrained through a ſtraw-baſket made for the purpoſe, and ſtretched over a barrel, which receives the ſtrained turpentine. This purification gives it a golden colour, and may be performed at all times of the year.

The ſecond manner, which is practiſed only in the mountain of De Buch, near Bordeaux, conſiſts in having a large tub, ſeven or eight feet ſquare, and pierced with ſmall holes at the bottom, ſet upon another tub to catch the liquor. This is expoſed to the hotteſt ſun for the whole day, filled two-thirds with turpentine, which as it melts falls through the holes, and leaves the impurities behind. This pure turpentine is leſs golden-coloured, and is much more eſteemed than the other. This proceſs can only be done in the ſummer.

To make *oil* of turpentine, an alembic, with a worm like what is uſed by the diſtillers, is employed here. It generally contains 250 lb. of turpentine, which is boiled gently, and kept at the boiling point till no more oil paſſes, when the fire is damped. This generally gives 60 lb. of oil, and the operation laſts one day.

The boiling turpentine, when it will give no more oil, is tapped off from the ſtill and flows into a tub, and from thence into a mould of ſand, which it fills, and is ſuffered to cool for at leaſt two days without diſturbing it. This reſidue is known under the name of *colophony*. It is of a brown colour, and very dry. It may be made clearer and nearer in colour to that of the reſin, by adding hot water to it before it is tapped off the ſtill, and ſtill boiling and ſtirring the water well with it, which is done with a beſom of wet ſtraw; and it is then ſold for roſin, but is little eſteemed, as it contains no eſſential oil.

TURTLE, *Iſland*, in the South Pacific Ocean, is nearly a league long, and not half ſo broad. It is ſurrounded by a reef of coral rocks, that have no ſoundings without them. S. lat. 19 49, W. long. 177 57.—*Morſe.*

TURTLE *Creek*, in Pennſylvania, a ſmall ſtream which empties through the E. bank of Monongahela river, about 12 miles from the mouth of that river, at Pittſburg. At the head of this creek, General Braddock engaged a party of Indians, the 9th of July, 1755, on his way to Fort du Queſne, now Pittſburg, where he was repulſed, himſelf killed, his army put to flight, and the remains of the army brought off the field by the addreſs and courage of Colonel, afterwards General Waſhington.—*ib.*

TURTLE *River*, in Georgia, empties into St Simon's Sound, and its bar has a ſufficiency of water for the largeſt veſſel that ſwims. At its mouth is the town of Brunſwick, which has a noble and capacious harbour. The town is regularly laid out, but not yet built. The lands on the banks of this river are ſaid to be excellent. —*ib.*

TURY, a river on the coaſt of Brazil, in S. America, 40 leagues E. S. E. of the river Cayta. The iſland of St John lies juſt off the river's mouth, and makes a very good harbour on the inſide of it. But the paſſage both in and out, is difficult, and no pilots are to be had.—*ib.*

TUSCARORA *Creek*, a ſmall ſtream of Pennſylvania, which empties through the S. W. bank of Juniatta river, 12 miles ſouth-eaſtward of Lewiſtown.—*ib.*

TUSCARORA *Villages*, lie a mile from each other, 4 miles from Queenſtown, in Upper Canada, containing together about 40 decayed houſes. Veſtiges of ancient fortifications are viſible in this neighbourhood. The Indian houſes are about 12 feet ſquare; many of them are wholly covered with bark, others have the walls of logs, in the ſame manner as the firſt ſettlers among white people built their huts, having chimnies in which they keep comfortable fires. Many of them, however, retain the ancient cuſtom of having the fire in the centre of the houſe. The lands in the vicinity are of a good quality.—*ib.*

TUSCARORAS, a tribe of Indians in the ſtate of New-York. They migrated from North Carolina, about the year 1712, and were adopted by the Oneidas, with whom they have ſince lived, on the ſuppoſition that they were originally the ſame tribe, from an affinity which there is in their language. They now conſiſt of about 400 ſouls, their village is between Kahnanwolohale and New-Stockbridge, on Tuſcarora or Oneida Creek. They receive an annuity of about 400 dollars from the United States —*ib.*

TUSCULANUM, a villa belonging to Cicero, near Tuſculum, where he wrote his *Quæſtiones Tuſculanæ*, ſo named from the place; thus become famous as well for the productions of genius as of nature. Formerly the villa of Sylla: now called *Grotta Ferrata*.—Another *Tuſculanum* (inſcription), a town of the Tranſpadana, ſituated on the weſt ſide of the Lacus Benatus. Now ſaid to be called *Toſcolano*, in the territory of Breſcia, ſubject to Venice. Here many monuments of antiquity are dug up.

TUSCULUM (anc. geog.) a town of Latium, to the north of Alba, ſituated on an eminence, and therefore called *Superum* (Horace, Strabo). In ſight of Rome, at about the diſtance of 100 ſtadia, or 12 miles. Adorned with plantations and princely edifices: The ſpot remarkable for the goodneſs of the ſoil, and its plenty of water. Built by Telegonus, who ſlew his father Ulyſſes (Ovid, Horace); called the grandſon of Ulyſſes in Silius Italicus. A municipium (Cicero); the birth-place of the elder Cato (Nepos, Cicero). Now *Freſcati*, in the Campania of Rome.

TUSKARAWI, the ancient name of a head water of Muſkingum river. It is alſo called Tuſcarawas. —*Morſe.*

TUTAPAN, a large town on the W. coaſt of New-Mexico, in the N. Pacific Ocean. From the river Sacatulca, the high and rugged land extends N. W. 25 leagues.—*ib.*

TUTENAG, according to Sir George Staunton, is, properly ſpeaking, zinc extracted from a rich ore, or calamine. The ore is powdered and mixed with charcoal-duſt, and placed in earthen jars over a ſlow fire, by means of which the metal riſes in the form of vapour, in a common diſtilling apparatus, and afterwards is condenſed in water. The calamine from which tutenag is thus extracted, contains very little iron, and no lead or arſenic, ſo common in the calamine of Europe (See CALAMINE, *Encycl.*) Hence it is that tutenag is more beautiful than our zinc, and that the white copper of the Chineſe takes ſo fine a poliſh. See *White* COPPER, in this *Supplement*.

TWELVE ISLES, or *Twelve Apoſtles*, iſles on the S ſide of Lake Superior, and on the S. ſide of the mouth of Weſt Bay.—*Morſe.*

TWENTY MILE *Creek*, an eaſtern branch of Tombigbee river, in Georgia, which runs firſt a S. by E. courſe, then turns to the S. W. Its mouth lies in about lat. 33 33 N. and long. 88 W.—*ib.*

TWENTY FIVE MILE *Pond*, a ſettlement in Lincoln county, Diſtrict of Maine.—*ib.*

TWIGHTWEES, a tribe of Indians, in the N. W. Territory, inhabiting near Miami river and Fort. Warriors 200.—*ib.*

TYBEE *Iſland*, on the coaſt of Georgia, lies at the mouth of Savannah river, to the ſouthward of the bar. It is very pleaſant, with a beautiful creek to the W. of it, where a ſhip of any burden may lie ſafe at anchor. A light-houſe ſtands on the iſland, 80 feet high, and in lat. 32 N. and long. 81 10 W. The light-houſe is 7 miles E. S. E. ¼ E. from Savannah, and 6 S. W. ¼ W. from Port Royal.—*ib.*

TYBOINE, a townſhip of Pennſylvania, in Cumberland county.—*ib.*

TYERS (Thomas), an author both in poetry and proſe, the friend of Johnſon, and well known to moſt of the eminent characters of the preſent time, was a ſtudent of the Temple in 1753. His father intended him for the law, but the young man it ſeems penned a ſonnet when he ſhould engroſs. He was an accompliſhed, but not a profound man; and had taſte and elegance of mind, ſlightly tinged with gleams of genius. He wrote ſome paſtorals and political tracts, which probably will not ſurvive the partiality of his particular friends.

TYGART's *Valley*, in Pennſylvania, lies on Monongahela river.—*Morſe.*

TYGER, a ſmall river of S. Carolina, riſes in the Alleghany Mountains, and, taking a S. E. courſe nearly parallel to Enoree river, empties into Broad river, five miles above the Enoree.—*ib.*

TYNGSBOROUGH, a townſhip of Maſſachuſetts, Middleſex county, on Merrimack river, 31 miles north of Boſton.—*ib.*

TYPOGRAPHY, as the word imports, is the art of printing by types; but it is likewiſe uſed to ſignify the multiplying of copies by any mechanical contrivance. Of the art of printing by types, and the many improvements from time to time either made or attempted in it, a pretty full account will be found in the *Encyclopædia*, under the titles LETTER, LOGOGRAPHY, and PRINTING; and in this *Supplement* under the word PRINTING.

Printing. Of typography, in the other and larger ſenſe, ſome account may likewiſe be found in the *Encyclopædia* under the title *Method of Copying* Writings; but to almoſt all theſe articles there is ample room for ſome additions here.

The *ſtereotype* printing of *Didot* and *Herhan*, being conſidered in France as a great improvement, muſt not be paſſed over wholly without notice. The term *ſtereotype* is derived from the Greek words ϛερεος and τυπος, becauſe in this method the types are fixed and immoveable in the form, ſo that none of them can be pulled or diſplaced by the preſſman. We need hardly obſerve, to thoſe who are at all acquainted with the hiſtory of printing, that the project of ſoldering a whole form together, or of caſting a ſolid form from an impreſſion made by a general ſyſtem of types, or page ready compoſed, is not new. It was realiſed 70 years ago by William Ged, a goldſmith in Edinburgh; for an account of whoſe method we refer the reader to his life in the *Encyclopædia*. Didot now follows nearly the ſame proceſs as Ged. He does not indeed caſt his types to a maſs, but after the form is compoſed and carefully corrected, he cements or ſolders the types together ſo firmly that none of them is liable to be looſened by the action of the preſs or the adheſion of the balls. How far this method of printing is of value with regard to books which are altered and improved in every ſubſequent edition, may, perhaps, be queſtioned; but on a looſe conſideration of the ſubject, it ſeems as if it would, in every caſe, be advantageous to a bookſeller to print a few copies of a work, and keep the types ſtanding to print others as they may be wanted;—we ſay it would be advantageous, if it were not for the immenſe value in types, which would, by that means, be locked up. To form ſome judgment of this, it may be ſtated, that the works of Virgil, printed by Didot, in 18mo, form a beautiful volume of 418 pages, of 35 lines each. The character ranges line for line with that called burgeois, N° 2. in Caſlon's book of ſpecimens, the face of the letter being rather ſmaller; and we are told* that the price of the plates of this work is twelve hundred franks, or 50l. ſterling. From this fact ſome judgment may be formed of the commercial queſtion. We have caſually looked at different books printed by Didot, but can ſay nothing of their correctneſs: the page is very pretty.

For multiplying copies of any writing, or of a book of ordinary ſize, Rochon, of the French National Inſtitute, and now director of the Marine Obſervatory at the port of Breſt, invented, about the year 1781, a machine for engraving, with great celerity and correctneſs, the pages of the book or manuſcript on ſo many plates of copper. It was ſubmitted to the examination of a committee of the Royal Academy of Sciences, whoſe report of its utility was given in the following words:

"This machine appears to us to unite ſeveral advantages. 1ſt, Engraved editions of books may be executed, by this means, ſuperior to thoſe which can be made by the hand of the engraver, however ſkilful; and theſe engraved originals will be made with much more ſpeed, and much leſs expenſe. 2d, As this machine is portable, and of no conſiderable bulk, it may become very uſeful in armies, fleets, and public offices, for the impreſſion of orders, inſtructions, &c. 3d, It poſſeſſes the advantage which, in a variety of circumſtances, is highly valuable, of being capable of being uſed by any man of intelligence and ſkill, without requiring the aſſiſtance of any profeſſional workman. And, *laſtly*, It affords the facility of waiting for the entire compoſition and engravings of a work before any of the copies are pulled off; the expenſe of plates, even for a work of conſiderable magnitude, being an object of little charge; and this liberty it affords to authors, may prove highly beneficial in works of which the chief merit conſiſts in the order, method, and connection of ideas."

Rochon's machine conſiſts of two braſs wheels*, placed on the ſame axis above each other, and ſeparated by a number of pillars, each two inches in length. Theſe two wheels, with the interval which ſeparates them, are equivalent to a ſingle wheel about three inches thick. In order therefore to ſimplify the deſcription, they are conſidered as a ſingle wheel which moves freely on its axis.

This wheel is perforated near its circumference with a number of ſquare holes, which are the ſheaths or ſockets through which a like number of ſteel punches, of the ſame ſhape, are inſerted, and are capable of moving up and down. They are very well fitted; and from this circumſtance, as well as the thickneſs of the double wheel, they have no ſhake, or ſide motion, independent of the motion of the wheel itſelf. Every punch is urged upwards by a ſeparate ſpring, in ſuch a manner, that the wheel armed with its characters, or ſteel types (the lower faces of the punches being cut into the figures of the ſeveral letters), may turn freely on its axis; and if it be moved, the ſeveral punches will paſs in ſucceſſion beneath an upright ſcrew, for preſſure. The ſcrew is fixed in a very firm and ſolid frame, attached to the ſupports of the machine; and by this arrangement a copperplate, diſpoſed on the table, or bed of the apparatus, will receive the impreſſion of all the punches in ſucceſſion, as they may be brought beneath the vertical preſſing ſcrew, and ſubjected to its action.

But as the preſs is fixed, it would neceſſarily follow that each ſucceſſive impreſſion would, in part, deſtroy or mutilate the previous impreſſions, unleſs the plate itſelf were moveable. It therefore becomes neceſſary that the plate ſhould be moveable in two directions: the firſt, to determine the interval between the letters and words, and form the lines; and the other motion, which is more ſimple, becauſe its quantity may remain the ſame through the whole of a book, ſerves to give the interval between line and line, and to form the pages.

It will eaſily be conceived that it would be a tedious operation to ſeek, upon the circumference of the wheel, each ſeveral character, as it might be required to come beneath the preſs, becauſe it is neceſſary to repeat this operation as many times as there are characters in a work. The author has conſiderably diminiſhed the time and trouble of this operation, by fixing upon the aixs of the great wheel, which carries the punches, another ſmall wheel, about four inches in diameter, the teeth of which act upon a rack, which carries a rule moving between two ſliders. This rule, or ſtraight line, will therefore repreſent the developement, or unfolding of the circumference of the wheel which cauſes it to move, and will ſhew the poſition at the great wheel, which carries the punches. For theſe two wheels be-

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* De- Philoſo-

* See Plate XLVI.

ing concentric, the developement of the ſmall toothed wheel, of about two inches radius, will exhibit, in a ſmall ſpace (for example that of a foot), an accurate regiſter of the relative poſitions of the punches with regard to the preſſing-ſcrew. To obtain this effect, nothing more is neceſſary than to place a fixed index oppoſite to the moveable rule, which laſt is divided in the following manner:

The punch on which the firſt letter of the alphabet is engraved, muſt be brought under the centre of the preſſing-ſcrew; and a line of diviſion then drawn upon the moveable rule, to which the letter itſelf muſt be added to diſtinguiſh it. The index, already mentioned, being placed oppoſite, and upon this firſt diviſion, will ſerve to place immediately beneath the preſſing-ſcrew the punch or rather the character, correſponding with the diviſion upon the rule, without its being afterwards neceſſary to inſpect the place either of the punch or the ſcrew, with regard to each other. Conſequently, as ſoon as the diviſions which correſpond with all the punches inſerted in the wheel are engraved upon the ſtraight rule, the fixed index will immediately determine the poſition into which that wheel muſt be brought, in order to place the punches under the preſſing-ſcrew in the order which the work may require.

This regiſter, for this name diſtinguiſhes the rule and its index, has no other function in the machine than to guide the hand of the operator, and to ſhew when the punch is very near its proper poſition beneath the preſſing-ſcrew. When this is the caſe, the required poſition is accurately obtained by means of a detent or catch.

The detent which he uſes for this operation is a lever with two tails, one of which is urged toward the circumference of the wheel by a ſpring. To this extremity of the lever is fixed a piece of hardened ſteel, of the figure of a wedge, which, by means of a ſpring, is preſſed towards the axis of the great wheel, but may be relieved, or drawn back, by preſſure on the oppoſite tail of the lever, ſo as to permit the great wheel to revolve at liberty.

In the next place, it muſt be explained how this detent takes hold of the wheel, ſo as to retain it preciſely in the ſituation neceſſary to cauſe any one of the punches, at pleaſure, to give its impreſſion to the plate. For this purpoſe there are a number of notches cut in the circumference of the wheel, for the purpoſe of receiving the detent. Theſe notches may be about half an inch deep, wider towards the circumference than elſewhere, and it will be of advantage that this outer width ſhould be as great as the circumference of the wheel can conveniently allow. By this contrivance, the wedge will not fail to preſent itſelf oppoſite to one of the notches into which it will fall, and draw the wheel exactly to its due ſituation, even though the index of the regiſter ſhould not be brought preciſely to the line of diviſion appropriated to any particular letter. For if this laſt degree of preciſion were required in working the machine, it would be very prejudicial to the requiſite ſpeed which, above all things, is required in its uſe. When the wedge is therefore left at liberty, it not only enters immediately into its place, and moves the wheel till its two ſides apply fairly to the interior ſurfaces of the notch, but retains the wheel in this ſtate with the neceſſary degree of ſtability.

The method of giving the proper figure to theſe notches is very eaſy. For this purpoſe it is neceſſary, in the firſt place, to impreſs all the characters contained in the wheel on a plate of copper or pewter. The ſupport on which the plate is fixed muſt be moved in a right line, after each ſtroke of the punch, through ſuch a ſpace that the characters may be arranged one after the other without touching. Now, as the perfect linear arrangement (ſuppoſing every other part to be true) muſt depend on the notches, it might ſeem ſufficient to cut theſe according to the method uſed for the wheels of clock-work: but as it is very difficult to avoid ſome obliquity on the face of the punch, and perhaps in the hole through which it paſſes, it is in almoſt every caſe neceſſary to retouch the notch itſelf. The requiſite degree of preciſion may be eaſily obtained, when, upon examining with attention the print of the characters engraved upon the plate, the inequalities ſhall have been aſcertained by a very fine line paſſing exactly under the baſe of two ſimilar letters, aſſumed as objects of compariſon: for the irregularity of linear poſition may, by this means, be determined with great exactneſs, and remedied to the moſt extreme nicety. In this operation, the workman muſt file away part of that ſurface of the notch which is oppoſite to the direction of the motion the character requires. Great care muſt be taken to file only a ſmall portion at a time, in order that the inſtant may be ſeized at which the wedge, by entering into the notch, brings the character to its due ſituation.

Theſe details, reſpecting the right-lined arrangement on the characters, muſt not divert our attention from the very great celerity with which any letter is brought to its place under the preſs by means of the regiſter and detent. This celerity is an object of ſo much importance in the engraving of a great work, that every means ought to be purſued which may tend to increaſe it. For this reaſon it is that inſtead of following the alphabetic order in the arrangement of punches on the ſurface of the wheel, we ought to prefer that in which the ſum of the different motions to be given to the wheel, for engraving an entire work, ſhall be the leaſt poſſible. This tedious enquiry may well be diſpenſed with, by obſerving the order in which printers diſpoſe their caſes of characters, that the letters of the moſt frequent recurrence may be moſt immediately under the hand of the workman.

If all the characters afforded an equal reſiſtance to impreſſion in a plate of metal, a conſtant force would never fail to drive the punches to the ſame depth. But the faces of the letters are very unequal, and conſequently it will be neceſſary to uſe a variable force. Moſt workmen uſe the hammer, and not a ſcrew, as in this machine for ſtamping. If the hammer had been uſed in this machine, it is evident, that if we ſuppoſed it to have fallen from the ſame height upon every one of the punches, the force of the ſtroke could be rendered variable according to the nature of the characters, by placing a capital, or head, upon each, of an height properly adjuſted to receive the hammer after paſſing through a greater or leſs ſpace. But the heads of our punches are variable at pleaſure, becauſe they are ſcrewed on; and thus it is that, by experimentally adjuſting the heads of all the punches, a ſet of impreſſions are obtained of equal depths from every one of them. When,

for

PLATE.XLVI.

ROCHON'S MACHINE FOR ENGRAVING METALLIC PLATES

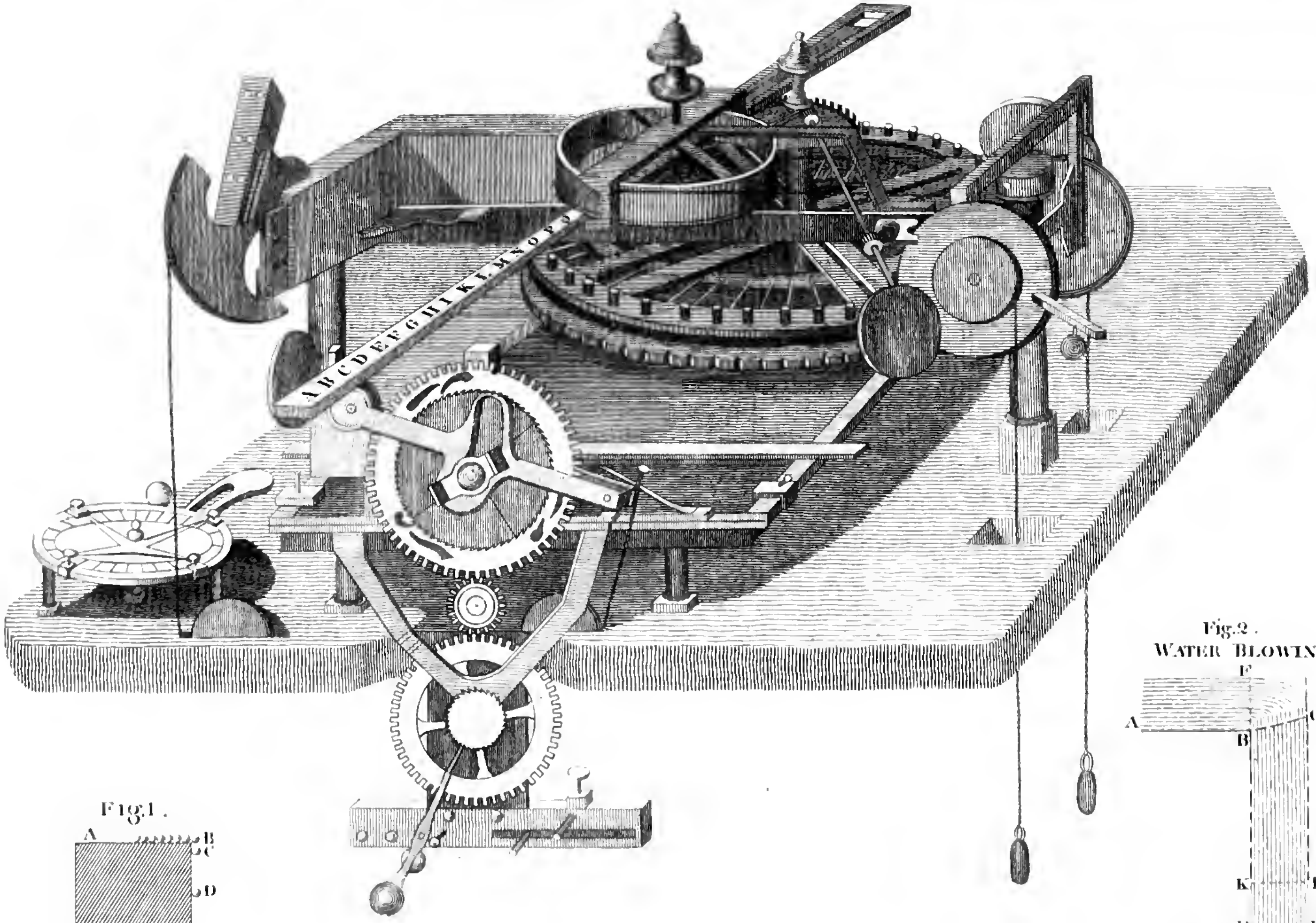


Fig.1.

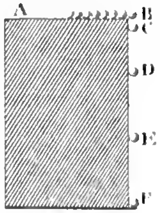
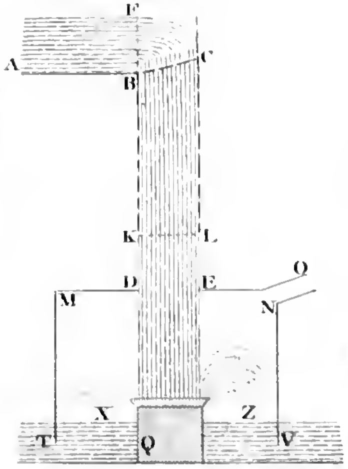


Fig.2.
WATER BLOWING



Lawson sculp.

for example, the letter *i* is placed under the hammer, the upper part of its head is at a ſmall diſtance from the head of the hammer, in order that its fall, which begins always at the ſame place, may ſtrike this letter weakly; but when the letter M is brought under the hammer, the upper part of its head being much leſs elevated than that of the letter *i*, will receive a much ſtronger blow. The impreſſions of the letters M and *i* will therefore always be equally deep, if the heads of the punches be once properly fixed by experiment.

Inſtead of the ſtroke of a hammer, however, our author makes uſe of the preſſure of a ſcrew, of which the threads are ſo inclined that it runs through its female ſocket, and would fall out merely by its own weight. This conſtruction affords the double advantage of preſerving the impreſſions from the effects of the circular motion, and of affording a fall in the ſcrew of nearly nine lines for each revolution. The head of this ſcrew is ſolidly fixed in the centre of a braſs wheel, of which the poſition is horizontal. The diameter of this wheel muſt be ſufficiently large, that its motion may not be perceptibly affected by the irregularities of friction in the ſcrew. This conſiderable diameter is alſo requiſite, becauſe the preſſure of the ſcrew depends, not only upon the force which is applied, but the diſtance of the place of application from the centre of movement.

It is eſſential that this wheel ſhould have very little ſhake; for which reaſon it is adviſable that the axis of the ſcrew ſhould be prolonged above the wheel itſelf, that it may ſlide in a ſocket firmly fixed to the frame of the machine. In this ſituation, the wheel, which is fixed on the prolongation of the ſcrew, will have its plane conſtantly preſerved in a ſituation parallel to itſelf, without any libration, notwithſtanding the riſe and fall of near nine lines, or three quarters of an inch, which it undergoes for each revolution on its axis.

It has been ſtated, as a requiſite condition, that the ſcrew ſhould conſtantly fall from the ſame fixed point, or elevation, upon the heads of every one of the punches. To accompliſh this eſſential purpoſe, a lever is firmly fixed to the ſupport of the ſcrew; which lever reſembles the beam of a balance, having one of its extremities armed with a claw, and the other ſerving to give it motion through a ſmall vertical ſpace. The claw falls into a notch in the upper ſurface of the wheel attached to the ſcrew, as ſoon as that wheel has riſen to the deſired elevation; and that lever itſelf is ſo far limited in its motion, that it cannot take hold of the wheel, excepting when it has reached that height. The wheel, therefore, remains confined and immoveable, by means of this detent, and cannot deſcend until it is delivered by preſſure upon the oppoſite tail of the lever. In this machine, the wheel which has the preſſing ſcrew for its axis does not perform an entire revolution. It was with a view that there might never be any fall capable of ſhaking and diſturbing the machine that the author determined to uſe only two-thirds of a revolution to ſtrike thoſe punches, which afford the ſtrongeſt reſiſtance. The ſcrew conſequently falls only through ſix lines upon thoſe heads which are leaſt elevated, and about two lines upon thoſe which ſtand higheſt. Whence the difference between the extreme heights does not exceed four lines.

It is obvious that ſo ſmall a difference is not ſufficient to ſtrike all the characters from M to the letter *i*, when the wheel which governs the ſcrew is put in motion by a conſtant weight, of which the impulſe, like that of a hammer, is increaſed only by the acceleration of its fall. It is evident that this requiſite variation of force might be had by changing the weight; but it is equally clear, that the numberleſs and inceſſant changes which the engraving of an entire work would demand, would be incompatible with that degree of ſpeed which forms one of the firſt requiſites. He was therefore obliged to render the force of the weight, which turns the ſcrew, variable, by cauſing it to act upon levers of greater or leſs lengths, according to the different quantities of impulſe required by the ſeveral punches. For this purpoſe he adopted the following conſtruction: He connected by a ſteel chain to the wheel, which moves the ſcrew, another wheel, having its axis horizontal, ſo that the two wheels reſpectively command each other. They are of equal diameter, and the chain is no longer than to make an entire turn round each wheel. This ſecond wheel, or leading pully, is intended to afford the requiſite variations of force, which it does by means of a ſnail fixed upon its axis. The ſnail is acted upon by a cord paſſing over its ſpiral circumference, or groove, and bearing a weight which is only to be changed when a new ſet of punches for characters of a different ſize are put into the great wheel. The ſpiral is ſo formed, that when the weight deſcends only through a ſmall ſpace, the part of the cord, which is unwound, acts at a very ſhort diſtance from the centre of the pulley; but when the fall is greater, the part of the ſnail upon which it acts is ſo far enlarged as to afford a much longer lever, and, conſequently, to give a proportionally greater effect to the ſtroke. This conſtruction, therefore, by giving the advantage of a longer lever to a greater fall of the ſcrew, affords all the power which the nature of the work, and the different ſpaces of the letters demand.

The ſupport on which the plate is fixed muſt, as has before been remarked, move ſo as to form ſtrait lines. This motion, which ſerves to ſpace the different characters with preciſion, is obtained by means of a ſcrew, the axis of which remains fixed, and carries a female ſcrew or nut. The nut itſelf is attached to the ſupport of the metallic plate, which receives the letters, and carries it in the right lined direction without any deviation; becauſe it is confined in a groove formed between two pieces of metal. The ſcrew is moved by a lever, which can turn it in one direction only, becauſe it acts by a click upon a ratchet-wheel, which is fixed to the head of the ſcrew. The action of this lever always begins from a fixed ſtop; but the ſpace through which it moves is variable, according to the reſpective breadths of the letters. This new conſideration induced M. Rochon to fix upon the rule or plate of the regiſter, a number of pins, correſponding with the different diviſions which anſwer to each punch: theſe pins determine the diſtance to which the lever can move. It therefore becomes a condition, that its poſition in the machine ſhould be oppoſite to the fixed index which determines the character at any time beneath the preſſing-ſcrew. The lever and its pin are therefore the ſole agents employed to ſpace the characters. If the plate were not moved by the lever, the impreſſions would fall upon each other; and thus, for example, the letter *i* would be totally obliterated by the impreſſion of the letter *l*.

Whenever, therefore, it is required to diſpoſe the letters

ters *i* and *l* beſide each other, the plate muſt be moved after ſtriking the letter *i* through a ſpace equal to the quantity of the deſired operation. Suppoſe this to be one-fourth of a line, and that the lever ſhould run through an arc of ten degrees to move the plate through this quantity; as ſoon as the pin of the letter *l* ſhall be adjuſted to the neceſſary length to enable the lever to deſcribe an arc of ten degrees, the operation of ſpacing the two letters *i* and *l* will be reduced to that of placing the laſt letter beneath the fixed index, and moving the plate till the lever ſhall be ſtopped by the pin belonging to the letter *l*. All the other letters will be equally ſpaced, if the diſpoſition of the punches in the wheel be ſuch, that the laſt ſtroke of any letter ſhall confound itſelf with any letter of a ſingle ſtroke, ſuppoſing them to be impreſſed one after the other, without moving the lever between ſtroke and ſtroke. This arrangement deſerves to be very ſeriouſly attended to, becauſe the proceſs could not be performed without it.

Many well-informed perſons are of opinion, that the perfect equality which this machine for engraving affords in the formation of letters and ſigns the moſt difficult to be imitated, may afford a means of remedying the dangers of forgery. It is certain that the performance exhibits a ſimple and ſtriking character of preciſion, which is ſuch, that the leaſt experienced eyes might flatter themſelves, in certain caſes, to diſtinguiſh counterfeits from originals. Lavoiſier, whom the friends of ſcience and the arts will not ceaſe to regret, made ſome experiments of this kind for the *caiſſe de'ſcompte*, which were attended with perfect ſucceſs. Artiſts appointed for that purpoſe endeavoured in vain to imitate a vignette, formed by the ſucceſſive and equal motion of a character of ornament.

TYRINGHAM, a townſhip of Maſſachuſetts, Berkſhire county. It contains 1397 inhabitants, lies 14 miles from the ſhire town, and 140 weſt of Boſton.—*Morſe*.

TYRONE, two townſhips of Pennſylvania; the one in York county, the other in that of Cumberland.—*ib.*

TYRREL, a maritime county of Edenton diſtrict, N. Carolina; bounded N. by Roanoke river and Albemarle Sound, and ſouth by Beaufort. It is generally a low, flat, and ſwampy country, and contains 4744 inhabitants, including 1176 ſlaves.—*ib.*

TYRTÆUS, an Athenian general and muſician, is celebrated by all antiquity for the compoſition of military ſongs and airs, as well as the performance of them. He was called to the aſſiſtance of the Lacedæmonians in the ſecond war with the Meſſenians, about 685 B. C.; and a memorable victory which they obtained over that people is attributed by the ancient ſcholiaſts upon Horace to the animating ſound of a new military flute or clarion, invented and played upon by Tyrtæus. Plutarch tells us that they gave him the freedom of their city; and that his military airs were conſtantly ſung and played in the Spartan army to the laſt hour of the republic. And Lycurgus the orator, in his oration againſt Leocrates, ſays, "The Spartans made a law, that whenever they were in arms, and going out upon any military expedition, they ſhould all be firſt ſummoned to the king's tent to hear the ſongs of Tyrtæus;" thinking it the beſt means of ſending them forth in a diſpoſition to die with pleaſure for their country. Fragments of his poetry, in elegiac verſe, are preſerved in Stobæus, Lycurgus Orat. in Fulvius Urſinus, at the end of Poems by illuſtrious women: and in the Oxford edition of *Eleg. & Lyric. Frag. & Scholia.* printed 1759. Εα Συζουσα, &c.

TYTLER (William, Eſq;), ſo well known in the literary world as one of the ableſt, and certainly the moſt gentlemanly, of the defenders of the fame of Mary Queen of Scots, was born at Edinburgh, October 12, 1711. He was the ſon of Mr Alexander Tytler, writer (or attorney) in Edinburgh, by Jane, daughter of Mr William Leſlie, merchant in Aberdeen, and granddaughter of Sir Patrick Leſlie of Idan, provoſt of that city. He received his education at the grammar ſchool (or, as it is there called, the High School) and the univerſity of his native city, and diſtinguiſhed himſelf by an early proficiency in thoſe claſſical ſtudies, which, to the lateſt period of his life, were the occupation of his leiſure hours, and a principal ſource of his mental enjoyments.

In the year 1731, he attended the academical lectures of Mr Alexander Bayne, Profeſſor of municipal law in the univerſity of Edinburgh, a gentleman diſtinguiſhed alike for his profeſſional knowledge, his literary accompliſhments, and the elegance of his taſte. The Profeſſor found in his pupil a congenial ſpirit; and their connection, notwithſtanding the diſparity of their years, was ſoon ripened into all the intimacy of the ſtricteſt friendſhip. So ſtrong indeed became at length that tie of affection, that the worthy Profeſſor, in his latter years, not only made him the companion of his ſtudies, but when at length the victim of a lingering diſeaſe, choſe him as the comforter of thoſe many painful and melancholy hours which preceded his death.

At the age of 31, Mr Tytler was admitted into the Society of Writers to his Majeſty's Signet, and continued the practice of that profeſſion with very good ſucceſs, and with equal reſpect from his clients and the public, till his death, which happened on the 12th of September 1792. He married, in September 1745, Anne Craig, daughter of Mr James Craig of Dalnair, writer to the ſignet, by whom he has left two ſons, Alexander Fraſer Tytler, his Majeſty's Judge advocate for Scotland, and Profeſſor of civil hiſtory in the univerſity of Edinburgh; and Patrick Tytler, Lieutenant-colonel of a regiment of fencible infantry, and Fort-major of the caſtle of Stirling; together with one daughter, Miſs Chriſtina Tytler. His wife died about nine years before him; and, previouſly to that period, he had loſt a ſon and a daughter, both grown to maturity.

The moſt remarkable feature of Mr Tytler's character was an ardour and activity of mind, prompted always by a ſtrong ſenſe of rectitude and honour. He felt with equal warmth the love of virtue and the hatred of vice; he was not apt to diſguiſe either feeling, nor to compromiſe, as ſome men more complying with the world might have done, with the faſhion of the time, or the diſpoſition of thoſe around him. He ſeldom waved an argument on any topic of hiſtory, of politics, or literature; he never retreated from one on any ſubject that touched thoſe more important points on which he had formed a decided opinion. Decided opinions he always formed on ſubjects of importance; for on ſuch ſubjects he formed no opinions raſhly; and what he firmly believed he avowed with confidence, and ſometimes with warmth.

Nor was it in opinion or argument only that this warmth and ardour of mind were conſpicuous. They prompted him equally in action and conduct. His affection to his family, his attachment to his friends and companions, his compaſſion for the unfortunate, were alike warm and active. He was in ſentiment alſo what Johnſon (who felt it ſtrongly in himſelf, and mentions it as the encomium of one of his friends) calls a *good hater*; but his hatred or reſentment went no further than opinion or words, his better affections only roſe into action. In his opinions, or in his expreſſion of them, there was ſometimes a vehemence, an appearance of acrimony, which his friends might regret, and which ſtrangers might cenſure; but he had no aſperity in his mind to influence his actual conduct in life. He indulged oppoſition, not enmity; and the world was juſt to him in return. He had opponents; but two of his biographers, who knew him well, as well as the people with whom he moſt aſſociated, declare their belief that he had not a ſingle enemy. His conteſts were on opinions, not on things; his diſputes were hiſtorical and literary. In converſation, he carried on theſe with uncommon intereſt and vivacity; and the ſame kind of impulſe which prompted his converſation (as is juſtly obſerved by an author, who publiſhed ſome notices of his life and character in the periodical work intitled *The Bee*) induced him to become an author. He wrote not from vanity or vain-glory, which Rouſſeau holds to be the only inducement to writing; he wrote to open his mind upon paper; to ſpeak to the public thoſe opinions which he had often ſpoken in private; opinions on the truth of which he had firmly made up his own conviction, and was ſometimes ſurpriſed when he could not convince others: it was fair to try, if, by a fuller expoſition of his arguments, he could convince the world.

With this view, he publiſhed, in 1759, his "Inquiry, hiſtorical and critical, into the Evidence againſt *Mary Queen of Scots*, and an Examination of the Hiſtories of Dr Robertſon and Mr Hume with reſpect to that Evidence;" in which he warmly eſpouſed the cauſe of that unfortunate Princeſs, attacked with ſeverity the conduct of her enemies, and expoſed the fallacy, in many parts the fabrication, of thoſe proofs on which the charges againſt her had been founded.

This was a cauſe worthy of an advocate who loved truth better than popular applauſe; and Mr Tytler evinced himſelf to be ſuch an advocate. The problem of Mary's guilt or innocence, if conſidered merely as a detached hiſtorical fact, would appear an object which, at this diſtance of time, ſeems hardly to merit that laborious and earneſt inveſtigation to which it has given riſe; though, even in this point of view, the mind is naturally ſtimulated to ſearch out the truth of a dark myſterious event, diſgraceful to human nature; and our feelings of juſtice and moral rectitude are intereſted to fix the guilt upon its true authors. But when we conſider that this queſtion involves a diſcuſſion of the politics of both England and Scotland during one of the moſt intereſting periods of their hiſtory, and touches the characters, not only of the two ſovereigns, but of their miniſters and ſtateſmen, it muſt then be regarded in the light of a moſt important hiſtorical inquiry, without which our knowledge of the hiſtory of our own country muſt be obſcure, confuſed, and unſatisfactory. In addition to theſe motives of inquiry, this queſtion has exerciſed ſome of the ableſt heads both of earlier and of latter times; and it is no mean pleaſure to engage in a conteſt of genius and of talents, and to try our ſtrength in the deciſion of a controverſy which has been maintained on both ſides with conſummate ability.

As we have elſewhere (ſee MARY, *Encycl.*) given an abſtract of the arguments on both ſides of this diſputed queſtion, it would be altogether improper to repeat them here; but juſtice to the ſubject of this memoir requires us to ſay, that by his manner of diſcuſſing it he acquired high reputation in the republic of letters. Before the appearance of the Inquiry, ſays an ingenious writer, it was the faſhion for literary diſputants to attack each other like miſcreants and banditti. The *perſon* was never ſeparated from the *cauſe*; and whatever attached the *one*, was conſidered as equally affecting the *other*; ſo that ſcurrility and abuſe bloated the pages even of a Bentley and a Ruddiman. The Hiſtorical Inquiry was free from every thing of that ſort: and though the higheſt name produced not a mitigation of the force of any argument, the meaneſt never ſuffered the ſmalleſt abuſe. He conſidered it as being greatly beneath the dignity of a man contending for truth, to overſtretch even an argument in the ſmalleſt degree, far more to pervert a fact to anſwer his purpoſe on any occaſion. In the courſe of his argument, he had too often occaſion to ſhew that this had been done by others; but he diſdained to imitate them. His reaſoning was forcible and elegant; impartially ſevere, but always polite, and becoming the gentleman and the ſcholar.

When this book appeared, it was univerſally read in Britain, and very well tranſlated into French, under the title of "Recherches Hiſtoriques et Critiques ſur les Principales Preuves del'Accuſation intentée contre Marie Reine d'Ecoſſe." The intereſt it excited among literary men may be judged of from the character of thoſe by whom it was reviewed on its publication, in the periodical works of the time. Dr Douglas, now biſhop of Saliſbury, Dr Samuel Johnſon, Dr John Campbell, and Dr Smollet—all wrote reviews of Mr Tytler's book, containing very particular accounts of its merits, and elaborate analyſes of the chain of its arguments. As an argument on evidence, no ſuffrage could perhaps be more deciſive of its merit than that of one of the greateſt lawyers, and indeed one of the ableſt men that ever ſat on the woolſack of England, the late Lord Chancellor Hardwicke, who declared Mr Tytler's Inquiry to be the beſt concatenation of circumſtantiate proofs brought to bear upon one point that he had ever peruſed. What effect that body of evidence, or the arguments deduced from it, ought to have upon the minds of thoſe to whom the ſubject may become matter of inveſtigation, we do not preſume to determine. The opinion of the late Dr Henry, author of the Hiſtory of Great Britain on a New Plan, may perhaps be thought neither partial nor confident. He ſays, in a letter to Mr Tytler, publiſhed in the firſt volume of Tranſactions of the Antiquarian Society of Scotland, That he would be a bold man who ſhould now publiſh an hiſtory of Queen Mary in the ſame ſtrain with the two hiſtorians (Mr Hume and Dr Robertſon), whoſe opinions on the ſubject the Inquiry had examined and controverted.

The moſt exceptionable part of Mary's conduct, which, though it may admit of an apology, cannot be vindicated, is her marriage to Bothwell; and for that marriage Mr Tytler made an apology, founded on facts, which he would be a daring or very bigotted man who would attempt to controvert. See the article already referred to.

Beſides the *Hiſtorical Inquiry*, and the *Diſſertation on the Marriage of Queen Mary with the Earl of Bothwell*, our author publiſhed ſeveral other works on hiſtorical and literary ſubjects; of which the firſt was, the *Poetical remains of James I. King of Scotland*, conſiſting of *the King's Quair*, in ſix cantos, and *Chriſt's Kirk on the Green*; to which is prefixed a diſſertation on the Life and Writings of King James, in one volume 8vo, printed at Edinburgh in 1783. This diſſertation forms a valuable morſel of the literary hiſtory of Europe; for James ranked ſtill higher in the literary world as a *poet*, than in the political world as a *prince* (A). Great juſtice is done to his memory in both reſpects in this diſſertation: and the two morſels of poetry here reſcued from oblivion will be eſteemed by men of taſte as long as the language in which they are written can be underſtood.

2. "A Diſſertation on Scottiſh Muſic," firſt ſubjoined to Arnot's hiſtory of Edinburgh. The ſimple melodies of Scotland have been long the delight of the natives, many of which, to them, convey an idea of pathos that can be equalled by none other; and are much admired by every ſtranger of muſical talents who has viſited this country. They have a powerful effect, indeed, when properly introduced, as a relief, into a muſical compoſition of complicated harmony. Theſe are of two kinds, pathetic and humorous. Thoſe who wiſh to receive information concerning this curious ſubject, will derive much ſatisfaction from the peruſal of this diſſertation. There is yet another kind of muſic peculiar to the Highlands of Scotland, of a more wild, irregular, and animating ſtrain, which is but ſlightly treated here, and requires to be ſtill more fully elucidated.

3. "Obſervations on the Viſion, a poem," firſt publiſhed in Ramſay's Evergreen, now alſo printed in the Tranſactions of the Society of Antiquaries of Scotland. This may be conſidered as a part of the literary hiſtory of Scotland.

4. "On the Faſhionable Amuſements in Edinburgh during the laſt century," *ibid.* It is unneceſſary to dwell on the light that ſuch diſſertations as theſe, when judiciouſly executed, throw upon the hiſtory of civil ſociety and the progreſs of manners. Mr Tytler was likewiſe the author of N° 16. of the Lounger, a weekly paper, publiſhed at Edinburgh in the year 1786. His ſubject is the Defects of Modern Female Education in teaching the Duties of a Wife; and he treats that ſubject like a maſter.

On all Mr Tytler's compoſitions the character of the *man* is ſtrongly impreſſed, which never, as in ſome other inſtances, is in the ſmalleſt degree contradicted by, or at variance with, the character of the *author*. He wrote what he felt, on ſubjects which he felt, on ſubjects relating to his native country, to the arts which he loved, to the times which he revered. His heart, indeed, was in every thing which he wrote, or ſaid, or did. He had, as his family and friends could warmly atteſt, all the kindneſs of benevolence: he had its anger too; for benevolence is often the parent of anger. There was nothing neutral or indifferent about Mr Tytler. In philoſophy and in hiſtory, he could not bear the coldneſs, or what ſome might call the temperance of ſcepticiſm; and what he firmly believed, it was his diſpoſition keenly to urge.

His mind was ſtrongly impreſſed by ſentiments of religion. His piety was fervent and habitual. He believed in the doctrine of a particular Providence, ſuperintending all the actions of individuals as well as the great operations of Nature: he had a conſtant impreſſion of the power, the wiſdom, and the benevolence of the Supreme Being; and he embraced, with thorough conviction, the truths of Chriſtianity.

His reading was various and extenſive. There was ſcarcely a ſubject of literature or taſte, and few even of ſcience, that had not at times engaged his attention. In hiſtory he was deeply verſed; and what he had read his ſtrong retentive memory enabled him eaſily to recal. Ancient as well as modern ſtory was familiar to him; and, in particular, the Britiſh hiſtory, which he had read with the moſt minute and critical attention. Of this, beſides what he has given to the public, a great number of notes, which he left in MS. touching many controverted points in Engliſh and Scottiſh hiſtory, afford the moſt ample proof.

In muſic as a ſcience he was uncommonly ſkilled. It was his favourite amuſement; and with that natural partiality which all entertain for their favourite objects, he was apt to aſſign to it a degree of moral importance which ſome might deem a little whimſical. He has often been heard to ſay, that he never knew a good taſte in muſic aſſociated with a malevolent heart: And being aſked, What preſcription he would recommend for attaining an old age as healthful and happy as his own? "My preſcription (ſaid he) is ſimple—ſhort but cheerful meals, muſic, and a good conſcience."

In domeſtic life, Mr Tytler's character was particularly amiable and praiſe-worthy. He was one of the kindeſt huſbands and moſt affectionate fathers. At the beginning of this account, we mentioned his having loſt, at an advanced period of life, an excellent wife, and a ſon and a daughter both grown to maturity, who merited and poſſeſſed his warmeſt affections. The temper of mind with which he bore theſe loſſes, he has himſelf expreſſed in a MS. note, written not long before his death; with which, as it conveys a ſentiment equally important in the conſideration of this life, and in the contemplation of that which is to come, we ſhall conclude the preſent memoir: "The lenient hand of time (ſays he, after mentioning the death of his wife and children), the lenient hand of time, the affectionate care of my remaining children, and the duty which calls on my exertions for them, have by degrees reſtored me to myſelf. The memory of thoſe dear objects gone before me, and the ſoothing hope that we ſhall ſoon meet again, is now the ſource of extreme pleaſure to me. In my retired walks in the country I am never alone; thoſe dear ſhades are my conſtant companions! Thus what I looked upon as a bitter calamity, is now become to me the chief pleaſure in life."

U, V.

(A) There is a beautiful hiſtorical picture of this prince playing on the harp, with his queen and a circle of his courtiers liſtening to the muſic, by Graham, in London; one of the moſt eminent artiſts of the age.

U, V.

VACCAS, *Cayo*, one of the Tortugas, or Florida Keys, to the eaſtward of Bahia Honda; the diſtance between them is 4 leagues, and the coaſt in its direction turns to the northward. On the S. ſide of Cayo Vaccas, about 8 miles from the W. end, there are wells of freſh water. A thick range of iſles go by this name. Bahia Honda is in lat. 24 35 N.—*Morse.*

VACCA, called alſo the *Cow's*, or *Neat's Tongue*, a low point on the W. coaſt of Chili, in S. America, which bounds the bay of Tonguey to the weſtward.—*ib.*

VACHE, or *Cows Iſland*, lies on the ſouth coaſt of the ſouthern peninſula of the iſland of St Domingo, and is about 4½ leagues long, and in the broadeſt part a league and a half from N. to S. The ſouth point is 3 leagues E. of Point Abacou; and in lat. 18 4 N. and long. from Paris 76 2 W. It has a very good ſoil, with 2 or 3 tolerable ports, and lies very conveniently for trade with the Spaniſh colonies on the continent, and with Cayenne. The ſeamen call this Aſh Iſland, a corruption from Vaſh, as it is pronounced.—*ib.*

VACH ET LE TORREAU, or *Cow and Bull Rocks*, on the ſouth coaſt of Newfoundland iſland, are about a mile S.E. of Cape St Mary, which is the point between the deep bay of Placentia on the W. and St Mary's Bay on the eaſt. They are fair above water, but there are others near them which lurk under water.—*ib.*

VACUUM BOYLEANUM, is the approach to a real vacuum, to which we can arrive by means of the air-pump.

Torricellian VACUUM, is the moſt complete vacuum which we can make by means of the torricellian tube. See BAROMETER, and PNEUMATICS, *Encycl.*

VADE-MECUM, the title given to ſuch books as men of particular profeſſions, having frequent occaſion to conſult, may eaſily carry about with them. Thus a ſmall volume, publiſhed in the beginning of the 18th century, giving an account of the ancient and preſent church of England, and of the duties, rights, privileges, and hardſhips of the clergy, is known by the title of *the Clergyman's Vade-mecum*.

VAE'S *Iſland, Anthony*, a ſmall iſland on the E. coaſt of Brazil, in S. America. It lies to the ſouthward of the ſandy Receif, and oppoſite to it, which is joined to the continent by a bridge.—*Morse.*

VAKEEL, a miniſter, agent, or ambaſſador.

VALADOLID or *Valladolid*, called by the Indians *Comayagua*, is the chief city of the province of Honduras, in New Spain. It is the ſeat of the Governor, and is a biſhop's ſee ſuffragant of Mexico, ſince the year 1558. It is ſeated on a plain, 30 miles W. of the Gulf of Honduras, 170 S. W. of Truxillo, and 65 S. E. of Merida. N. lat. 14 10, W. long. 51 21.—*Morse.*

VALENCIA, a town in the province of Caracas, on Terra Firma, South-America, about 80 miles N. of Baraquicimeto, and 250 W. of Cumana. N. lat. 10, W. long. 67.—*ib.*

VALGUS, *Bow* or *Bandy Legged*. Some children are bow-legged from their birth; others become ſo from ſetting them on their feet too early. The tibia of ſome is crooked; the knees of others are diſtorted; from a fault in the ankle, the feet of ſome are turned inwards, theſe are called *vari*; and in others they turn outwards, theſe are called *valgi*. The beſt method of preventing theſe diſorders in weakly children, is to exerciſe them duly, but not violently; by dancing or toſſing them about in one's arms, and not ſetting them much on their feet, at leaſt not without properly ſupporting them: if the diſorder attends at the birth, or increaſes after it is begun, apply emollients, then apply boots of ſtrong leather, wood, &c. as required to diſpoſe the crooked legs gradually to a proper form: or other inſtruments may be uſed inſtead of boots, which, when not too coſtly, are uſually to be preferred. Slighter inſtances of the diſorders yield to careful nurſing without inſtruments.

VALLEY *Forge*, a place on Schuylkill river, 15 miles from Philadelphia. Here General Waſhington remained with his army, in huts, during the winter of 1777, after the Britiſh had taken poſſeſſion of that city.—*Morse.*

VALPARAISO, a large and populous town of Chili, in South-America, having a harbour forming the port of St Jago, in lat. 33 2 36, S. and long. 77 29, W. It is 390 miles E. of the iſland of Juan Fernandes. It carries on a conſiderable trade with the port of Callao.—*ib.*

VANCOUVER'S *Fort*, in Kentucky, ſtands at the junction of the two branches of Big Sandy river, 20 miles N. of Harmar's ſtation.—*ib.*

VANDA', the Indian name of a plant of the genus EPIDENDRUM; which ſee, *Encycl.* The *vandá* is thus deſcribed by Sir William Jones.

" CAL. *Spathes* minute, ſtraggling. COR. *Petals* five, diverging, oval-oblong, obtuſe, wavy; the two loweſt larger; the three higheſt equal, bent towards the nectary. *Nectary* central, rigid: *Mouth* gaping, oblique: *Upper lip* ſhorter, three-parted, with a poliſhed honey-cup; *under lip* concave in the middle, keeled above, with two ſmaller cavities below, two proceſſes at the *baſe*, incurved, hollow, oval pointed, converging, honey-bearing. STAM. *Filaments* very ſhort. *Anthers* round, flattiſh, margined, covered with a lid, eaſily deciduous from the *upper lip* of the nectary. PIST. *Germ.* beneath long, ribbed, contorted with curves of oppoſite flexure. *Style* very ſhort, adhering to the *upper lip*. *Stigma* ſimple. PER. *Capſule* oblong-conic, wreathed, ſix-keeled, each with two ſmaller keels, three-celled, crowned with the dry corol. SEEDS innumerable, like fine duſt affixed to the *receptacle* with extremely fine hairs, which become thick wool. *Scapes* incurved, ſolitary, from the cavity of the leaf, at moſt ſeven-flowered; pedicles alternate. *Petals* milk-white externally, tranſparent; brown within, yellow-ſpotted. *Upper lip* of the nectary ſnow-white; *under lip* rich purple, or light crimſon, ſtriated at the baſe, with a bright yellow gland, as it ſeems, on each proceſs. The flowers gratefully fragrant, and exquiſitely beautiful, looking as if compoſed of ſhells, or made of enamel; criſp elaſtic, viſcid internally. *Leaves* ſheathing,

ing, oppoſite, equally curved, rather fleſhy, ſword-form, retuſe in two ways at the ſummit, with one acute point. *Roots* fibrous, ſmooth, flexible; ſhooting even from the top of the leaves."

This lovely plant attaches itſelf chiefly to the higheſt *Amras* and *Bilvas* (the *Mangifera* and *Cratæva* of Lin.); but it is an air-plant, and lives (ſays the Preſident) in a pot *without earth or water:* its leaves are excavated upwards, to catch and retain dew.

VANDALIA, a duchy of Farther Pomerania, ſubject to the king of Pruſſia. Stolpen is the capital.

VANDALIA, a country in Germany, in the circle of Lower Saxony and duchy of Mecklenburg. It lies between the biſhopric and duchy of Schwerin, the lordſhips of Stocrock and Stargard, Pomerania, and the marquiſate of Brandenburg; and is 75 miles in length and 7 in breadth. It contains ſeveral ſmall lakes, and the principal town is Guſtrow.

VANDERMONDE, member of the National Inſtitute of Sciences and Arts, was born at Paris in the year 1735. He devoted his youth to ſelf-inſtruction; and even at the age of thirty was far enough from ſuſpecting that he was deſtined to inſtruct others in his turn. Chance brought him near to the celebrated Fontaine. That ſexagenary geometrician eaſily divined the progreſs which Vandermonde would one day make in the mathematics; in him he anticipated, as it were, a ſucceſſor to himſelf; he patroniſed and careſſed him, let him into the ſecret of his reſearches, calculations, inventions, of that lively enjoyment which profound ſpeculation gives to an elevated attentive mind; and which, blended with the ſweets of tranquillity, the charms of retreat, and the conſciouſneſs of ſucceſs, becomes often a ſort of paſſion, as felicitous as durable. All that time Fontaine, whoſe attention was again directed to the reſearches which he had added to thoſe of Jean Bernoulli, relative to the then famous queſtion *of the toutocrenes*, had the glory to be vanquiſhed only by D'Alembert and La Grange. Vandermonde, a witneſs to this combat, neceſſarily illuſtrious, animated by the honour which he ſaw annexed to that glorious defeat, enchanted with the ſight of Fontaine, as happy, in ſpite of his age, from his love of geometry, as a youth of twenty could be with a ſentiment leſs tranquil, thought he ſhould inſure his happineſs for ever, by yielding to a paſſion which the ice of age could not extinguiſh; in a word, he devoted himſelf to geometry.

His labours, however, were for ſome time ſecret; and perhaps the public would never have enjoyed the benefit of any of his works, if another geometrician (whoſe name, ſays Lacepede, cannot be pronounced, in this place, without a mixture of intereſt and regret) had not inſpired him with a conſciouſneſs of his own ſtrength, and courage to diſplay it. Fontaine had already devoted him to geometry; Duſejour exhorted him to penetrate even into its ſanctuary. In brief, he preſented himſelf to the Academy of Sciences, into which he was admitted in 1771; and in that very year juſtified the ſuffrages of his aſſociates, by a paper which he publiſhed relative to the reſolution of equations

From the 16th century the method of reſolving equations of the four firſt degrees has been known, and ſince that time the general theory of equations has received great improvements. In ſpite, however, of the recent labours of many great geometricians, the ſolutions of equations of the fifth degree had in vain been attempted. Vandermonde wiſhed to conſolidate his labours with thoſe of other illuſtrious analyſts; and he propoſed a new theory of equations, in which he ſeems to have made it particularly his buſineſs to ſimplify the methods of calculation, and to contract the length of the *formulæ*, which he conſidered as one of the greateſt difficulties of the ſubject.

This work was quickly followed by another on the problems called by geometricians *problems of ſituation.* It ſeems to have been the deſtiny of Vandermonde, as well as of Fontaine, who firſt initiated him into the myſteries of mathematical ſcience, to labour frequently upon ſubjects already handled by the greateſt maſter. In his firſt memoir he had ſtarted, ſo to ſpeak, in competition with La Grange and Euler; in his ſecond, with Euler and Leibnitz. This laſt was of opinion that the analyſis made uſe of in his time, by the geometricians, was not applicable to all queſtions in the phyſical ſciences; and that a new geometry ſhould be invented, to calculate the relations of poſitions of different bodies, in ſpace: this he called *geometry of ſituation**. Excepting, however, one application, made by Leibnitz himſelf, to the game of *ſolitaire*, and which, under the appearance of an object of curioſity, ſcarcely worthy the ſublimity and uſefulneſs of geometry, is an example for ſolving the moſt elevated and important queſtions, Euler was almoſt the only one who had practiſed this geometry of ſituation. He had reſorted to it for the ſolution of a problem called the *cavalier*, which alſo appeared very familiar at firſt ſight, and was alſo pregnant with uſeful and important applications. This problem, with the vulgar, conſiſted merely in running through all the caſes of the cheſs-board with the *knight* of the game of cheſs; to the profound geometrician, however, it was a precedent for tracing the route which every body muſt follow, whoſe courſe is ſubmitted to a known law, by conforming to certain required conditions, through all the points diſpoſed over a ſpace in a preſcribed order. Vandermonde was chiefly anxious to find in this ſpecies of analyſis a ſimple notation, likely to facilitate the making of calculations; and he gave an example of this, in a ſhort and eaſy ſolution of the ſame problem of the cavalier, which Euler had rendered famous.

His taſte for the high conceptions of the ſpeculative ſciences, as blended with that which the *amor patriæ* naturally inſpires for objects immediately uſeful to ſociety, had led him to turn his thoughts towards perfecting the arts converſant in weaving, by indicating a manner of noting the points through which are to paſs the threads intended to form the lines which terminate the ſurface of different regular bodies: accordingly a great part of the above memoir is taken up with this ſubject.

In the year following (1772) he printed a third memoir; in which he traced out a new path for geometers, diſcovering, by learned analytical reſearches, *irrational* quantities of a new ſpecies, ſhewing the ſequels of which theſe *irrationals* are the terms or the ſum, and pointing out a direct and general method of making in them all the poſſible reductions.

In the ſame year appeared his work on the Elimination of unknown Quantities in Algebra. This elimination is the art of bringing back thoſe equations which include many unknown quantities, to equations which only

* See Poſition, *Suppl.*

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enius.

only contain one. The perfection of reſearches in this art would conſiſt in obtaining a general and particular *formula* of elimination in a form the moſt conciſe and convenient, in which the number of equations and their degrees ſhould be deſigned by indeterminate letters. Vandermonde, while he conſidered the geometers as very diſtant from this point, had ſome glimpſe of a poſſibility of reaching it, and propoſed ſome new methods of approaching nearer it.

In 1778, he preſented in one of the public ſittings of the Academy, a new ſyſtem of harmony, which he detailed more fully in another public ſitting of 1780. In this ſyſtem, Vandermonde reduces the modes of proceeding adopted until his time, to two principal rules, which thus become eſtabliſhed on effects admitted by all muſicians. Theſe two general rules, one on the ſucceſſion of according ſounds, the other on the arrangement of the parts, depend themſelves on a law more elevated, which, according to Vandermonde, ought to rule the whole ſcience of harmony.

By the publication of this work, he ſatisfactorily attained the end he had propoſed to himſelf, and obtained the ſuffrages of three great men, repreſentatives, ſo to ſpeak, of the three great ſchools of Germany, France, and Italy; Gluck, Philidor, and Piccini.

With theſe labours, intermingled with frequent reſearches on the mechanic arts, as well as on objects of political economy, the attention of Vandermonde was taken up; when, July 14, 1789, the voice of liberty reſounded over the whole ſurface of France, and ſuddenly all the thoughts, as well as all the affections, of Vandermonde, were engaged on the ſide of what he called liberty.

He became ſo furious a democrate, ſo outrageous an enemy to every thing eſtabliſhed, that he concurred in the abolition of the Royal Academy, of which he had been ſo ambitious of becoming a member, and aſſociated himſelf cloſely with Robeſpierre, Marat, and the reſt of that atrocious gang of villains, who covered France with ruins, with ſcaffolds, and with blood. This part of Vandermonde's hiſtory is ſuppreſſed by his eulogiſt Lacepede, becauſe, forſooth, diſcuſſions on *political opinions* ought not, in his opinion, to be admitted into the ſanctuary of the ſciences.

In that ſanctuary he did not long remain. Soon after his atrocities, he was attacked by a diſorder in his lungs, which almoſt taking away his breath, manifeſted itſelf by alarming ſymptoms, and conducted him by rapid ſteps to the tomb. He died in the end of the year 1795; a ſtriking inſtance of the wayward violence of the human mind, which even the love of ſcience could not keep at a diſtance from tumult and uproar.

VAN DYKES, *Joſt* and *Little*, two of the ſmaller Virgin Iſlands, ſituated to the N. W. of Tortola. N. lat. 18 25, W. long. 63 15.—*Morſe.*

VANNSTOWN, in the country of the Cherokees, lies on a branch of Alabama river.—*ib.*

VARENIUS (Bernard), a learned Dutch geographer and phyſician of the 17th century, who was author of the beſt mathematical treatiſe on geography intitled *Geographia Univerſalis, in qua affectiones generalis Telluris explicantur*. This excellent work has been tranſlated into all languages, and was honoured by an edition, with improvements, by Sir Iſaac Newton, for the uſe of his academical ſtudents at Cambridge.

Variable,
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Variolæ
Vaccinæ.

VARIABLE, in geometry and analytics, is a term applied by mathematicians to ſuch quantities as are conſidered in a variable or changeable ſtate, either increaſing or decreaſing. Thus the abſciſſes and ordinates of an ellipſis, or other curve line, are variable quantities; becauſe theſe vary or change their magnitude together, the one at the ſame time with the other. But ſome quantities may be variable by themſelves alone, or while thoſe connected with them are conſtant: as the abſciſſes of a parallelogram, whoſe ordinates may be conſidered as all equal, and therefore conſtant; alſo the diameter of a circle, and the parameter of a conic ſection, are *conſtant*, while their abſciſſes are *variable*. See FLUXIONS, *Encycl.*

VARIATION OF CURVATURE, in geometry, is uſed for that inequality or change which takes place in the curvature of all curves except the circle, by which their curvature is more or leſs in different parts of them; and this variation conſtitutes the quality of the curvature of any line.

1
Variolæ Vaccinæ long known in Glouceſterſhire.

VARIOLÆ VACCINÆ, or *Cow pox*, is the name commonly, though, as ſome people think, improperly, given to a very ſingular diſeaſe, which, for two or three years paſt, has occupied a great ſhare of the attention of medical men. It has been many years prevalent in ſome of the great dairy counties in England, particularly Glouceſterſhire; and it has been long underſtood by the farmers and others in theſe counties, that it for ever exempts all perſons who have been infected with it from the contagion of ſmall-pox.

It is very ſurpriſing that, though they knew this fact, and although no perſon had ever been known to die of the cow-pox, they never thought of having recourſe to a voluntary infection of this kind, in order to free themſelves and their families from the poſſibility of being infected with the variolous poiſon, which ſo often proves mortal. In one caſe, indeed, communicated to Dr Pearſon by Mr Downe of Bridport, the experiment was long ago tried by a farmer upon his own perſon, and with complete ſucceſs: But this only makes it the more wonderful that his example ſhould not have been followed.

2
And in the duchy of Holſtein.

In the town of Kiel, however, in the duchy of Holſtein, where the diſeaſe is ſaid to be well known, as frequently affecting cows, we are told that children are ſometimes inoculated with cow-pox *(Die Finnen)*, with a view to preſerve their beauty; but that the people in the country do not like this inoculation, becauſe they pretend that it leaves behind it ſeveral diſorders.

3
Vaccine inoculation introduced by Dr Jenner.

With theſe exceptions Dr Jenner was the firſt perſon who introduced the vaccine inoculation; and to him the public are alſo indebted for the firſt careful and accurate inveſtigation of this intereſting ſubject. The following is his account of the origin and hiſtory of the diſeaſe, and of its characteriſtic ſymptoms.

4
Origin of the diſeaſe, according to him.

" There is a diſeaſe to which the horſe, from his ſtate of domeſtication, is frequently ſubject. The farriers have termed it *the greaſe*. It is an inflammation and ſwelling in the heel, from which iſſues matter poſſeſſing properties of a very peculiar kind, which ſeems capable of generating a diſeaſe in the human body (after it has undergone the modification which I ſhall preſently ſpeak of), which bears ſo ſtrong a reſemblance to the ſmall-pox, that I think it highly probable that it may be the ſource of that diſeaſe.

5 Its appearance on the cow and the perſon who milks her.

“ In this dairy county (Glouceſterſhire), a great number of cows are kept, and the office of milking is performed indiſcriminately by men and maid ſervants. One of the former having been appointed to apply dreſſings to the heels of a horſe affected with *the greaſe*, and not paying due attention to cleanlineſs, incautiouſly bears his part in milking the cows with ſome particles of the infectious matter adhering to his fingers. When this is the caſe, it commonly happens that a diſeaſe is communicated to the cows, and from the cows to the dairy maids, which ſpreads through the farm until moſt of the cattle and domeſtics feel its unpleaſant conſequences. This diſeaſe has obtained the name of the cow-pox. It appears on the nipples of the cows in the form of irregular puſtules. At their firſt appearance they are commonly of a paliſh blue, or rather of a colour ſomewhat approaching to livid, and are ſurrounded by an eryſipelatous inflammation. Theſe puſtules, unleſs a timely remedy be applied, frequently degenerate into phagedenic ulcers, which prove extremely troubleſome. The animals become indiſpoſed, and the ſecretion of milk is much leſſened. Inflamed ſpots now begin to appear on different parts of the hands of the domeſtics employed in milking, and ſometimes on the wriſts, which quickly run on to ſuppuration, firſt aſſuming the appearance of the ſmall veſications produced by a burn. Moſt commonly they appear about the joints of the fingers, and at their extremities; but whatever parts are affected, if the ſituation will admit, theſe ſuperficial ſuppurations put on a circular form, with their edges more elevated than their centre, and of a colour diſtantly approaching to blue. Abſorption takes place, and tumors appear in each axilla. The ſyſtem becomes affected, the pulſe is quickened, and ſhiverings, with general laſſitude, and pains about the loins and limbs, with vomiting, come on. The head is painful, and the patient is now and then even affected with delirium. Theſe ſymptoms varying in their degrees of violence, generally continue from one day to three or four, leaving ulcerated ſores about the hands, which, from the ſenſibility of the parts, are very troubleſome, and commonly heal ſlowly, frequently becoming phagedenic, like thoſe from whence they ſprung. The lips, noſtrils, eyelids, and other parts of the body, are ſometimes affected with ſores; but theſe evidently ariſe from their being needleſsly rubbed or ſcratched with the patient's infected fingers. No eruptions of the ſkin have followed the decline of the feveriſh ſymptoms in any inſtance that has come under my inſpection, one only excepted; and in this caſe a very few appeared on the arms: they were very minute, of a vivid red colour, and ſoon died away without advancing to maturation: ſo that I cannot determine whether they had any connection with the preceding ſymptoms.

“ Thus the diſeaſe makes its progreſs from the horſe to the nipple of the cow, and from the cow to the human ſubject.

6 Its ſingularity,

“ Morbid matter of various kinds, when abſorbed into the ſyſtem, may produce effects in ſome degree ſimilar; but what renders the cow-pox virus ſo extremely ſingular is, that the perſon who has been thus affected is for ever after ſecure from the infection of the ſmall-pox; neither expoſure to the variolous effluvia, nor the inſertion of the matter into the ſkin, producing this diſtemper.

7 Thoug is ſom times founde with other caſe.

“ It is neceſſary to obſerve, that puſtulous ſores frequently appear ſpontaneouſly on the nipples of cows; and inſtances have occurred, though very rarely, of the hands of the ſervants employed in milking being affected with ſores in conſequence, and even of their feeling an indiſpoſition from abſorption. Theſe puſtules are of a much milder nature than thoſe which ariſe from that contagion which conſtitutes the true cow-pox. They are always free from the bluiſh or livid tint ſo conſpicuous in that diſeaſe. No eryſipelas attends them, nor do they ſhew any phagedenic diſpoſition, as in the other caſe, but quickly terminate in a ſcab, without creating any apparent diſorder in the cow. This complaint appears at various ſeaſons in the year, but moſt commonly in the ſpring, when the cows are firſt taken from their winter food and fed with graſs. It is very apt to appear alſo when they are ſuckling their young. But this diſeaſe is not to be conſidered as ſimilar in any reſpect to that of which I am treating, as it is incapable of producing any ſpecific effects on the human conſtitution. However, it is of the greateſt conſequence to point it out here, leſt the want of diſcrimination ſhould occaſion an idea of ſecurity from the infection of the ſmall-pox, which might prove deluſive.”

Dr Jenner adds, that the active quality of the virus from the horſe's heels is greatly increaſed after it has acted on the nipples of the cow, as it rarely happens that the horſe affects his dreſſer with ſores, and as rarely that a milkmaid eſcapes the infection when ſhe milks infected cows. It is moſt active at the commencement of the diſeaſe, even before it has acquired a pus like appearance. Indeed the Doctor is rather induced to think that the matter loſes this property entirely as ſoon as it is ſecreted in the form of pus, and that it is the thin darkiſh looking fluid only, oozing from the newly formed cracks in the heels, ſimilar to what ſometimes exudes from eryſipelatous bliſters, which gives the diſeaſe. He is led to this opinion, from having often inſerted pus taken from old ſores in the heels of horſes, into ſcratches made with a lancet, on the ſound nipples of cows, which has produced no other effect than ſimple inflammation.

He is uncertain if the nipples of the cow are at all times ſuſceptible of being acted upon by the virus from the horſe, but rather ſuſpects that they muſt be in a ſtate of prediſpoſition, in order to enſure the effect. But he thinks it is clear that when the cow-pox virus is once generated, the cows, when milked with a hand really infected, cannot reſiſt the contagion, in whatever ſtate their nipples may chance to be. He is alſo doubtful whether the matter, either from the cow or the horſe, will affect the ſound ſkin of the human body; but thinks it probable that it will not, except on thoſe parts where the cuticle is very thin, as on the lips.

At what period the cow-pox was firſt noticed in Glouceſterſhire is not upon record. The oldeſt farmers were not unacquainted with it in their earlieſt days when it appeared upon their farms, without any deviation from the phenomena which it now exhibits. Its connection with the ſmall-pox ſeems to have been unknown to them. Probably the general introduction of inoculation firſt occaſioned the diſcovery. Dr Jenner conjectures that its riſe in that neighbourhood may not have been of very remote date, as the practice of milking cows might formerly have been in the hands of women

women only; and conſequently the cows might not in former times have been expoſed to the contagious matter brought by the men ſervants from the heels of horſes. He adds, that a knowledge of the ſource of the infection is new in the minds of moſt of the farmers, but has at length produced good conſequences; and that it ſeems probable, from the precautions they are now diſpoſed to adopt, that the appearance of the cow-pox in that quarter may either be entirely extinguiſhed or become extremely rare.

“ With reſpect to the opinion adduced (Dr Jenner obſerves), that the ſource of the infection is a peculiar morbid matter ariſing in the horſe; although I have not (ſays he) been able to prove it from actual experiments conducted immediately under my own eye, yet the evidence I have adduced appears to eſtabliſh it.

“ They who are not in the habit of conducting experiments, may not be aware of the coincidence of circumſtances, neceſſary for their being managed ſo as to prove perfectly deciſive; nor how often men engaged in profeſſional purſuits are liable to interruptions, which diſappoint them almoſt at the inſtant of their being accompliſhed; however, I feel no room for heſitation reſpecting the common origin of the diſeaſe, being well convinced that it never appears among the cows, except it can be traced to a cow introduced among the general herd which has been previouſly infected, or to an infected ſervant, unleſs they have been milked by ſome one who, at the ſame time, has the care of a horſe affected with diſeaſed heels.”

The following caſe, which we alſo quote from Dr Jenner, would ſeem to ſhew that not only the heels of the horſe, but other parts of the body of that animal, are capable of generating the virus which produces the cow-pox.

“ An extenſive inflammation of the eryſipelatous kind appeared, without any apparent cauſe, upon the upper part of the thigh of a ſucking colt, the property of Mr Millet, a farmer at Rockhampton, a village near Berkeley. The inflammation continued ſeveral weeks, and at length terminated in the formation of three or four ſmall abſceſſes. The inflamed parts were fomented, and dreſſings were applied by ſome of the ſame perſons who were employed in milking the cows. The number of cows milked was twenty-four, and the whole of them had the cow-pox. The milkers, conſiſting of the farmer's wife, a man, and a maid-ſervant, were infected by the cows. The man-ſervant had previouſly gone through the ſmall-pox, and felt but little of the cow-pox. The ſervant-maid had ſome years before been infected with the cow-pox, and ſhe alſo felt it now in a ſlight degree: but the farmer's wife, who never had gone through either of theſe diſeaſes, felt its effects very ſeverely. That the diſeaſe produced upon the cows by the colt, and from them conveyed to thoſe who milked them, was the *true* and not the *ſpurious* cow-pox, there can be ſcarcely any room for ſuſpicion; yet it would have been more completely ſatisfactory had the effects of variolous matter been aſcertained on the farmer's wife; but there was a peculiarity in her ſituation which prevented my making the experiment.”

8
Jenner's nion of origin the dif- e con- verted.

Subſequent authors have not been all diſpoſed to adopt Dr Jenner's opinion that this diſeaſe derives its origin from the greaſe in horſes. We have ſeen the Doctor himſelf allow that he has not been able to prove it deciſively by actual experiments; and to eſtabliſh a fact ſo contrary to all analogy, perhaps no weaker evidence ought to be admitted. The only other beſtial diſorder with which we are acquainted, which is capable of being communicated by contagion to the human ſpecies, is hydrophobia: but here the diſorder is the ſame in man as in the animal from which he derives it; and the analogy holds good in the propagation of the vaccine diſeaſe from the cow to her milker. But that the diſcharge from a local diſeaſe in the heel of a horſe ſhould be capable of producing a general diſorder in the conſtitution of a cow, with ſymptoms totally different, and that this new diſeaſe once produced ſhould be capable of maintaining an uniform character in the cow and in man, ſeems a much greater departure from the ordinary proceeding of Nature. We are very far from ſaying that this is impoſſible; for little indeed do we know of what Nature can or cannot do. All we mean to ſay is, that a fact ſo very extraordinary ought not to be haſtily admitted.

In Holſtein, we are told that the farmers do not know of any relation exiſting between the greaſe and the cow-pox, at leaſt a perſon who reſided three years in that country never heard of any. This, however, is certainly no proof. The ſame communication which contains this remark (a letter from Dr De Carro of Vienna to Dr G. Pearſon) adds, “ that in great farms men do not milk cows, but that in the ſmaller ones that happens very often; that a diſeaſe of horſes, called *mauke* (true German name for *greaſe*), is known by all thoſe who take care of them; that old horſes particularly, attacked with the mauke, are always put in cow's ſtables, and there are attended by women; and that it is particularly in harveſt that men in ſmall farms milk cows.” It muſt be allowed, then, that in this ſituation, ſuppoſing Doctor Jenner's opinion well founded, the cow-pox was naturally to be looked for, and here accordingly we find it. The queſtion is certainly of no real utility, and therefore it has very properly been leſs attended to than other points reſpecting this diſorder which lead to important practical concluſions.

Of all the queſtions which have ariſen relative to the cow-pox, there is none ſo intereſting, and luckily there is none which has received ſo full a diſcuſſion, or ſo ſatisfactory an anſwer, as the one we are now about to conſider. Are thoſe perſons who have once had the cow-pox effectually and for ever ſecured againſt the variolous contagion?

9
A previous attack of this diſeaſe renders the body unſuſceptible of ſmall-pox.

Dr Jenner, in his firſt publication, was decidedly of opinion that a previous attack of this diſorder rendered the human body for ever unſuſceptible of the variolous virus; and beſides the univerſal popular belief in the countries where cow-pox is known, he brought forward a number of caſes in ſupport of his aſſertion. By ſome of theſe it appeared that perſons who had been affected with the cow-pox above twenty or thirty years before, continued ſecure againſt infection, either by the effluvia from patients under ſmall pox, or by inoculation. But along with this opinion he entertained other two, which, to many people, appeared ſo ſurpriſing as to take away all credit from the former. The firſt was, that a previous attack of ſmall-pox did not prevent a ſubſequent attack of cow-pox; and the ſecond was perhaps ſtill more wonderful, that the cow pox virus, although it rendered the conſtitution unſuſcepti-

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Difficulties explained.

ble of the ſmall pox, ſhould nevertheleſs leave it unchanged with reſpect to its own action, for that the ſame perſon is ſuſceptible of repeated attacks of the cow-pox.

Theſe opinions have been ſubmitted to the teſt of very extenſive experience by a variety of intelligent practitioners; and we think there can now be little doubt that the two laſt are erroneous, while the truth of the firſt has been eſtabliſhed by an immenſe body of incontrovertible evidence.

The opinions that a perſon who has had the ſmall-pox may afterwards have the cow-pox, and that the ſame perſon may have the cow-pox more than once, probably aroſe from the diſtinction between the local effects of the vaccine virus, and the general diſorder of the conſtitution not having been ſufficiently attended to. It is generally admitted, that in the inoculated ſmall-pox the local affection may go ſo far as that a puſtule ſhall ariſe on the part, containing matter capable of communicating the true ſmall-pox to others, and yet, if no general affection of the conſtitution takes place, the patient is not ſecure from the diſorder. In like manner, there are caſes upon record which prove that a perſon may, after having had the ſmall-pox, have a local affection produced by inoculation, in which true variolous matter ſhall be formed capable of communicating both the local and conſtitutional ſymptoms of ſmall-pox to others; and nurſes, when much expoſed to variolous contagion, often have an eruption reſembling ſmall-pox upon ſuch parts of their ſkin as have been expoſed to the action of the virus, though they have formerly undergone the diſeaſe. Yet there is probably no perſon at this day who will go ſo far as to aſſert that the ſame perſon can have the ſpecific variolous fever more than once.

The caſe ſeems to be preciſely the ſame with reſpect to cow-pox. Doctor Pearſon and others have inoculated a number of perſons after they have had the ſmall-pox with the vaccine virus, and have produced only the local affection; and by the ſame teſt it is aſcertained that the ſame perſon cannot more than once have the conſtitutional ſymptoms of the cow-pox. Dr Woodville indeed tells us that he has ſeen one caſe of genuine cow-pox puſtule and ſpecific fever in a conſtitution which had previouſly ſuffered the ſmall-pox. There can be no higher authority on this ſubject than that of Dr Woodville; and if he had actually ſeen his patient in the ſmall-pox as well as the cow-pox, we ſhould have admitted this ſingle caſe as completely deciſive of the queſtion. But the only evidence of this perſon having had the ſmall-pox, is the aſſertion of the patient that he had it *when a child*. This we can by no means ſuſtain as concluſive in oppoſition to the Doctor's own experience, as well as the experience of Dr Pearſon.

That the milkers are ſubject to repeated attacks of the local ſymptoms of cow-pox, whether they have had the ſmall-pox or not, is certain. In the caſe of the farmer's ſervants at Rockhampton, which we have quoted above from Dr Jenner, one of whom had previouſly undergone the ſmall-pox, and the other the cow-pox, and both of whom were afterwards infected by the cow-pox *in a ſlight degree*, it ſeems reaſonable to conclude that the local ſymptoms only were preſent in the laſt attack. We may at the ſame time obſerve, that in a caſe of this kind, where a very painful ulcer is produced in a very ſenſible part, this may probably be attended by an increaſed frequency of pulſe; yet if this has not the ſpecific marks of the cow-pox fever, we ſhould not ſay that ſuch a perſon has the diſorder conſtitutionally.

11 Succeſs vaccine inoculation.

With reſpect to the principal propoſition, that the ſpecific fever of cow-pox renders the conſtitution unſuſceptible of the variolous fever, we think no doubt now remains. Above 1000 perſons who have undergone the vaccine inoculation have been afterwards inoculated with variolous matter, which has produced no other than local effects. Beſides theſe, there have been a vaſt number inoculated by private practitioners in different parts of the kindom, the reſult of which has not been reported. But we may ſafely ſuppoſe, that if any one of them had afforded a concluſion oppoſite to the one now generally admitted, it would have been communicated to the public.

We muſt not, however, conceal one ſeemingly well authenticated caſe which has lately occurred, and which, ſo far as it goes, certainly militates againſt this concluſion, and which, we doubt not, will be eagerly caught at by the opponents of the new practice. We quote it from the Medical and Chirurgical Review for September 1800.

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" Mr Malim, ſurgeon of Carey Street, London, inoculated a child, two years and an half old, with vaccine matter procured from Dr Jenner. On the third day there were ſufficient marks of the action of the virus, and from this time to the end of the diſeaſe the local affection proceeded regularly and without interruption. On the eighth day the child complained of headache and ſickneſs; had a quick pulſe, white tongue, and increaſed heat, with an enlargement and tenderneſs in the axilla. Theſe ſymptoms ſubſided in the courſe of the next day, and the child remained well till the twelfth, when it had a very ſevere attack of fever, ſucceeded, the following day by an eruption; the appearance, progreſs, and termination of which, left no doubt in the minds of ſeveral eminent practitioners of its being the ſmall pox. That it was really ſo, has been ſince clearly proved by inoculation. There was a child ill of ſmall-pox in the houſe at the time the above inoculation for cow-pox was performed."

The Reviewers juſtly remark, that the hiſtory is defective, in not deſcribing more minutely the appearances of the inoculated parts at the different ſtages, as well as in not mentioning the length of time that the matter had been taken previous to being uſed. Both theſe points are the more important, as a ſuſpicion naturally ariſes, that the local affection which ſucceeded the vaccine inoculation was not the genuine cow-pox puſtule, but one of the ſpurious kind, which had not the power of deſtroying variolous ſuſceptibility. The matter having been furniſhed by Dr Jenner, no doubt, renders this ſuppoſition the leſs probable; but if it was either long or improperly kept after it came out of his hands, it may have undergone a material change, by putrefaction or otherwiſe. Dr Jenner mentions an inſtance of a practitioner, who had been accuſtomed to preſerve variolous matter in a warm pocket; a ſituation favourable for producing putrefaction in it. This matter when inſerted, was found to produce inflammation, ſwellings of the axillary glands, fever, and ſometimes eruptions; but not of the true variolous kind, as patients thus inoculated

lated were found ſtill ſuſceptible of the ſmall-pox contagion. It is ſurely a poſſible ſuppoſition, though merely a conjecture, that the vaccine matter in Mr Malim's caſe had undergone ſome ſuch change.

The caſe however, is in ſeveral reſpects an intereſting one. As it has been ſuppoſed that variolous contagion, communicated in the form of exhalation, does not affect the conſtitution in leſs than fourteen or fifteen days, and as the vaccine matter, communicated by inoculation, produces its ſpecific effects ſome days earlier, it has been ſuggeſted, that wherever a perſon has been accidentally expoſed to variolous effluvia, we ſhould endeavour to anticipate the ſmall-pox by immediately inoculating with the vaccine virus. But if there be nothing fallacious in the above caſe, it appears that this meaſure would not ſtop the progreſs of the ſmall-pox, but that our patient would incur the additional danger of having two diſeaſes inſtead of one.

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At all events, it muſt be allowed that this child had been infected by the ſmall-pox before the vaccine matter had begun to produce its ſpecific effects, and probably even before the inoculation. Thus the ſmall-pox may be conſidered as having begun before the cow-pox; and though we ſhould be forced to allow that, matters being thus ſituated, the latter diſorder could not prevent the farther progreſs of the former, it by no means follows, that when the cow-pox has fairly run its courſe, the conſtitution is ſtill ſuſceptible of ſmall-pox. The two diſeaſes muſt have exiſted in this patient at the ſame time, though the one was in a latent ſtate during the active ſtage of the other.

This ſolitary caſe, then is by no means concluſive, and certainly is not ſufficient to outweigh the immenſe maſs of concurring evidence which is oppoſe to it.

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We proceed now to another highly important branch of our ſubject—the compariſon of the advantages and diſadvantages of the two diſeaſes, with a view to the practice of inoculation.

Notwithſtanding the immenſe number of caſes in which the inoculation of the cow-pox has been tried, we are not yet fully qualified to appreciate the value of the new practice; becauſe the diſeaſe has varied very much in ſeverity, and even in its moſt remarkable ſymptoms, and that without any cauſe which has yet been diſcovered.

Dr Jenner's account of the diſeaſe gave us reaſon to think that the local affection in cow-pox was more ſevere than in the inoculated ſmall pox: That the fever in this diſeaſe was never attended with dangerous ſymptoms: that thoſe ſymptoms which affect the patient with ſeverity are entirely ſecondary, excited by the irritating proceſſes of inflammation and ulceration: that the diſeaſe was not attended with any eruption reſembling ſmall-pox: and that the ſore produced by the inoculation was apt to degenerate into a very diſtreſſing phagedenic ulcer, which required to be treated with applications of a cauſtic nature, of which he found the unguentum hydrargyri nitrati the moſt uſeful.

Soon after Dr Jenner's publication, the attention of medical men was forcibly drawn to the ſubject; and ſeveral eminent practitioners in London, particularly Dr George Pearſon, and Dr Woodville phyſician to the ſmall-pox and inoculation hoſpitals, immediately began to practiſe the vaccine inoculation. The latter gentleman ſoon publiſhed an accurate and candid account of the effect of this virus upon 200 patients, with a table of the reſults of above 500 caſes in which the inoculation was performed.

15
Anomalies in the progreſs of the diſeaſe.

It is very remarkable, that in none of theſe caſes did the inoculated part ulcerate in the manner deſcribed by Dr Jenner, nor did the inflammation ever occaſion any inconvenience, excepting in one inſtance, in which it was ſoon ſubdued by the aqua lythargiri acetati. The general affection of the conſtitution, on the other hand, though in a great majority of caſes it was very ſlight, yet, in ſome inſtances, was ſevere. An eruption, exactly reſembling ſmall-pox, was, contrary to expectation, a very common occurrence, and in ſome the puſtules were not fewer than 1000; and although in theſe caſes the diſeaſe was ſtill unattended with ſecondary fever, yet the febrile ſymptoms which took place from the commencement were conſiderable, and even alarming, as ſometimes alſo happens with the inoculated ſmall-pox.

Dr Woodville ſometimes inoculated with matter from the primary ſore in the arm, and ſometimes with matter taken from the puſtular eruption; and it appears from the table that a much larger proportion of thoſe who were inoculated in the latter way had puſtules, than of thoſe who were inoculated either with matter immediately from the cow, or from the primary ſore in the human body. There were 447 patients in all inoculated, either from the cow or from the primary ſore; and of theſe 241 had puſtules, and 206 had none. Sixty-two perſons, on the other hand, were inoculated with matter from the puſtules of ten different patients; and of theſe no fewer than 57 had puſtules, and only 5 eſcaped without. Nor can it be ſaid that this diſproportion aroſe from theſe 10 patients having the diſeaſe in a more virulent form than ordinary, for matter was alſo taken from the primary ſore in 4 of the 10, with which 48 were inoculated; of whom 27 had puſtules, and 21 had none: whereas, of 9 perſons who were inoculated with matter from the puſtules of theſe ſame 4, only 2 eſcaped without puſtules. This obſervation correſponds alſo with Dr Pearſon's experience.

Although theſe eruptions have been met with by other practitioners, yet they certainly appear very rarely in private practice. Dr Woodville, for this reaſon, conſiders them, in a more recent publication as the effect of ſome adventitious cauſe, independent of the cow-pox: And this he ſuppoſes to be the variolated atmoſphere of the hoſpital, which thoſe patients were neceſſarily obliged to inſpire during the progreſs of the cow-pox infection. This opinion, however, does not ſeem to agree well with his former remark, which, as we have ſaid, is confirmed, by Dr Pearſon, that eruptions rarely took place, if care was taken to avoid matter for inoculation from ſuch as had puſtules; a fact that cannot be explained on ſuch a ſuppoſition. Neither is this idea reconcileable with what he alſo tells us, that the proportion of caſes in the hoſpital attended with puſtules has been of late only three or four in a hundred.

This change in the appearances of the diſeaſe in the hands of different practitioners, and even of the ſame practitioner at different times, is one of the moſt unaccountable circumſtances reſpecting this ſingular diſorder.

der. There is ſome curious information on this ſubject, contained in a letter from Mr Stromeyer of Hanover to Mr Hannehmann.

“ This year (ſays he) we have inoculated 40 perſons, as well with the vaccine matter received of Dr Pearſon as with that from Dr Jenner; all of whom underwent the diſeaſe properly.

“ Betwixt the London and Glouceſter vaccine matter, it appears to me there ſubſiſts an eſſential difference. The London matter produces frequently an eruption of ſmall pimples; but they diſappear within a day or two at fartheſt. Dr Pearſon calls theſe eruptions *puſtules*.—The Glouceſter matter has never produced this effect here; but *frequently occaſioned ulcerations of the inoculated part, of a tedious and long duration; which the latter never did:* on account of which I now only make uſe of Dr Pearſon's vaccine matter. The nettle-fever-like eruptions I have obſerved ſeveral times, but never that ſort of eruption, repeatedly noticed in London, which ſo much reſembles the ſmall-pox.”

If theſe obſervations of Mr Stromeyer ſhould be confirmed by the experience of others, they would go far to explain the difference which the London practitioners have found in this diſeaſe from the account given of it by Dr Jenner, notwithſtanding the abſence of the eruption reſembling ſmall-pox at Hanover. We believe an interchange of vaccine matter has once or twice taken place between London and Glouceſterſhire. Is it ſince that period that the eruption has been leſs frequent at London? Dr Pearſon is inclined to ſuppoſe, that the comparative ſeverity of the diſeaſe at London, during the firſt winter, aroſe rather from the difference in the human conſtitution at the different ſeaſons of the year, than from any change in the ſtate of the vaccine matter.

16 Mortality from the old practice over-rated by the advocates for the new.

In comparing the degree of danger from the inoculation of cow-pox with that ariſing from the inoculated ſmall-pox, we are convinced that Dr Pearſon greatly over-rates the mortality in the latter diſorder. He ſuppoſes it to be no leſs than one in 200. Dr Moſeley, on the other hand, who is a violent opponent of the vaccine inoculation, aſſerts, that he has inoculated ſeveral thouſands with variolous matter, in Europe and the Weſt Indies, without ever loſing a patient and that ſeveral other perſons, whom he knows, have done the ſame, with the ſame ſucceſs. We are afraid, however, that the experience of other inoculators does not afford ſo favourable a reſult. We believe that in this country the mortality is often occaſioned by improper treatment; and from comparing the accounts which we have received from practitioners of extenſive experience, and undoubted veracity, we believe that, where the treatment is proper from the beginning, the ſymptoms very rarely ariſe to an alarming height, and that the mortality is not ſo great as one in 600. And this eſtimate nearly correſponds with Dr Woodville's very great experience. It muſt be allowed, that patients in an hoſpital are ſubject to ſome diſadvantages, which may be avoided in private practice; yet, out of the laſt 5000 caſes of variolous inoculation at the inoculation hoſpital, prior to the publication of the Doctor's reports, the mortality did not exceed one in 600.

Notwithſtanding this ſtatement, however, we are happy to ſay, that the danger in the vaccine diſeaſe is ſtill much leſs. Dr Pearſon tells us, that in little more than ſix months after the new inoculation was introduced into London, which includes the period at which the cow-pox aſſumed the moſt unfavourable appearance, 2000 perſons at leaſt underwent the operation; of theſe, one only, an infant at the breaſt, under the care of Dr Woodville, died. In this ſolitary fatal caſe, the local tumor was but very inconſiderable; and the eruptive ſymptoms took place on the ſeventh day, when the child was attacked with fits of the ſpaſmodic kind, which recurred at ſhort intervals, with increaſed violence, and carried it off on the eleventh day after the cow-pox matter had been infected into its arm, and after an eruption of about 80 puſtules had appeared.

1 Great ceſs of new i lation.

Since that time a much greater number, amounting certainly to ſeveral thouſands have been inoculated with cow-pox in different parts of Great Britain and on the continent. Among theſe, not one fatal inſtance, that we have heard of, has occurred.

But even if the danger to the individual from the ſmall-pox and from the cow-pox were equal, there is an important advantage to the public attending the latter, which we think would alone be ſufficient to intitle it to a preference—It is not capable of being propagated by the effluvia ariſing from the bodies of perſons infected with it. There are many ſituations in which a prudent ſurgeon will be reſtrained from inoculating with ſmall-pox, leſt the contagion ſhould ſpread to other people, who may be either prevented by prejudice from ſubmitting to the operation, or in whom it would be obviouſly improper, from the circumſtances of age, teething, or the preſence of ſome other diſeaſe. Here the cow-pox virus may be ſubſtituted with great propriety. It is chiefly from this quality that the cow-pox bids fair to extirpate the ſmall-pox entirely.

This valuable property of the vaccine diſorder is not, however, to be admitted without ſome limitation. When it produces numerous puſtules on the body, Dr Woodville tells us, that the exhalations they ſend forth are capable of affecting others in the ſame manner as the ſmall-pox. Two inſtances of caſual infection in this way have fallen under his obſervation. In one, the diſeaſe was ſevere, and the eruption confluent; in the other, the diſeaſe was mild, and the puſtules few. It has been remarked, that the inoculated cow-pox is little if at all, different from the diſeaſe when caſually caught. But, ſtrictly ſpeaking, the above are the only two caſes in which the diſeaſe has been communicated otherwiſe than by inoculation.

18 Wheth the co pox an ſmall-p ought t conſide as diffe diſeaſe

The writers upon this ſubject are divided in opinion, whether the cow-pox and ſmall-pox ought to be conſidered as different diſeaſes, or whether they are merely varieties of the ſame diſeaſe.

They certainly, notwithſtanding the ſtrong analogy which ſubſiſts between them, differ from each other in ſeveral ſtriking particulars. The cow-pox comes to man from the cow, and is capable of being carried back from him to that animal. Similar attempts with variolous matter have failed: in this reſpect, then, theſe two morbid poiſons are altogether different.

The local tumor produced by the inoculation of the cow pox is commonly of a different appearance from that which is the conſequence of inoculation with variolous matter: for if the inoculation of the cow-pox be performed by a ſimple puncture, the conſequent tumor, in the proportion of three times out of four, according to Dr Woodville, aſſumes a form completely circular, and it continues circumſcribed, with its edges elevated and well defined, and its ſurface flat, through every ſtage of the diſeaſe; while that which is produced from the variolous matter, either preſerves a peculiar form, or ſpreads along the ſkin, and becomes angulated, or irregular, or disfigured by numerous veſiculæ. Another diſtinction ſtill more deciſive and general, is to be drawn from the contents of the cow-pox tumor; for the fluid here formed very rarely becomes puriform; and the ſcab which ſucceeds is of a harder texture, exhibits a ſmoother ſurface, and differs in its colour from that which is formed by the concretion of pus. The appearances, however, are ſometimes ſo changed, that they can in no reſpect be diſtinguiſhed from thoſe which ariſe from the inoculation of ſmall-pox. We may alſo mention that the tendency of the ſore in the inoculated part to degenerate into a phagedenic ulcer does not occur in ſmall-pox.

On the other hand, the points in which theſe two diſeaſes reſemble each other are very remarkable. When introduced into the body by inoculation, they affect the conſtitution in nearly the ſame length of time, and ſeem to be governed by nearly the ſame laws. They mutually deſtroy the ſuſceptibility of the body for the action of each other.

Dr Pearſon, who thinks the diſeaſes ought to be conſidered as diſtinct ſpecies, nevertheleſs draws the following concluſions, as eſtabliſhed by experience.

"That in certain conſtitutions, or under the circumſtances of certain co-operating agents, *the vaccine poiſon produces a diſeaſe reſembling the ſmall-pox;* and of courſe the puſtule in the inoculated part is *very different from that of the vaccine pox ordinarily occurring*, and the eruptions *reſemble very much, if not exactly, ſome varieties of the ſmall-pox:* That in ſome inſtances theſe eruptions have occurred, although the inoculated part exhibited the genuine vaccine puſtule: That the matter of ſuch eruptive caſes, whether taken from the inoculated part, or from other parts, produces univerſally (A), or at leaſt generally, ſimilar eruptive caſes; and has not (he believes) been ſeen to go back, by paſſing through different conſtitutions, to the ſtate in which it produces what is called the *genuine vaccine diſeaſe:* That eruptions, of a different appearance from variolous ones, ſometimes occur in the true cow-pox."

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From theſe facts we are ſtrongly inclined to think that the vaccine diſeaſe and the ſmall-pox ought merely to be conſidered as varieties of the ſame diſeaſe; and we have little doubt that they both derive their origin from the ſame ſource.

If Dr Jenner's opinion, that the vaccine diſeaſe is derived from *the greaſe*, were fully eſtabliſhed, we ſhould be diſpoſed to offer a conjecture, that the *ſmall pox*, in coming from the horſe to man, may have paſſed through ſome animal different from the cow, and may thus have undergone a modification ſimilar to, but not exactly, the ſame with what takes place in the paſſage of the virus through the conſtitution of the cow.

But without having recourſe to this conjecture, which is perfectly gratuitous, we are of opinion that the variations which have taken place in the cow-pox within the laſt three years are ſufficient to warrant a belief, that the ſmall-pox may have originally been exactly the ſame diſeaſe, even in the human conſtitution, as the cow-pox is now; but that in a ſucceſſion of ages, and from the operation of cauſes wholly unknown to us, it may have been changed to what we now ſee it.

We ſhall now conclude this article with a few practical remarks, which we hope may be of uſe to practitioners who mean to begin the vaccine inoculation.

20 Practical remarks.

It is of the utmoſt conſequence that the matter employed ſhould be the genuine vaccine virus. Dr Jenner points out the following particulars as ſources of a ſpurious cow-pox: 1. That ariſing from puſtules on the nipples or udder of the cow, which puſtules contain no ſpecific virus. 2. From matter, although originally poſſeſſing the ſpecific virus, which has ſuffered a decompoſition, either from putrefaction, or any other cauſe leſs obvious to the ſenſes. 3. From matter taken from an ulcer in an advanced ſtage, though the ulcer aroſe from a true cow-pox. 4. From matter produced on the human ſkin from the contact of ſome peculiar morbid matter generated by a horſe.

Many have remarked that inoculation with the vaccine matter is more apt to fail in communicating the infection than with variolous matter, eſpecially if it be ſuffered to dry upon the lancet before it is uſed. This does not ſeem to depend upon the virus of the former being more volatile, but upon its becoming more hard and indiſſoluble upon exſiccation. Care ſhould therefore be taken to moiſten it a conſiderable time before it is uſed.

We have already noticed the danger that may ariſe from miſtaking the local effects of the vaccine diſeaſe for its effects upon the conſtitution. To guard practitioners againſt this error, Dr Woodville makes the following remarks: "When a conſiderable tumor and an extenſive redneſs take place at the inoculated part, within two or three days after the infectious matter has been applied, the failure of inoculation may be conſidered as certain as where neither redneſs nor tumor is the conſequence. This rapid and premature advancement of the inflammation will always be ſufficient to prevent the inoculator from miſtaking ſuch caſes for thoſe of efficient inoculation. But there are other circumſtances under which I have found the inoculation to be equally ineffectual, and which, as being more likely to deceive the inoculator, require his utmoſt circumſpection and diſcrimination. I here allude to caſes in which it happens that though the local affection does not exhibit much more inflammation than is uſual, yet neither veſicle nor puſtule ſupervenes; and in which, about the ſixth or ſeventh day, it rapidly advances into an irregular ſuppuration, producing a feſtering or cruſtaceous ſore. Care, however, ſhould be taken to diſtinguiſh this caſe from that in which the inoculated part aſſumes a puſtular form, though it continues for one or two days only, when the ſame appearances follow as thoſe above deſcribed; for I have experienced the latter inoculation to be as effectual as where the tumor has proceeded in the moſt regular manner."

(A) We have ſeen that Dr Woodville's table contains a few exceptions to this rule, though it ſtrongly confirms the general truth of the propoſition.

"The efflorefcence at the inoculated part, which ſeldom intervenes before the eighth, or later than the eleventh day, is to be regarded as an indication that the whole ſyſtem is affected; and if the patient has not felt any indiſpoſition on or before its approach, he may be aſſured that there will not be any afterwards. When efflореſcence does not commence till the eleventh day, it is almoſt always attended with more indiſpoſition than when it occurs on the eighth or ninth day. The efflоreſcence is more frequent in young infants than in children advanced to three or four years of age; and the former have the efflоreſcence, and the diſeaſe more favourably than the latter, inſomuch that by far the greater part of them have no perceptible illneſs, and require no medicines. On the other hand, in adults, the cow-pox frequently produces headache, pain of the limbs, and other febrile ſymptoms, for two or three days, which are greatly relieved by a briſk purgative."

Since the above was written, vaccination has been extended all over Europe and into many parts of Aſia. It has been practiſed on a very large ſcale in the Weſt India iſlands, with the moſt complete ſucceſs. In the United States it has been extenſively adopted with the happieſt effects. Doctor J. R. Coxe of Philadelphia and Doctor Waterhouſe of Cambridge, Maſſachuſetts, have particularly diſtinguiſhed themſelves by their zeal and activity in extending the knowledge and practice of vaccination, and the medical gentlemen generally throughout the union, have laudably co-operated with them to extend the benefit of this moſt important diſcovery in all the ſtates. Many thouſands have been inoculated and have had the diſeaſe in the regular form, and from the numerous trials which have been fairly made, there is no room to doubt of its being a complete preſervative againſt the ſmall-pox, and from the rapidity with which this beneficial practice is extending there is every reaſon to expect that it will ſoon be univerſally eſtabliſhed.

We would, upon the whole, recommend the vaccine inoculation to our medical readers as being an effectual preventative againſt the ſmall pox, and ſafer to the individual, while it is more advantageous to the public at large, in being leſs capable of propagation by contagion.

UCAH, *Port*, on the N. W. coaſt of North-America, is ſituated on Waſhington's Iſland, ſouth of Port Geyer, and north of Port Sturgis. At its mouth are Needham's Iſles. The middle of the entrance of this bay is in lat. 52 25 N.—*Morse.*

UCAYALA *River*, a ſouth branch of Amazon river.—*ib.*

UCHE, an Indian town ſituated on the Chata Uche river. It is ſituated, according to Bartram, on a vaſt plain, and is the largeſt, moſt compact, and beſt ſituated Indian town he ever ſaw. The habitations are large and neatly built; the walls of the houſes are conſtructed of a wooden frame, then lathed and plaiſtered inſide and out with a reddiſh well tempered clay or mortar, which gives them the appearance of red brick walls; and the roofs are neatly covered with cypreſs bark, or ſhingles. The town appears populous and thriving, full of youth and young children; and is ſuppoſed to contain about 1500 inhabitants. They are able to muſter 500 gunmen or warriors. Their national language is radically different from the Creek or Muſcogulge tongue, and is called the Savanna or Savanuca tongue. It is ſaid to be the ſame or a dialect of the Shawaneſe. Although in confederacy with the Creeks, they do not mix with them; and are of importance enough to excite the jealouſy of the whole Muſcogulge confederacy, and are uſually at variance, yet are wiſe enough to unite againſt a common enemy to ſupport the intereſt of the general Creek confederacy.—*ib.*

VASE *River, Au*, empties into the Miſſiſſippi from the N. E. 3 miles below the Great Rock, about 55 N. W. by N. of the mouth of the Ohio, and about the ſame diſtance N. W. of Fort Maſſac. It is navigable into the N. W. Territory about 60 miles, through a rich country, abounding in extenſive natural meadows, and numberleſs herds of buffaloe, deer, &c. It is about 8 miles above Cape St Antonio.—*ib.*

VASSALBOROUGH, a poſt-town of the diſtrict of Maine, in Lincoln county, on Kennebec river, half way between Hallowell and Winſlow, 204 miles N. by E. of Boſton, and 551 from Philadelphia. It was incorporated in 1771, and contains 1,240 inhabitants. —*ib.*

VAUCLIN *Bay*, on the eaſt coaſt of the iſland of Martinico. Vauclin Point forms the ſouth ſide of Louis Bay, on the eaſt coaſt of the ſame iſland.—*ib.*

VAVAOO, one of the Friendly Iſlands in the South Pacific Ocean. It is about two days ſail from Hapaee. —*ib.*

VEALTOWN, a village of New-Jerſey, near Baſkenridge, about 7 miles ſouth-weſterly of Morriſtown. —*ib.*

VEAU, *Anſe a*, a village on the north ſide of the ſouth peninſula of the iſland of St Domingo, 5 leagues weſt by north of Miragoane, 4½ eaſtward of Petit Trou, and 19 north-eaſt of Les Cayes.—*ib.*

VECTOR, or RADIUS VECTOR, in aſtronomy, is a line ſuppoſed to be drawn from any planet, moving round a centre, or the focus of an ellipſe, to that centre or focus. It is ſo called, becauſe it is that line by which the planet ſeems to be carried round its centre; and with which it deſcribes areas proportional to the times.

VEGA, or *Conception of la Vega Real*, a town in the north-eaſt part of the iſland of St Domingo, on the road from St Domingo city to Daxabon. It is ſituated near the head of Yuna river, which empties into the bay of Samana; 12 leagues north-weſt by weſt of Cotuy, and about 38 eaſterly of Daxavon, or Daxabon. It ſtands on a beautiful plain among the mountains, on the very ſpot where *Guarionex*, cacique of the kingdom of Magua, had reſided. In 1494, or 1495, the ſettlement of this town was begun by Columbus. Eight years after, it had become a city of importance, and ſome times during the year, there were 240,000 crowns in gold, minted at this place. It was almoſt deſtroyed by an earthquake in 1564.—*Morse.*

VEGETABLES. } See *Vegetable* SUBSTANCES in
VEGETATION. } this *Suppl.*

VEJAS, or *Morro de Vejas*, on the coaſt of Peru, is about half a league from the iſland of Lobos.—*Morse.*

VELA, a cape on the coaſt of Terra Firma, S. America, in about lat. 12 N. and long. 72 W. and about 18 leagues N. by E. of the town of La Hacha.—*ib.*

VELAS, or *Velaſco*, a port on the weſt coaſt of New-Mexico, is 7 leagues north-weſt by north of the Morro Hermoſa, and 8 from St Catharine's Point —*ib.*

VELICALA. a town on and near the head of the peninſula of California, near the coaſt of the N. Pacific Ocean, and northerly from Anclote Point. N. lat. about 20 35, W. long. 115 50.—*ib.*

VENEZUELO, a province of Terra Firma, bounded eaſt by Caracas, ſouth by New-Grenada, weſt by Rio de la Hacha, and on the north by the North Sea. It abounds with game and wild beaſts, producing plenty of corn twice a year, with fruits, ſugar, and tobacco, and the beſt cocoa plantations in America. It ſpreads round a gulf of the ſame name that reaches near 30 leagues within land; and the middle of this country is occupied by a lake 20 leagues long, and 30 broad, with a circumference of 80, and navigable for veſſels of 30 tons. It communicates with the gulf by a ſtrait, on which is built the city of Maracaibo, which gives name to both lake and ſtrait, which is defended by ſeveral forts which were attacked in the laſt century by Sir Henry Morgan, and the whole coaſt laid under contribution, and Maracaibo ranſomed. The province is about 100 leagues in length, and as much in breadth. It had its name from its ſmall lagoons, which make it appear like Venice at the entrance of the lake. The Spaniards maſſacred above a million of the natives in 1528. In 1550, the country was again depopulated; when a great number of black ſlaves were brought from Africa, and was one of the principal epochs of the introduction of negroes into the Weſt Indies. Soon after, a revolt of the negroes was the cauſe of another maſſacre, and Venezuelo became again a deſert. At preſent it is ſaid to contain about 100,000 inhabitants, who live tolerably happy, and raiſe great numbers of European ſheep. They cultivate tobacco and ſugar, which are famous over all America. They manufacture alſo ſome cotton ſtuffs. It has many populous towns, and its waters have gold ſands. Its capital, of the ſame name, or Cora, ſtands near the ſea coaſt, about 50 miles ſouth-eaſt of Cape St Roman, N. lat. 10 30, W. long. 70 15.—*ib.*

VENEZUELO, a ſpacious gulf of the ſame province, communicating by a narrow ſtrait with Maracaibo Lake.—*ib.*

VENTA *de Cruz*, a town on the iſthmus of Darien, and Terra Firma. Here the Spaniſh merchandiſe from Panama to Porto Bello is embarked on the river Chagre, 40 miles ſouth of the latter, and 20 north of the former. N. lat. 9 26, weſt long. 81 36.—*ib.*

VENTILATION OF SHIPS is a matter of ſo great importance, that we would rather hazard the ſtating of an idle project for this purpoſe, than omit any thing which may be uſeful. We hazard nothing, however, in ſtating the following plan by Mr Abernethy, who candidly acknowledges that it is built upon the principles which we, together with the learned editor of Chambers's Cyclopædia, have borrowed from Dr Hailes. This plan conſiſts merely in cauſing two tubes to deſcend from above the deck to the bottom of a veſſel, or as low as ventilation is required; and which ſhould communicate by ſmaller pipes (open at their extremities) with thoſe places deſigned to be ventilated. There ſhould be a contrivance for ſtopping theſe communicating pipes, ſo that ventilation may be occaſionally prevented from taking place, or confined to any particular part of the veſſel.

One of the principal air tubes ſhould deſcend as near to the ſtern of the veſſel as convenient, and the other as near to the ſtem.

Through that tube which is in the head, the foul air is to be extracted; and through that which is in the ſtern, the freſh air is to deſcend to the different decks and other apartments of the veſſel.

The extraction of the air is eaſily effected in the following manner: Let a tranſverſe tube be fitted to that which deſcends in the head of the veſſel: it may be ſunk within the level of the deck, ſo as to cauſe no inequality of ſurface. Let it be continued till it comes beneath the fire place, then aſcend in a perpendicular direction through the fire, and open a little above it; or it may be made to communicate with the chimney. It would be more convenient if the fire was near the place where the tube riſes through the deck; but the experiment muſt equally ſucceed, if the tube be made to deſcend again till it is beneath the common fire-place. The effect that will reſult from this contrivance is obvious; when the tube which paſſes through the fire is heated, the air will aſcend with a force proportionable to its levity, and the aſcending column can only be ſupplied from below, conſequently it muſt come from all thoſe parts of the ſhip with which the main tube communicates.

When the ports are open, the quantity of air thus exhauſted from the ſhip will be ſupplied from all quarters; but if they were all ſhut, and the hatchways and other openings completely cloſed, the renewal of freſh air is made certain by means of the tube which deſcends in the ſtern. The main air tube, where it riſes above the deck in the ſtern, ſhould have an horizontal one fitted to it, which might be made to traverſe, ſo that it could be turned to windward; it might alſo expand at its extremity like the mouth of a trumpet; and thus perfectly freſh air muſt enter, and the force of the gale would tend to impel it into the veſſel.

When that part of the tube which paſſes through the fire is red hot, the draught which would be thus occaſioned might perhaps be too great, and the open pipes which communicate with the decks might emit and imbibe the freſh air in ſo direct a ſtream, that it might be injurious to thoſe perſons within the current.

Mr Abernethy therefore thinks it would be better if thoſe ſmaller pipes which lead from the main tubes were made to run along the decks and communicate with them by numerous orifices. Two pipes opening into the main exhauſting tube might be extended along the tops of the deck, in the angle formed between the ſides and the ceiling: and thus the air would be extracted equally from all parts, and in a manner not likely to occaſion injurious currents. Some diviſion of the ſtream of air which enters from the ſtern might alſo be made, if it were thought neceſſary.

Thus a very complete, and in no way injurious, ventilation may be obtained: the air in the veſſel would be perfectly changed when the fire was ſtrong, without expenſe or trouble; and a gradual and ſalubrious alteration of it might at all times be made, by a very little additional quantity of fuel. The air tubes ſhould conſiſt of ſeparate joints, ſo that occaſionally they might be taken to pieces; and to prevent their being injured or put out of order by rough uſage, the copper pipes ſhould be made of conſiderable ſtrength, placed againſt the ſides of the veſſel, and even incaſed in wood.

In the Letters and Papers of the Bath Society, &c. we have the following deſcription of a ventilator for preſerving corn on ſhip board, by Thomas South, Eſq:

Plate XLVII.

Fig. 1. is a cylindrical air-veſſel, or forcing pump, of lead, tin, or other cheap metal; its internal diameter being ten inches, and its length three feet; having a crutch-handled piſton to work with, and an iron noſle, *viz.* a hollow inverted cone, two feet long, to condenſe the air, and increaſe its power in its paſſage downwards. This cylinder ſhould be rivetted or ſcrewed, by means of an iron collar or ſtraps, to the deck it paſſes through, both above and below, as at *a a*; and ſhould be farther ſecured by ſome holdfaſt near *b*, to keep it ſteady in working.

Fig. 2. is a bottom of wood, four inches and a half thick, with a projecting rim at its baſe, for the metal cylinder to reſt on when cemented and ſcrewed to the wood. The centre of this bottom is excavated, for the reception of the crown of the noſle. In the ſame figure the noſle is repreſented with its crown like a bowl diſh, to condenſe the air gradually, without reſiſtance, in its advance to the more contracted baſe of the inverted cone, *i. e.* the top of the entrance of the noſle. About two-thirds down this noſle may be fixed a male ſcrew, as *c c*, for the purpoſe hereafter mentioned.

N. B. The forcing-pump ſhould be caſed in wood, to protect it from outward bruiſes, which would prevent the working of the piſton, and ruin its effects. The leather round the embolus ſhould be greaſed when uſed.

Fig. 3. is a crutch-handle, faſtened to the embolus A by its iron legs B, B. A is a cylinder of wood, caſed with leather, ſo as to fit well, but glide ſmoothly, in the metal cylinder; having an opening as large as its ſtrength will permit, for the free acceſs of atmoſpheric air. C is a valve well leathered on its top, and yielding downwards to the preſſure of the air when the piſton is raiſed up. D is a croſs bar of iron, to confine the valve, ſo that it may cloſe inſtantly on the return of the piſton downwards.

Fig. 4. is a tin pipe or tube, of leſs than four inches diameter, and of ſuch length, as when fixed to the baſe of the cylinder, fig. 1. ſhall admit the noſle *d*, fig. 2. to within half an inch of the valve E, at the bottom of the wooden cylinder F, in fig. 4; which valve E will then yield to the preſſure of air condenſed in its paſſage through the noſle, and deliver it into the pipes below. This valve muſt be well leathered on its upper ſurface, and faſtened with an hinge of leather to the cylinder it is meant to cloſe: affixed to its bottom is the ſpindle G, paſſing through a ſpiral ſpring H, which, being compreſſed on the deſcent of the valve, will, by its elaſticity, cauſe it to riſe again, cloſe the aperture above, and retain the air delivered beneath it. On connecting this cylinder with the upper end of the noſle, at *e e*, fig. 2. we muſt carefully prevent any lapſe of air that way, by a bandage of oakum ſmeared with wax, on which to ſcrew the cylinder, like the joints of a flute, air-tighr. I is a bar of iron, having a riſing in its centre, wide enough for the ſpindle to play through, but at the ſame time ſufficiently contracted to prevent the paſſage of the ſpiral ſpring.

Fig. 5. is an aſſemblage of tin pipes, of any lengths, ſhaped ſuitably and conveniently to their ſituation in the ſhip, to the form of which, when ſhut into one another, they muſt be adapted; obſerving only, that the neck be ſtraight for a length ſufficient to admit the lower end of the cylinder, fig. 4. as high as the letter F, or higher.

Fig. 6. To the middle pipe, which runs along the bottom, ſhould be fixed a perpendicular one, fully perforated, to convey the air more readily into the centre of the heap; and this may have a conical top, as repreſented in the Plate, perforated with a ſmaller punch to prevent the air from eſcaping too haſtily. In large cargoes, two or three of theſe perpendiculars may be neceſſary; and each ſhould be well ſecured by an iron bar *g*, ſcrewed down to prevent their being injured by the ſhifting of the cargo in ſtormy weather or a rolling ſea. The top of the conical cap of theſe pipes may reach two-thirds up the cargo.

Fig. 7. is a valve of the ſame conſtruction as that repreſented in fig. 4. but incloſed in a tube of braſs, having a female ſcrew at *f f*, adapted to the male ſcrew *c c*, on the noſle fig. 2. and may then be inſerted into the head of the pipe fig. 5. This will add to the expenſe; but in a large apparatus is to be preferred, as a more certain ſecurity from lapſe of air, than the junction of the tube fig. 4. to the neck *e e* in fig. 2.

N. B. *e e* is a neck of wood, making a part of the bottom fig. 2. whereon to ſecure the tube fig. 4. when applied to the noſle. The joints of the pipes, when put together for uſe, ſhould be made air-tight, by means of bees wax or ſome ſtronger cement, till they reach the bottom of the veſſel, when there is no farther need of this precaution. The horizontal pipes ſhould run by the ſide of the kelſon the whole length of the hold. The tin plates of which K is made, ſhould be punched in holes, like the roſe of a watering-pot, in two or three lines only at moſt, and then formed into a tube, with the rough ſide outwards. L may have four or five lines of the like perforations. M, and the reſt, ſhould gradually increaſe in their number as they advance towards the middle of the hold, and continue fully perforated to the laſt pipe which ſhould be cloſed at its end to prevent the ingreſs of the corn. It is the centre of the cargo which moſt requires ventilating, yet air ſhould pervade the whole. Like the trade winds, it will direct its courſe to the part moſt heated, and, having effected its ſalutary purpoſe there, will diſperſe itſelf to refreſh the maſs.

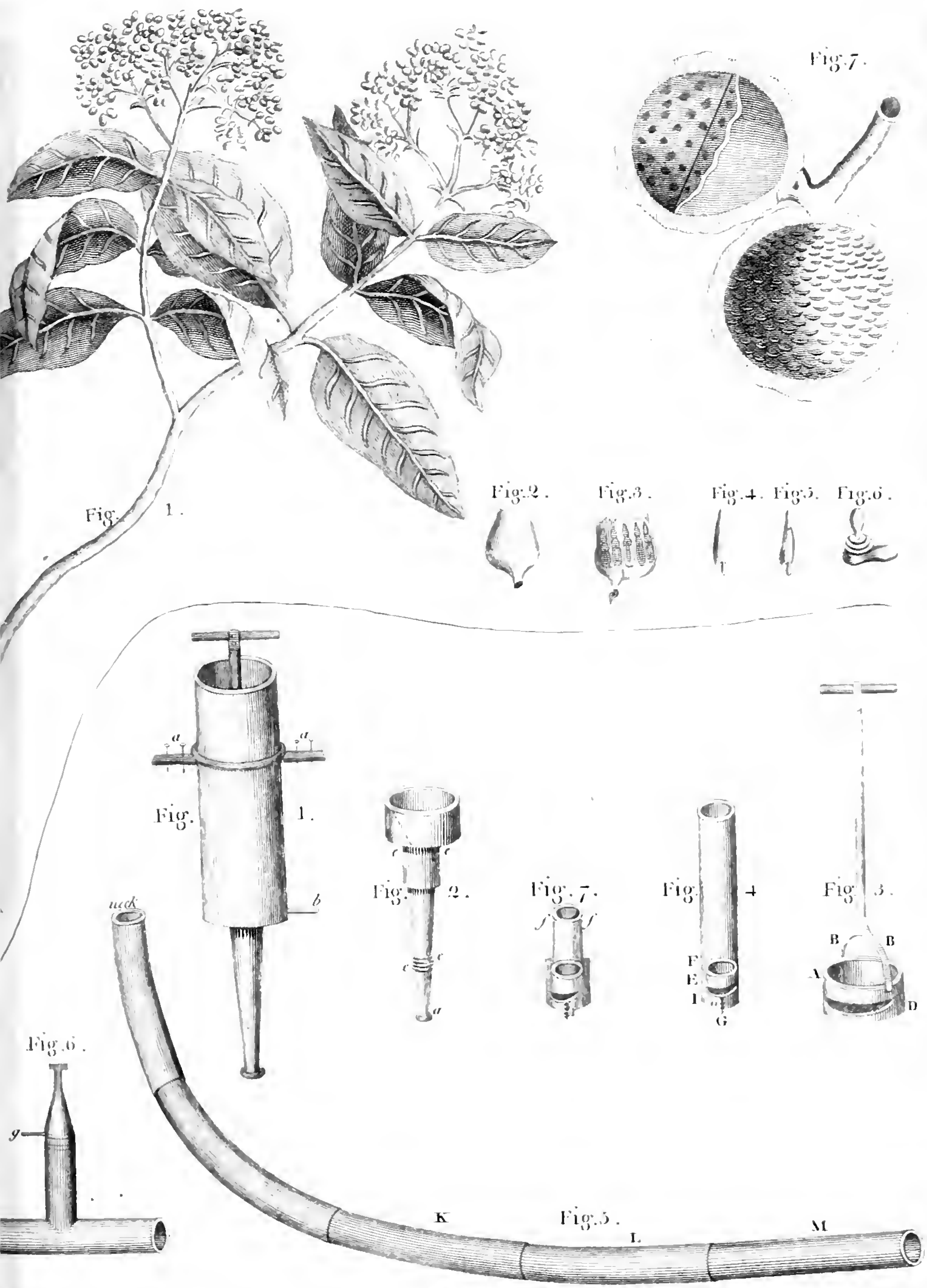
Where the hatches are cloſe-caulked, to prevent the influx of water, vent-holes may be bored in convenient parts of the deck, to be bunged up, and opened occaſionally, from whence the ſtate of the corn may be known by the effluvia which aſcend when the ventilator is working.

The power of the ventilator is determined by the ſquare of its diameter multiplied into the length of the ſtroke, and that again by the number of ſtrokes in any given time.

The air-veſſel or forcing-pump, with the reſt of the apparatus here deſcribed, is adapted to a veſſel of 120 tons burden; but by lengthening the air-veſſel, extending its diameter to 14 inches, and adding 10 inches more to the length of the ſtroke, a power may be obtained of ventilating a cargo of 400 tons within the hour.

If

URCEOLA ELASTICA. PLATE XLVII.



If this machine be properly wrought for one hour every day, or even every two days, beginning the operations immediately when the corn is put on board, the cargo may be preſerved from taint or injury of every kind during the longeſt voyage.

VENTO *Sierra*, on the north coaſt of S. America, are mountains ſo named, behind the land called Punta de Delrio, oppoſite to Tortugas Iſland.—*Morſe.*

VENUS, *Point*, in Otaheite Iſland, in the ſouth Pacific Ocean, is the eaſt point of Matavai or Port Royal Bay, and north point of the iſland. S. lat. 17 29, W. long. 149 36.—*ib.*

VERA *Cruz, La*, the grand port of Mexico, or New Spain, having a ſafe harbour protected by a fort, ſituated on a rock of an iſland nearly adjoining, called St John de Ulloa, in the Gulf of Mexico. It is, perhaps, one of the moſt conſiderable places for trade in the world, being the natural centre of the American treaſure, and the magazine for all the merchandize ſent from New Spain, or that is tranſported thither from Europe. It receives a prodigious quantity of Eaſt India produce by way of Acapulco, from the Philippine Iſlands. Moſt of its houſes are built of wood, and the number of Spaniſh inhabitants is about 3,000, mulattoes and mungrels, who call themſelves white. It is rather unhealthy, from the rank bogs around it. N. lat. 19 12, weſt long. 97 30. It is in the eaſt extremity of the province of Tlaſcala, or Los Angelos. At the Old Town, 15 or 16 miles further weſt, Cortez landed on Good Friday, 1518, when, being determined to conquer or die, he ſunk the ſhips that tranſported his handful of men hither. La Vera Cruz is 215 miles ſouth-eaſt of the city of Mexico.—*ib.*

VERAGUA, by Ulloa made a province of Terra Firma, in S. America, but others have it as a province of Guatimala and New Spain, in North-America; joining on the W. to Coſta Rica; on the E. to Panama; with the North Sea on the north; and the South Sea on the ſouth. The coaſt was firſt diſcovered by Chriſtopher Columbus in 1503, to whom it was granted with the title of Duke, and his poſterity ſtill enjoy it. The province is very mountainous, woody and barren; but has inexhauſtible mines of ſilver, and ſome gold, the duſt of the latter being found among the ſands of the rivers. Santiago de Veraguas, or Santa Fe, the capital, is but a poor place; and in this province is the river Veragua, on which that town ſtands.—*ib.*

VERAGUA, the river above mentioned, empties into the ſea 18 leagues to the ſouth-eaſt of the river or lake of Nicaragua, in lat. 10 5 N. Here is a very good port; but the iſland at its mouth is foul. The beſt anchorage is on the weſt and ſouth ſides next the main, where ſhips may ride under ſhore in from 8 to 9 fathoms, and ſafe from the north and eaſterly winds, that are moſt violent on this coaſt. Several iſlands lie off from the coaſt, both ſingly and in cluſters, from this to Cape Gracias a Dios; and to the eaſtward from hence is Chagre river.—*ib.*

VERA *Paz*, a province of the audience of Guatimala, and New Spain, in N. America. It has the bay of Honduras and Chiapa on the north, Guatimala on the ſouth, Honduras on the eaſt, and Soconuſca, with part of Chiapa, on the weſt. It is 48 leagues long, and 28 broad. The lands are mountainous, yielding little corn, but abounding in cedar, &c. The principal commodities are drugs, cocoa, cotton, wool, honey, &c. Its capital of the ſame name, or *Coban*, ſtands on the weſt ſide of a river which runs into Golfo Dulce, 184 miles eaſt of Guatimala. N. lat. 15 10, W. long. 93 15—*ib.*

VERDE, or *Green Iſland*, on the N. coaſt of S. America, is at the mouth of the river St Martha.—*ib.*

VERDE *Key*, one of the Bahama Iſlands. N. lat. 22 12, W. long. 75 15.—*ib.*

VERDE, PORTO, or *Vedra*, is on the N. Atlantic Ocean, about 4½ leagues S. E. by E. of Rio Roxo. The iſland of Blydones is at the entrance of this port, round which ſhips may ſail on any ſide, there being 7 fathoms on the N. where it is ſhoaleſt, and 20 fathoms on the S. ſide, where is the beſt entrance into the river. This is a port of good trade, and ſometimes large ſhips put in here. The iſlands of Bayonne are 5 leagues to the S. of the iſland in the mouth of the port.—*ib.*

VERDEN, a duchy of Germany, in the circle of Lower Saxony. It is bounded on the eaſt and ſouth by that of Lunenberg; on the weſt, by the Weſer and the duchy of Bremen; and on the north, by the duchies of Bremen and Lunenburg; extending both in length and breadth about 28 miles. It conſiſts chiefly of heaths and high dry lands; but there are good marſhes on the rivers Weſer and Aller. In 1712, the Danes wreſted this duchy from Sweden, and, in 1715, ceded it to the king of Great Britain, as elector of Hanover; which ceſſion, in 1718, was confirmed by the Swedes. The inhabitants are Lutherans.

VERDERONNE, or *La Bourlarderie*, an iſland on the E. coaſt of Cape Breton Iſland. It is 7 or 8 leagues long; and at each end is a channel, through which the waters of the Labrador Lakes, in the inner part of Cape Breton Iſland, diſcharge into the ocean on the eaſt.—*Morſe.*

VERDIGRIS, or ACETITE OF COPPER. See that article, *Encycl.* where an account is given of the proceſs by which verdigris was long manufactured. A different, and more economical proceſs, however, has for ſome years been practiſed in Montpellier, which is worthy of notice, becauſe it may be adopted in this country by ſubſtituting the huſks of gooſeberries or currants for thoſe of grapes.

In the manufacture of verdigris, the materials are copper and the huſks of grapes after the laſt preſſing. The copper is formed into round plates, half a line in thickneſs, and from twenty to twenty-five inches in diameter. Each plate, at Montpellier, is divided into twenty-five laminæ, forming almoſt all oblong ſquares of from four to ſix inches in length, three in breadth, and weighing about four ounces. They are beat ſeparately with a hammer on an anvil to ſmooth their ſurfaces, and to give the copper the neceſſary conſiſtence. Without this precaution it would exfoliate, and it would be more difficult to ſcrape the ſurface in order to detach the oxydated cruſt. Beſides this, ſcales of pure metal would be taken off, which would haſten the conſumption of the copper.

The huſks, which ſhould not be too much preſſed are firſt made to ferment by being put into cloſe vats, and the fermentation is generally completed in three or four days. The time, however, muſt vary according to the temperature in which they are kept, and other circumſtances. Whilſt the huſks are fermenting, a preliminary preparation is given to the copper plates. This conſiſts in diſſolving verdigris in water in an earthen veſſel, and rubbing over each plate with a piece of coarſe linen dipped in this ſolution. The plates are then immediately placed cloſe to each other, and left in that manner to dry. Sometimes the plates are only laid on the top of the fermented huſks, or placed under thoſe which have been already uſed for cauſing the copper to oxydate. It has been obſerved, that when this operation has not been employed, the plates grow black at the firſt operation, inſtead of becoming green. It is not, however, neceſſary to thoſe which have been once uſed, and are to be uſed again.

When the plates are thus prepared, and the huſks have been brought to ferment, the workmen try whether the latter are proper for the proceſs, by placing under them a plate of copper, and leaving it buried there for twenty-four hours. If the plate, after this period, is found covered with a ſmooth green cruſt, in ſuch a manner that none of the metal appears, they are then thought fit for being diſpoſed in layers with the copper. On the other hand, if drops of water are obſerved on the ſurface of the plates, the plates are ſaid to *ſweat*, and it is concluded that the heat of the huſks has not ſufficiently ſubſided. They conſequently defer making another trial till the next day. When they are aſſured that the huſks are in a proper ſtate, they form them into layers in the following manner:

The plates are all put into a box, which, inſtead of having a bottom, is divided in the middle by a wooden grate. The plates diſpoſed on this grate are ſo ſtrongly heated by a chaffing-diſh placed under them, that the woman employed in this labour is ſometimes obliged to take them up with a cloth, in order that ſhe may not burn her hands. As ſoon as they have acquired that heat, they are put into jars in layers with the huſks. Each jar is then cloſed with a covering of ſtraw, and left to oxydate. Thirty or forty pounds of copper, more or leſs according to the thickneſs of the plates, are put into each jar. At the end of ten, twelve, fifteen, or twenty days, the jar is opened; and if the huſks are white, it is time to take out the plates. The cryſtals are then ſeen detached, and of a ſilky appearance on their ſurface. The huſks are thrown back, and the plates are put in what is called *relai*. For that purpoſe they are immediately depoſited in a corner of the cellar on ſticks ranged on the floor. They are placed in an upright poſition, one leaning againſt the other; and at the end of two or three days they are moiſtened, by taking them up in handfuls and immerſing them in water in earthen pans. They are depoſited quite wet in their former poſition, and left there for ſeven or eight days; after which they are once or twice immerſed again. This immerſion and drying are renewed ſix or eight times every ſeven or eight days. As the plates were formerly put into wine, theſe immerſions were called *one wine*, *two wines*, *three wines*, according to the number of times. By this proceſs the plates ſwell up, the green is nouriſhed, and a coat of verdigris is formed on all their ſurfaces, which may be eaſily detached by ſcraping them with a knife.

This verdigris, which is called *freſh* verdigris, *moiſt* verdigris, is ſold by the manufacturers to people who dry it for foreign exportation. In this firſt ſtate it is only a paſte, which is carefully pounded in large wooden troughs, and then put into bags of white leather, a foot in height and ten inches in diameter. Theſe bags are expoſed to the air or the ſun, and are left in that ſtate till the verdigris has acquired the proper degree of dryneſs. By this operation it decreaſes about 50 *per cent.* more or leſs according to its primitive ſtate. It is ſaid to ſtand proof by the knife, when the point of that inſtrument puſhed againſt a cake of verdigris through the ſkin cannot penetrate it. White lead may be made by a ſimilar proceſs.

Cryſtallized VERDIGRIS is manufactured at Montpelier in the following manner: A vinegar, prepared by the diſtillation of ſour wine, is put into a kettle, and boiled on the common verdigris. After ſaturation the ſolution is left to clarify, and then poured into another kettle of copper, where it is evaporated till a pellicle forms on the ſurface. Sticks are then immerſed into it, and by means of ſome packthread are tied to ſome wooden bars that reſt on the edge of the kettle. Theſe ſticks are about a foot long, and are ſplit croſs-wiſe nearly two inches at the end, ſo that they open into four branches, kept at about the diſtance of an inch from each other by ſmall bags. The cryſtals adhere to theſe ſticks and cover them entirely, forming themſelves into groups or cluſters, of a dark blue colour, and a rhomboidal ſhape. Each cluſter weighs from five to ſix pounds. Three pounds of moiſt verdigris are required for one pound of the cryſtals; the undiſſolved reſiduum is thrown away.

VERDUN, an ancient, ſtrong, and conſiderable town of France, in the department of Meuſe, and late province of Lorrain, with a biſhop's ſee, and a ſtrong citadel. Its fortifications were conſtructed by the Chevalier de Ville and Marſhal de Vauban. The latter was a native of this place. In 1755, great part of the cathedral was deſtroyed by lightning. Verdun was taken by the Pruſſians in 1792, but retaken by the French ſoon after. The inhabitants are noted for the fine ſweetmeats they make. It is ſeated on the river Maeſe, which runs through the middle, 42 miles ſouth-weſt of Luxemburg, and 150 eaſt of Paris. E. Lon. 5° 28′ N. lat. 43° 9′.

VERE, a pariſh of the iſland of Jamaica, having Manury Bay in it; a very ſecure road for ſhipping —*Morse*.

VERGENNES, a poſt-town, and one of the moſt growing and commercial towns of Vermont, in Addiſon county, on Otter Creek, about 6 Miles from its mouth in Lake Champlain. It is regularly laid out, and contains a Congregational church, and about 60 houſes. In its neighbourhood are ſeveral mills. It is 115 miles north of Bennington, 22 S. of Burlington, and 407 N. E. by N. of Philadelphia. The townſhip contained 201 inhabitants in 1790.—*ib.*

VERINA, a ſmall village, and Spaniſh plantation of New-Andaluſia, and Terra Firma, S. America. Its tobacco is reputed the beſt in the world. It lies 60 miles eaſt of Cumana.—*ib.*

VERMEJA, or *Vermillion Bay*, on the north ſhore of the Gulph of Mexico, or coaſt of Louiſiana. It is to the N. W. of Aſcenſion Bay, in about lat. 30 N. and long. 92 W.—*ib.*

VERMEJO, or *Bermejo*, an iſland and port on the coaſt nifuge.

coaſt of Peru, 2 degrees N. and a little weſt of Lima. It is 4 leagues from Mongon on the north, and 6 from Guarmey Port on the ſouth.—*ib.*

VERMIFUGE, a medicine which expels worms from the inteſtines. Of theſe medicines numbers are daily advertiſed in the newſpapers as infallible, though the ingredients of which they are compoſed are carefully kept ſecret. We think it our duty therefore to aſſure our readers, that the medicines vended by quacks are generally the very ſame that would be preſcribed by a regular phyſician for the diſeaſe in which they are pretended to be ſpecifics, with this only difference, that the unſeen and unprincipled quack generally preſcribes them in more powerful doſes than the regular phyſician deems ſafe for his patient. Thus Ching's famous worm medicine, which has been ſo ſtrenuouſly recommended, is nothing more than mercury given in the very ſame form in which it is given by every phyſician; but Ching gives it in doſes, which, though they have not injured the children of a biſhop and a judge, we have *known* to *ſalivate* other children to the great hazard of their lives. It is indeed wonderful that parents ſhould truſt the health and the lives of their children to men whom they never ſaw, and whom they know to be not oppreſſed with an over delicate ſenſe of honour, in preference to a man of ſcience who has a character to ſupport, and who is probably their friend, and almoſt always their acquaintance.

Of the different vermifuges, however, it muſt be confeſſed that the greater number are liable occaſionally to fail. One of the moſt powerful which we have mentioned in the article MEDICINE, *Encycl.* is compoſed of the ſpiculæ of the *cowhage* or *cow-itch;* and ſince that article was publiſhed, it has come more into uſe, chiefly through the recommendation of Mr Chamberlaine ſurgeon. He ſays that a tea ſpoonful of the electuary (See MEDICINE, *Encycl.* p. 342.) may be ſafely given to a young child, and one or even two table ſpoonfuls to adults. The medicine is to be taken in the morning faſting; and the doſe to be repeated for two or three mornings, after which a gentle purge completes the cure. This medicine, however, Mr Chamberlaine prohibits in every caſe where there is a tendency to inflammation in any part of the inteſtinal canal, or where the mucus has been carried off or greatly diminiſhed by dyſentery or any other cauſe.

Dr Haemmerlin of Ulm has lately recommended as a very powerful and ſafe vermifuge the coraline of Corſica, and ſays that it has been ſo uſed in that iſland with complete ſucceſs from time immemorial. It is a fucus adhering to the rocks waſhed by the ſea, and ſometimes to the ſtones and ſhells thrown upon the ſhore. It is found in little tufts. It is generally of a yellow colour, with a reddiſh tincture. When dried, as it appears when offered for ſale, it contains a ſtrong ſmell of the ſea. It conſiſts of little cartilaginous ſtalks, with full threads, gradually cylindrical and tubulated. Its taſte is ſalt and unpleaſant. In the ſyſtem of plants of Linnæus, it belongs to the claſs *cryptogamia.* Its moſt common names are, ſea rock moſs; the Grecian herb; lemithochorton; and the coraline of Corſica. It is the *conferva helminthortos* of Schwendimann, and the *fucus helminthocorton* of Latourette. There is reaſon to think that all thoſe ſpecies of fucus whoſe texture is ſoft and ſpungy, might be applied to the ſame medicinal uſes. There is a ſort of red coraline found in Sweden which, according to ſome writers, is a greater deſtroyer of worms than any other known ſubſtance; being not too ſtrong for the ſtomach either of infants or of adults. Schwendimann aſſerts that the *conferva dichotoma* of Linnæus, which is found in the ditches in England, hears a ſtrong analogy to the coraline of Cortica. Might not this conferva be tried as a vermifuge? The Corſican coraline is in great eſtimation in the pharmacopœias of the Continent, eſpecially in that of Geneva, in which is given a recipe for preparing a ſyrup of it.

Vermillias, || Vermont.

VERMILLIAS *Barryeras*, on the coaſt of Brazil, between the Iſland of St John's and Sypomba Iſland, which are 7 leagues aſunder. Here is a large bay with good anchorage.—*Morſe.*

VERMILLION, *Point*, called alſo Long Point, is the peninſula between Bay Puan and Lake Michigan. —*ib.*

VERMILLION *River*, in the N. W. Territory, runs north-weſtward into Illinois river, nearly oppoſite the S. W. end of Little Rocks, and 267 miles from the Miſſiſſippi. It is 30 yards wide, but ſo rocky as not to be navigable.—*ib.*

VERMILLION *Indians* reſide 220 miles up the Miami of the Lake.—*ib.*

VERMONT, one of the United States of North America, lies between 42° 44′ and 45° N. lat. and 1° 43′ and 3° 36′ E. lon. from Philadelphia. It is in length 158 miles, and breadth 70 (A) containing between 900 and 1000 ſquare miles. It is bounded north, by Lower Canada; eaſt, by Connecticut River, which divides it from New Hampſhire; ſouth, by Maſſachuſetts; weſt, by New York.

Vermont is naturally divided by the Green Mountain, which runs from ſouth to north, and divides the ſtate nearly in the middle. It is at preſent divided into the following counties, which lie in a circuit as you proceed from Bennington county, north, on the weſt ſide of the Green Mountains to the Canada line, then eaſt to Connecticut river; then ſouth, along the river to the Maſſichuſetts line, viz. Bennington, Rutland, Addiſon, Chittendon, Franklin, Orleans, Eſſex, Caledonia, Orange, Windſor and Windham.

The towns are incorporated and organized much in the ſame manner as the towns in Maſſachuſetts and Connecticut. In each of the towns granted by the governor of New Hampſhire, while this territory was under the juriſdiction of that province, in number 114, there is a reſerve of one right of land, in fee, uſually containing 330 acres, for the firſt ſettled miniſter in ſuch town; one right, as a glebe, for the church of England; one right to the ſociety in Great Britain for the propagation of the goſpel in foreign parts; and one right for the ſupport of a ſchool in the town. In the remaining towns granted by the State of Vermont, there is one right for the uſe of an univerſity; one for the uſe of ſchools, in each town; one for the uſe of county

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(A) The northern line, ſeparating Vermont from Canada, is 90 miles long. The ſouthern line, dividing Vermont from Maſſachuſetts, is 40 miles in length. In the middle 55 miles.

county grammar ſchools, and one for the ſupport of the goſpel.

Lake Champlaine, more than half of which lies within the ſtate of Vermont, from Whitchall, formerly Skeenſborough, at the ſouthern extremity, including South Bay, to latitude 45°, is one hundred miles in length. It is about 14 miles in breadth in the wideſt place(n). Lake Memphremagog lies partly in the ſtate of Vermont, and partly in Lower Canada, the line croſſing it about 7 miles from the ſouthern extremity. This lake communicates with the St Lawrence, by the river St Francis. There are numerous ſmall lakes and ponds of leſs note, ſome of the principal of which are, Willoughby's lake, in Weſtmore, and Bell-water lake in Barton; the former furniſhes fiſh reſembling baſs, ſome weighing 23 pounds. They make a delicious feaſt for the new ſettlers. People travel 20 miles to this lake to procure a winter's ſtock of this fiſh. Leiceſter Pond or Lake, in the town of Saliſbury, is remarkable for the depth and tranſparency of its waters, and for a large ſpecies of trout which it produces, ſome of which have been found to weigh above nineteen pounds. Lake Bombazon, in Caſtleton, gives riſe to a branch of Poultney river, on which iron works have been erected in Fair Haven; and a large pond in the town of Wells. Lake Pleaſant in Greenſborough, abounds in trout of one or two pounds weight, many barrels of which are caught in a ſeaſon.

Few countries are better watered than the ſtate of Vermont. Numerous perennial fountains riſe on almoſt every farm. In this ſtate is the height of land, between Connecticut, Hudſon and St Lawrence. Streams deſcend from the mountains in various directions, and form numerous ſmall rivers, which fertilize the lands through which they paſs and furniſh abundant conveniences for mills and founderies. The river Connecticut forms the eaſtern boundary of Vermont. From its preſent importance to the commerce of this ſtate, and the opening of an Inland navigation from Hartford in Connecticut, to Barnet in Vermont, more than 100 miles from the ſouth line of this ſtate, which has lately been effected, it merits to be noticed in this place. This river has its ſource in the high lands which divide the waters falling ſouthward into the Atlantic, from thoſe which fall into the St Lawrence, about 50, others ſay 25, miles north of latitude 45°. From its northernmoſt part, to latitude 45° it is the boundary between the United States and the Britiſh dominions in America. The eaſtern, or principal branch of Connecticut river riſes in New Hampſhire, and runs north, then making a ſemi-circle, turns to the ſouth, and runs nearly ſouth about 40 miles below lat. 45°; then about 40 more it runs S. W. till it comes to Haverhill; then it runs ſouth to Northfield; below Northfield is a very large bend to the weſtward, and ſoon after to the eaſt again. Thence it proceeds, with ſome meanders, about Northampton and Hadley, nearly ſouth to Hartford, and thence ſoutheaſterly to Saybrook, where it empties itſelf into the ſound. Its length, from its ſource to the ſea, including all its turnings, is nearly four hundred miles, and it croſſes four parallels of latitude. Loaded boats aſcend from Hartford in Connecticut, to the mouth of Wells river, and even as far as Barnet near the foot of the falls, about two hundred and twenty miles from the ſea. In this courſe the navigation is interrupted by the Falls at Hadley, (which in one place deſcend *thirty feet*, and with amazing grandeur, though not in a continued ſheet. The deſcent is greater than in any one place at Bellows Falls) Miller's Falls, at and near Northfield; Bellows Falls, between Rockingham in Vermont, and Walpole in New Hampſhire; Queechy Falls, a little below the mouth of the river of that name, and White River Falls, four and an half miles below Dartmouth College. Companies have been formed by the ſeveral ſtates of Maſſachuſetts, New Hampſhire and Vermont, for the purpoſe of removing theſe obſtructions; and their object is now nearly accompliſhed. All the falls in this river, except Queechy and White River Falls, are locked.

The falls of Queechy are but a ſlight obſtruction. The falls or rapids of White River, have three diſtinct bars, which make a portage of three miles. In ſome parts, the water falls 20 feet.

At the mouth of Queechy, commonly called Water Queechy river, there is one of the moſt beautiful caſcades in New England. The river, here about 258 feet wide, pours over a ledge of rocks 40 feet high, in an almoſt perpendicular manner, juſt broken enough to throw the water in every fantaſtical and delightful form.

Many ſmaller rivers fall into Connecticut river, Memphremagog, Lake Champlaine, and the Hudſon.

The ſouth branch of Nullegan riſes in Random, and interlocks with the head of the Clyde. By theſe rivers the Indians formerly came in canoes from Lake Memphremagog to Connecticut river; the carrying place from one river to the other is about a mile. It croſſes the line between Random and Calderſburgh.

The rivers and lakes abound with various kinds of fiſh. Shad are taken in Connecticut river, as high as Bellows Falls, over which they never paſs. Salmon in plenty have heretofore been caught in the ſpring, the whole length of Connecticut river, and in moſt of its tributary ſtreams; but few, however, of late years. A ſmall ſpecies of ſalmon is taken in Lake Champlaine, the Winouſki, or Onion river, La Moille and Miſſiſcoui, but in none of the ſouthern rivers. Perch, pike, pickerel, maſkinungas, a very large ſpecies of pickerel, pout, mullet, and a fiſh called lake baſs, are found in great plenty. All the ſtreams abound with ſalmon-trout.

There are handſome bridges built over the Connecticut at Bellows Falls, Windſor and Hanover.

Beſides the numerous ſprings of freſh water, there are ſome chalybeate ſprings. There is a ſpring in Orwel, near

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(n) The ſtate of New York has, by an act of the legiſlature, eſtabliſhed a company for the purpoſe of opening an inland navigation, by the Hudſon, from Lanſingburgh to fort Edward, and from fort Edward to Wood Creek and Lake Champlaine. The work is now in forwardneſs, and, when completed, will open to Vermont a water communication with Lanſingburgh, Albany and New York: The whole of this inland navigation will be three hundred and ſeventy miles, from latitude 45° to New York.

near Mount Independence, and another in Bridport, which produce the Epſom ſalts.

There is alſo a curious mineral ſpring on ſome low land over againſt the great Ox Bow, diſcovered about the year 1770.

Vermont is divided, from north to ſouth, by a high chain of mountains. This chain has, from the evergreens with which it is covered in many places, obtained the name of *Green Mountain*, from which the name of *Vermont* is derived to the ſtate. The ſouthern extremity is called Weſt Rock, a precipice about three miles from New Haven, in Connecticut; thence the mountain ranges northward, riſing in height, as it advances through Connecticut, Maſſachuſetts and Vermont. The hills in Fairfield county are a principal branch, on the coaſt of the Green Mountains. Towards Lake Memphremagog it ſpreads into a high plain country, exceedingly fertile, and paſſes into the province of Quebec. After having formed the rapids of St Francis, it collects into a high range of mountains, which terminate near the St Lawrence. From Maſſachuſetts line, more than 80 miles to the north, the weſtern verge of the Green Mountain is from twenty to thirty miles on a ſtraight line from Connecticut river. Almoſt the whole of this country is formed with mountains ranging parallel with the courſe of Connecticut river. The weſt range, which continues unbroken, with few exceptions, nearly through the ſtate, is, in general, much the higheſt. On the eaſt they decreaſe gradually to the meadows, and ſometimes to the edge of the river. Theſe laſt are interſected by the rivers which run into the Connecticut, in a direction nearly from the northweſt to the ſoutheaſt. The vallies, or rather glens, which ſeparate theſe ranges, are generally narrow, and moſtly covered with hemlock, fir and ſpruce.

About 100 miles from Maſſachuſetts line, between the waters of White river and Winouſki, or Onion river, there paſſes off to the northeaſt, a range of high lands, frequently riſing into very elevated mountains. This runs parallel with Connecticut river; the height being from ten to fifteen miles diſtant, as far as the north line of the ſtate. The weſtern range continues northward, ſometimes falling below the clouds, ſometimes riſing above them. Between theſe two ranges, extending from twenty to thirty miles in breadth, is a beautiful champaign country, ſecond in fertility, perhaps, to none in Vermont.

The moſt remarkable mountains in the ſtate, are Mount Anthony, between Bennington and Pownal, Stratton Mountain, Danby Mountain, Kellington Peaks, Kingſton Mountain, Camel's Rump, Manſfield Mountain, a very high mountain between Kelly Vale and Belvidere, Upper Great Monadnock, quite in the N. E. corner of the ſtate, and Aſcutney, between Windſor and Weatherfield. On the weſt of the Green Mountain, there is one, and in ſome places, two or three ranges of ſmaller mountains, though frequently interrupted. Theſe extend as far as the north line of the county of Rutland: From that, to the latitude of forty-five degrees, one hundred miles in length, and from twenty to thirty miles in breadth, between Lake Champlaine and the Green Mountain, is a fine tract of land, abounding with only moderate hills. Through this whole extent, few tracts can be found unfit for cultivation.

It is remarkable that the hills and mountains are generally covered on the eaſt ſides with what is called hard wood, ſuch as birch, beach, maple, aſh, elm, and butternut; the weſt ſide is generally covered with evergreens.

The climate, ſoil, productions, and animals differ little from thoſe in New England.

The trade from this ſtate is principally to Hartford, Boſton and New York. Some little trade is carried on with the province of Quebec. The remittances to Quebec are moſtly made in lumber, ſuch as boards, plank, ſquare timber and ſtaves, by Lake Champlaine and the St Lawrence. The articles of export to Hartford, Boſton, Portland and New York, are horſes, beef, pork, butter, cheeſe, wheat, wheat flour, iron, nails, pot and pearl aſhes. Of the two laſt articles, one thouſand tons were made in the ſtate in the year 1791.

The number of people in Vermont, according to the cenſus taken in 1790, was 85,589. The inhabitants of Vermont conſiſt principally of emigrants from Maſſachuſetts and Connecticut, and their deſcendants. There have been ſome from Rhode Iſland, New Hampſhire, New York, and New Jerſey. Two towns in Caledonia county are moſtly peopled from Scotland, and are Preſbyterians, partly of the Seceſſion, and partly of the covenanted Church. The manners of the people are the ſame as thoſe of the ſtates from whence they emigrated. The body of the inhabitants are congregationaliſts. The other denominations are baptiſts, epiſcopalians, quakers, and a few methodiſts. The ſtate is rapidly peopling. In 1788, the townſhip of Danville, in the county of Orange, was a wilderneſs without a ſingle family. In 1792 they had two conſiderable companies of militia; beſide a company of light infantry, dreſſed in uniform.

The inhabitants of this ſtate are an aſſemblage of people from various places, of different ſentiments, manners and habits. They have not lived together long enough to aſſimilate and form a general character. Aſſemble together, in imagination, a number of individuals of different nations; conſider them as living together amicably, and aſſiſting each other through the toils and difficulties of life, and yet rigorouſly oppoſed in particular religious and political tenets; jealous of their rulers, and tenacious of their liberties, (diſpoſitions which originate naturally from the dread of experienced oppreſſion, and the habit of living under a free government)—and you have a pretty juſt idea of the character of the people of Vermont. Indolence is never a characteriſtical feature of the ſettlers of a new country. Emigrants in general are active and induſtrious. The oppoſite characters have neither ſpirit nor inclination to quit their native ſpot. The inference is, that Vermont is peopled with an active, induſtrious, hardy, frugal race; as is really the caſe. And as it is a maxim that the inhabitants of all new countries grow virtuous before they degenerate, it will moſt probably be ſo in Vermont.

The inhabitants of the ſeveral towns ſeem generally diſpoſed, as ſoon as they are able, to ſettle a miniſter of the goſpel among them. Miſſionaries, from Connecticut and Maſſachuſetts, to the new and ſcattered ſettlements, have been generally well received and treated with grateful reſpect and kindneſs.

In 1796 there were, on the militia rolls, 19,500 men. Theſe were formed into 4 diviſions, conſiſting of 8 brigades and 22 regiments. The increaſe ſince may be eſtimated according to the increaſe of inhabitants. The bravery of the *Green Mountain Boys* is proverbial.

In a new country, like Vermont, few have leiſure to attend the arts and ſciences beyond the preſent occaſions of life. The higher branches of learning are therefore very little taught in this ſtate. Numbers, however, are educated in the ſeminaries of the neighbouring ſtates. In October, 1791, the legiſlature of the ſtate paſſed an act for eſtabliſhing a univerſity at Burlington, on Lake Champlaine, in a delightful ſituation, on the ſouth ſide of the Winouſki, or Onion river, and appointed 10 truſtees. The ſum of ſix thouſand pounds was ſecured by donation, part of which was to be applied to the erecting of buildings, and part ſettled as a fund for the ſupport of the inſtitution. There have been reſerved in the ſeveral grants made by this ſtate about thirty-three thouſand acres of land, for the uſe of the univerſity. This in a few years, will become a very valuable fund. There is in every town, granted by the ſtate, conſiſting of about one hundred, a right of land, containing about three hundred and thirty acres, on an average, reſerved for the uſe of county grammar ſchools; and in every town through the ſtate, there is a right for the ſupport of town ſchools. In no country is common ſchooling more attended to. A family of children, who could not read, write, and underſtand common arithmetic, would be looked upon as little better than ſavages. The proviſion, in this reſpect, is certainly worthy of imitation. The inhabitants of each town are empowered by law to divide it into as many diſtricts as ſhall be found convenient; to appoint one or more perſons in each diſtrict, who, with the ſelectmen of the town, form a board of truſtees for the ſchools of that town; and are empowered to leaſe all lands and loan monies that belong to the town, for the uſe of ſchools, and to proſecute or defend any ſuit or matter relating to their truſt. The inhabitants of each diſtrict have likewiſe a power to appoint a committee of one or more perſons, to raiſe by tax, on the rateable eſtates of the inhabitants of the diſtrict, one half of the ſum which they may find neceſſary for building a ſchool-houſe and ſupporting a ſchool. The remainder of the money is to be raiſed by ſubſcription, or, if voted by two-thirds of the inhabitants, by a tax in like manner. By theſe means, every claſs of citizens may have acceſs to the common ſchools.

In five counties, grammar ſchools have been eſtabliſhed, viz.

Towns.	Counties.	Years.
At Norwich,	Windſor,	1785.
Caſtleton,	Rutland,	1787.
Peacham,	Caledonia,	1795.
Middlebury,	Addiſon,	1797.
St Alban's,	Franklin,	——

The Middlebury academy in 1800, was, by act of Aſſembly, erected into a college with the uſual charter privileges, and is now flouriſhing under the government and inſtruction of a preſident and ſubordinate officers. The college edifice is the largeſt in the ſtate.

The academy at Peacham is very flouriſhing, and has ample funds in lands appropriated by charter, as has been mentioned. The annual rent of theſe lands, it is expected will, when the lands ſhall be leaſed, yield an annual income of eight or nine hundred dollars. A handſome donation of a farm, worth 1200 dollars, has lately been made by Mr James Orr, deceaſed, of Barnet, originally from Scotland. A large and convenient building has been erected for the accommodation of the ſtudents.

A Medical Society was inſtituted in this State in 1784, and another in 1794.

The inhabitants of Vermont, by their repreſentatives in convention, at Windſor, on the 25th of December, 1777, declared that the territory called Vermont, was, and of right ought to be, a free and independent ſtate; and for the purpoſe of maintaining regular government in the ſame, they made a ſolemn declaration of their rights, and ratified a conſtitution, which is well known.

The ſouth part of the territory of Vermont was formerly claimed by Maſſachuſetts. As early as the year 1718, that government had granted forty-nine thouſand acres, comprehending part of the preſent towns of Brattleborough, Fulton and Putney, as an equivalent to the colony of Connecticut, for ſome lands which had been granted by Maſſachuſetts within the limits of the Connecticut charter. In the year 1725, the government of Maſſachuſetts erected a fort in the town of Brattleborough. Around this fort were begun the firſt ſettlements within the preſent limits of Vermont. On a final ſettlement of a diſpute between Maſſachuſetts and New-Hampſhire, the preſent juriſdictional line between Vermont and Maſſachuſetts, was run and eſtabliſhed, in the year 1741. From that time until the year 1764, this territory was conſidered as lying within the juriſdiction of New Hampſhire. During this period, numerous grants were made; and, after the year 1760, ſome conſiderable ſettlements were begun under the authority of that province. In the year 1764, by order of the king of Britain, this territory was annexed to the province of New York. The government of that province pretended to claim the right of ſoil, as well as juriſdiction, and held the grants formerly made under New Hampſhire, to be void. This occaſioned a long ſeries of altercation between the ſettlers and claimants under New Hampſhire and the government of New York, and which, at the commencement of the late revolution, terminated in the eſtabliſhment of a ſeparate juriſdiction in the preſent ſtate of Vermont. A particular detail of this controverſy would be unentertaining. It is ſufficient to obſerve, that on the 17th day of October, 1790, the diſpute was finally compromiſed, by commiſſioners appointed by the ſtates of New York and Vermont; and the claims of New York, both to juriſdiction and property, extinguiſhed, in conſideration of the ſum of thirty thouſand dollars to be paid by the ſtate of Vermont to that of New York; and on the 4th of March, 1791, Vermont was admitted a member of the federal union. In the late war, between Britain and the United States, the inhabitants of this territory took a very early and active part. Immediately on the news of the battle of Lexington, a company of Volunteers, under the late general Ethan Allen, attacked and took the Britiſh garriſon of Crown Point and Ticonderoga. A regiment was commiſſioned by Congreſs and continued in ſervice under the command of the late colonel Warner. Other troops were raiſed and conſtantly kept in ſervice by the convention of New Hampſhire grants, and afterwards by the ſtate of Vermont. The ſpirit of theſe troops, and the militia of the grants, in the battle of Hubberton and Bennington, in the year 1777, and the aſſiſtance which they afforded in the capture of Burgoyne, are well known to the public. General Burgoyne in a letter to the Britiſh miniſtry, written at Saratoga, makes the following obſervation: "The inhabitants of the New Hampſhire grants, a territory unpeopled and almoſt unknown in the laſt war, now pour forth by thouſands, and hang like dark clouds on my left."—*Morſe.*

VERNON, a place in Suſſex county, New-Jerſey, eaſt of the ſource of Wall Kill, and about 21 miles N. E. of Newtown.—*ib.*

VERRETTES, a ſettlement in the French part of the Iſland of St Domingo, on the S. W. bank of Artibonite river; 4 miles S. by E. of the ſettlement of Petit Riviere.—*ib.*

VERSAILLES, the chief town of Woodford county, Kentucky; ſituated on a ſmall ſtream which falls into Kentucky river. It contains a court-houſe, ſtone gaol, and about 30 houſes, and lies 13 miles W. by S. of Lexington.—*ib.*

VERSHIRE, a townſhip of Vermont, Orange county, adjoining Fairlee, and containing 439 inhabitants.—*ib.*

VERT *Bay*, or *Green Bay*, in the Straits of Northumberland, in N. America, opens to the N. E. oppoſite St John's iſland. The head of the bay approximates within 12 miles of the north-eaſternmoſt branch of the Bay of Fundy. It is about 10 leagues to the N. W. of Tatamagauche Harbour, and ſerves in part to ſeparate the Britiſh provinces of Nova-Scotia and New-Brunſwick.—*ib.*

VESPA (See *Encycl.*). A new ſpecies of this genus of inſects has been lately deſcribed by *Cuvier*, in a note read before the Philomathic Society of Paris. It has ſome reſemblance to the *veſpa nidulans* of Fabricius, which, as is generally known, is a native of certain parts of America. The neſts of the veſpa nidulans are conſtructed of a very fine web, of a very ſolid and pretty white paſte. Their form is that of a bell cloſed upon all ſides, excepting a narrow hole at the bottom; and they are ſuſpended from the branches of trees.

The *veſpa* deſcribed by Cuvier, which is a native of Cayenne in America, has in general more volume than the preceding ſpecies, and its paſte is grey, coarſer, leſs homogeneous, and leſs ſolid. The bottom of its neſt alſo, in lieu of being ſhaped funnel-like, is flat, and the orifice appears at one of the ſides of the bottom part, and not in the middle. In the country where it is found, this ſpecies of waſp is called the *tatou fly* (*mouche tatou*). It differs greatly in form from that which Fabricius has deſcribed; it is all entirely of a ſhining black; the firſt articulation, or joint of its abdomen, is narrow, and in form of a pear; the ſecond, larger than the others, is in form of a bell: the wings are brown. The following is the character aſſigned to it by Cuvier:

Veſpatatua, Nigra, Nitida, Alis fuſcis, abdomine pedicellato.

VESPERTILIO (ſee *Encycl.*) has been ſubjected to ſome cruel, but curious experiments, by the Abbé Spallanzani and M. de Jurine. The former of theſe philoſophers having let looſe ſeveral bats in a chamber perfectly dark, found that they flew about in it without any impediment, neither ruſhing againſt any thing in the apartment, nor touching the walls with their wings. This ſurpriſed him; but imagining that they were conducted by ſome glimpſe of light which he did not perceive, he blindfolded them with a ſmall and very cloſe hood. They then ceaſed to fly; but he obſerved, at the ſame time, that this did not proceed from any deprivation of light, but rather from the conſtraint thence occaſioned, eſpecially when a hood of a very light texture was attended with the ſame effect.

He then conceived the idea of paſting up the eyes of the bats with a few drops of ſize or gum; but they ſtill flew about in the ſame manner as if their eyes had been open. As this, however, was not ſufficient, he paſted up the eyes of theſe animals with round bits of leather; and this even did not impede them in their flight.

That he might at length be certain of his object, he blinded them entirely, either by burning the cornea with a red hot wire, or by pulling out the pupil with a pair of ſmall pincers, and ſcooping out the eye entirely. Not contented even with this precaution, he covered the wounds with pieces of leather, that the light might have no influence whatever on the remains of the organs which had been deſtroyed. The animals ſeemed to ſuffer very much by this cruel operation; but when they were compelled to uſe their wings, either by day or by night, and even in an apartment totally dark, they flew perfectly well, and with great caution, towards the walls, in order to ſuſpend themſelves when they wiſhed to reſt. They avoided every impediment, great or ſmall, and flew from one apartment to another, backwards and forwards, through the door by which they were connected, without touching the frame with their wings. In a word, they ſhewed themſelves as bold and lively in their flight as any other animals of the ſame ſpecies which enjoy the uſe of their eye-ſight.

Theſe experiments were repeated by M. Jurine, and with the ſame reſults. Spallanzani had ſuppoſed that the bat poſſeſſed ſome organ or ſenſe which is wanting in the human ſpecies, and which ſupplies to theſe animals the place of viſion; and Jurine determined to aſcertain the truth or falſehood of this hypotheſis by anatomical reſearches. During the courſe of theſe, he found the organ of hearing very great in proportion to that of other animals, and a conſiderable nervous apparatus aſſigned to that part. The upper jaw alſo is furniſhed with very large nerves, which are expanded in a tiſſue on the muzzle.

M. Jurine then extended his experiments to the organ of hearing and that of ſmell. Having put a ſmall hood on a long eared bat, it immediately pulled it off, and flew. He ſtopped up its ears with cotton; but it freed itſelf in the like manner from that inconvenience. He then put into its ears a maſtic of turpentine and wax. During the operation the animal ſhewed a great deal of impatience, and flew afterwards very imperfectly.

A long-eared bat, the ears of which had been bound up, flew very badly: but this did not ariſe from any pain occaſioned by the ligature; for when its ears were ſewed up, it flew exceedingly well. In all probability the animal would have preferred having its ears bound up to having them ſewed. Sometimes it flew towards the cieling, extending its muzzle before it ſettled.

M. Jurine poured liquid pomatum into the ears of a bat which enjoyed the uſe of its ſight. It appeared to be much affected by this operation; but when the ſubſtance

ſtance was removed it took flight. Its ears were again filled, and its eyes were taken out; but it flew then only in an irregular manner, without any certain or fixed direction.

The ears of a horſe-ſhoe bat, which had the uſe of its ſight, were filled with tinder mixed with water. It was uneaſy under the operation, and appeared afterwards reſtleſs and ſtunned; but it conducted itſelf tolerably well. On being blinded, it ruſhed with its head againſt the ceiling, and made the air reſound with ſtrokes which it gave itſelf on the muzzle. This experiment was repeated on other bats with the like effects.

The tympanum of a large horſe-ſhoe bat was pierced with a pin (*trois quart*). The animal appeared to ſuffer much from the operation, and fell down in a perpendicular direction when thrown into the air. It died next morning. The ſame effect was produced on piercing the tympanum of a long-eared bat with a needle.

The author then made very accurate reſearches on the difference between the organiſation of the brain of theſe two kinds of bats; and, after a careful diſſection, found that the eye of the long-eared bat is much larger than that of the horſe-ſhoe bat, but that the optic nerve is proportioned to it. The outer part of the ear of the former is much larger than that of the latter, but the interior part is ſmaller.

The horſe ſhoe bat is indemnified for this difference by a greater extenſion of the organ of ſmell, as evidently appears when the external elevations and irregularities of its muzzle are examined. When it is about to take flight, it agitates its noſe much more than the long-eared bat.

From theſe experiments, the author concludes: *Firſt*, That the eyes of the bat are not indiſpenſably neceſſary to it for finding its way; *ſecondly*, That the organ of hearing appears to ſupply that of ſight in the diſcovery of bodies, and to furniſh theſe animals with different ſenſations to direct their flight, and enable them to avoid thoſe obſtacles which may preſent themſelves.

VESSEL *Bay*, on the eaſt ſhore of Lake Champlain, ſets up to the N. E. in the townſhip of Charlotte, in Vermont.—*Morſe*.

VIBRATION Figures, are certain figures formed by ſand or very dry ſaw-duſt, on a vibrating ſurface, which is connected with the ſenſation of ſound in our organs of hearing. If the ſurface, on which the figures are to be formed, be ſtrewed over with bodies eaſily put in motion, theſe, during the vibration, remain on the parts at reſt, and are thrown from the parts in motion. The form of the parts at reſt, which will be ſhewn by the ſand that remains unmoved, and which, in general, is ſymmetric, is called a *vibration figure*. To produce ſuch a figure, nothing is neceſſary but to know the method of bringing that part of the ſurface which you wiſh not to vibrate into a ſtate of reſt, and of putting in motion that which you wiſh to vibrate. On this depends the whole expertneſs of producing vibration figures.

Thus take a ſquare piece of glaſs, pretty thin, and very ſmooth, ſuch as that uſed for windows, about four or five inches over, or even more. Smooth it at the edges on a grinding-ſtone; ſtrew a little ſaw-duſt over its ſurface, and lay hold of it gently with the thumb and fore-finger of the left hand. Holding it thus by the middle, with the right hand rub a violin bow ſoftly againſt one of its edges, drawing the bow either up or down in a direction almoſt perpendicular to the ſurface of the glaſs, and you will ſee a tremulous movement, and the whole duſt leap about. If the bow be exactly in the middle of one of the ſides, the duſt will arrange itſelf almoſt in the direction of the two diagonals, dividing the ſquare into four iſoſceles triangles. If the bow be applied at a quarter only of the diſtance of the one corner from the other, the duſt will arrange itſelf in ſuch a manner as to be found in the two diameters of the ſquare, dividing it into four equal ſquares. At other times, when the bow deviates a little, the duſt forms a figure like a double C, when the two letters are joined back to back. If the ſquare be held by the two extremities of the diameter oppoſite to that againſt which the bow is applied, the duſt will form a kind of oval, one of the axes of which will be the ſame diameter. If the glaſs be of a circular figure, and be held by the middle, the duſt will arrange itſelf in ſuch a manner as to form the ſix radii of a regular hexagon. Theſe diſcoveries were made by Dr Chladni, about the time that he invented the muſical inſtrument, to which he gave the name of EUPHON (ſee that article, *Suppl.*); and as he found the vibration figures to vary in form with the various tones produced by the vibrating ſubſtances, a proſecution of his experiments may probably contribute to throw new light on the philoſophy of muſical ſounds. We ſhall therefore give, from the 3d volume of *Neues Journal der Phyſik*, by Profeſſor Gren, a few directions for making ſuch experiments.

Any ſort of glaſs may be employed, provided its ſurface be ſmooth; and when the plate has acquired the proper vibration, it ſhould be kept in that ſtate for ſome ſeconds, by continuing to rub it with the bow. The figures will thus be accurately formed.

Such plates ſhould be procured as are pretty equal in thickneſs. It may be ſaid, in general, that a plate the thinner it is will be ſo much the fitter for theſe experiments, though in this reſpect there is a certain minimum. In ſmall plates, ſuch as thoſe that are circular, and not above ſix inches in diameter, the obſervation is general; but in larger plates too great thinneſs is prejudicial. Beſides, it will be found that very thin glaſs is commonly very uneven, and muſt therefore be unfit for the experiments.

In practiſing the experiments, it will be proper to have plates of different ſizes; and the ſand employed ſhould not be too fine. In other words, it muſt be of ſuch a nature that when you incline the glaſs-plate it may readily roll off; becauſe, in that caſe, it will be eaſily thrown from the vibrating parts. It will be of advantage that it be mixed with fine duſt, which ſhews peculiar phenomena during the experiments, as it collects itſelf at one place of the vibrating part.

The plate muſt be equally beſtrewed with ſand, and not too thick, as the lines will then be exceedingly fine, and the figures will acquire a better defined appearance.

VICIOSAS *Iſlas*, iſles of the Bay of Honda, on the coaſt of Honduras, or the Spaniſh Main.—*Morſe*.

VICTORIA, an iſland on the coaſt of Braſil, eaſtward of St Sebaſtian's Iſland.—*ib*.

VICTORY, *Cape*, is the extreme N. W. point of the ſtraits of Magellan, at the opening to the S. Pacific Ocean. S. lat. 52 15, W. long. 76 40.—*ib*.

Victory, a townſhip of Vermont, ſituated in Eſſex county, and bounded eaſt by Guildhall, on Connecticut river.—*ib.*

VIENNA, a port of entry and poſt-town of the eaſtern ſhore of Maryland, Dorcheſter county, on the weſt ſide of Nanticoke river, about 15 miles from its mouth. It contains about 30 houſes, but carries on a briſk trade with the neighbouring ſea-ports, in lumber, corn, wheat, &c. Its foreign exports in 1794, amounted to 1,667 dollars. It is 15 miles N. W. of Saliſbury, 32 S. S. E. of Eaſton, and 150 S. S. W. of Philadelphia.—*ib.*

Vienna, the capital of Greene county, Kentucky; ſituated on the north ſide of Green river, about 158 miles W. S. W. of Lexington.—*ib.*

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VIETA (Francis), a very celebrated French mathematician, was born in 1540 at Fontenai, or Fontenai-le-Comté, in Lower Poitou, a province of France He was Maſter of requeſts at Paris, where he died in 1603, being the 63d year of his age. Among other branches of learning in which he excelled, he was one of the moſt reſpectable mathematicians of the 16th century, or indeed of any age. His writings abound with marks of great originality, and the fineſt genius as well as intenſe application. His application was ſuch, that he has ſometimes remained in his ſtudy for three days together without eating or ſleeping. His inventions and improvements in all parts of the mathematics were very conſiderable. He was in a manner the inventor and introducer of Specious Algebra, in which letters are uſed inſtead of numbers, as well as of many beautiful theorems in that ſcience. He made alſo conſiderable improvements in geometry and trigonometry. His angular ſections are a very ingenious and maſterly performance: by theſe he was enabled to reſolve the problem of Adrian Romanus, propoſed to all mathematicians, amounting to an equation of the 45th degree. Romanus was ſo ſtruck with his ſagacity, that he immediately quitted his reſidence of Wirtzbourg in Franconia, and came to France to viſit him, and ſolicit his friendſhip. His Apollonius Gallus, being a reſtoration of Apollonius's tract on Tangencies, and many other geometrical pieces to be found in his works, ſhew the fineſt taſte and genius for true geometrical ſpeculations.—He gave ſome maſterly tracts on Trigonometry both plane and ſpherical, which may be found in the collection of his works, publiſhed at Leyden in 1646, by Schooten, beſides another large and ſeparate volume in folio, publiſhed in the author's life-time, at Paris, in 1579, containing extenſive trigonometrical tables, with the conſtruction and uſe of the ſame, which are particularly deſcribed in the introduction to Dr Hutton's Logarithms, p. 4. &c. To this complete treatiſe on trigonometry, plane and ſpherical, are ſubjoined ſeveral miſcellaneous problems and obſervations; ſuch as, the quadrature of the circle, the duplication of the cube, &c. Computations are here given of the ratio of the diameter of a circle to the circumference, and of the length of the ſine of 1 minute, both to a great many places of figures; by which he found that the ſine of 1 minute is

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alſo the diameter of a circle being 1000, &c. that the perimeter of the inſcribed and circumſcribed polygon of 393216 ſides will be as follows, viz. the

perim. of the inſcribed polygon - 31415926535
perim. of the circumſcribed polygon 31415926537

and that therefore the circumference of the circle lies between thoſe two numbers.

Vieta having obſerved that there were many faults in the Gregorian Kalendar, as it then exiſted, compoſed a new form of it, to which he added perpetual canons, and an explication of it, with remarks, and objections againſt Clavius, whom he accuſed of having deformed the true Lelian reformation, by not rightly underſtanding it.

Beſides theſe, it ſeems a work, greatly eſteemed, and the loſs of which cannot be ſufficiently deplored, was his *Harmonicon Cæleſte*, which being communicated to father Merſenne, was, by ſome perfidious acquaintance of that honeſt minded perſon, ſurreptitiouſly taken from him and irrecoverably loſt, or ſuppreſſed, to the great detriment of the learned world. There were alſo, it is ſaid, other works of an aſtronomical kind, that have been buried in the ruins of time.

Vieta was alſo a profound decipherer, an accompliſhment that proved very uſeful to his country. As the different parts of the Spaniſh monarchy lay very diſtant from one another, when they had occaſion to communicate any ſecret deſigns, they wrote them in ciphers and unknown characters during the diſorders of the league. The cipher was compoſed of more than 500 different characters which yielded their hidden contents to the penetrating genius of Vieta alone. His ſkill ſo diſconcerted the Spaniſh councils for two years, that they publiſhed it at Rome, and other parts of Europe, that the French king had only diſcovered their ciphers by means of magic.

VILLA *de Moſc*, a town in the province of Tabaſco, 4 leagues from the town of Eſtape, on Tabaſco river.—*Morſe.*

Villa *Hermoſo*, a town of Mexico or New-Spain, near the mouth of a river which falls into the Bay of Campeachy, and Gulf of Mexico.—*ib.*

Villa *Nova*, in Brazil, about 120 miles weſt of Porto Seguro, and as far S. E. by S. of Carloſa.—*ib.*

Villa *Rica*, or *Almeria*, a town of Tlaſcala or New-Spain, in N. America. It ſtands on the coaſt on a ſmall river, having an indifferent port, but in a better air than Vera Cruz, 20 leagues north of the latter. A clandeſtine trade is carried on here between ſome of the Spaniſh merchants on the ſhore, and French of St Domingo and Martinique.—*ib.*

VILLIA, *La*, a town and river of Veragua and Guatimala audience, in New-Spain. It is about 7 leagues from Nata, bordering on Panama. The river is very large, and at low water breaks at the mouth as on a flat ſhore; ſo that large ſhips anchor within cannon ſhot, but barks of about 40 tons may go up about a league and a half. The harbour is a quarter of a league above the town. About a league to the windward, is a large rock, generally covered with vaſt numbers of wild fowl.—*ib.*

VINALHAVEN, a townſhip on the coaſt of the Diſtrict of Maine, in Hancock county, containing 578 inhabitants. It is ſouth-eaſt of Deer Iſland, and 250 miles from Boſton.—*ib.*

VINCENTS,

VINCENTS, *Fort*, in the N. W. Territory, ſtands on the eaſt ſide of Wabaſh river, 150 miles from its mouth. It was erected in the year 1787, in order to repel the incurſions of the Wabaſh Indians, and to ſecure the weſtern lands from intruding ſettlers. It has four ſmall braſs cannon, and is garriſoned by a Major and 2 companies. The town of Vincents contained, in 1792, about 1,500 ſouls, principally of French extraction. It is 300 miles S. W. of Fort Recovery. N. lat. 39 15, W. long. 90 7. They raiſe Indian corn, and wheat; and tobacco of an extraordinary good quality; ſuperior, it is ſaid, to that produced in Virginia. They have a fine breed of horſes, brought originally by the Indians from the Spaniſh ſettlements, on the weſtern ſide of the Miſſiſſippi. Here are large herds of ſwine, and black cattle, and the ſettlers deal with the Indians for furs and deer-ſkins. Hemp of a good quality grows ſpontaneouſly in the low lands of the Wabaſh; as do grapes, of which the inhabitants make a ſufficient quantity, for their own conſumption, of well taſted red wine. Hops, large and good, are found in many places, and the lands are particularly adapted to the culture of rice. All European fruits thrive well both here, and in the country bordering on the river Ohio.—*ib.*

VINCENT, *St*, one of the 14 captainſhips of Brazil, in S. America, and the moſt ſoutherly one. The capital is an inconſiderable place, with only about 60 houſes, and the harbour will not receive large veſſels. It has 5 or 6 ſugar-mills, and lies 76 leagues ſouth-weſt of Rio Janeiro. S. lat. 23 40, W. long. 45 10.—*ib.*

VINCENT, *St*, a town on the coaſt of Brazil; ſituated on Amiaz Iſland, in the Bay of All Saints or Sanctos; in which iſland is the city of Dos Sanctos, the iſland lying on the weſt ſide of the entrance into the iſland. S. lat. 24 15, W. long. 46 30.—*ib.*

VINCENT, *de la Pazes, St*, or *Onda*, a town of Popayan and Terra Firma, in S. America; about 25 miles eaſtward of San Sebaſtian, with a port where canoes from Carthagena and St Martha unload their merchandize. —*ib.*

VINCENT, a townſhip of Pennſylvania, ſituated in Cheſter county.—*ib.*

VINCENT, *Port St*, on the coaſt of Chili, in the S. Pacific Ocean, is 6 miles N. N. E. of the mouth of the river Biobio, having a ſafe harbour and ſecure againſt all winds but the weſt, which blows right in. Talcaguama Port is 6 miles to the northward of it.—*ib.*

VINCENTO, a channel which goes in on the weſt ſide of the channel of Amiaz Iſland, in the Bay of All Saints, on the coaſt of Brazil.—*ib.*

VINER'S *Iſland*, in Hudſon's Bay, lies N. E. of the mouth of Albany river.—*ib.*

VINEYARD, *New*, a plantation in Lincoln county, Diſtrict of Maine, on the two north-eaſternmoſt branches of Sandy river, about 59 miles N. by W. of Brunſwick, and 37 N. W. of Hallowell.—*ib.*

VINEYARD *Sound*, on the ſouth-eaſtern coaſt of Maſſachuſetts, is the ſtrait or paſſage between the Elizabeth Iſlands and Martha's Vineyard. The S. W. channel of which, about 7 miles broad, has Gay Head on the S. E. and the Sow and Pigs on the N. W.—*ib.*

VINTAIN, a town ſituated about two miles up a creek on the ſouthern ſide of the river Gambia. It is much reſorted to by Europeans, on account of the great quantities of bees-wax which are brought hither for ſale. The wax is collected in the woods by the Feloops, a wild and unſociable race of people. Their country, which is of conſiderable extent, abounds in rice; and the natives ſupply the traders, both on the Gambia and Caſſamanſa rivers, with that article, and alſo with goats and poultry, on very reaſonable terms. The honey which they collect is chiefly uſed by themſelves in making a ſtrong intoxicating liquor, much the ſame as the mead which is produced from honey in Great Britain.

In their traffic with Europeans, the Feloops generally employ a factor, or agent, of the Mandingo nation, who ſpeaks a little Engliſh, and is acquainted with the trade of the river. This broker makes the bargain; and, with the connivance of the European, receives a certain part only of the payment; which he gives to his employer as the whole; the remainder (which is very truly called the *cheating money*) he receives when the Feloop is gone, and appropriates to himſelf as a reward for his trouble. Vintain, according to Mr Park, from whoſe valuable travels this account of the Feloops is taken, is ſituated in 13° 9′ North Lat. and 15° 56′ Long. Weſt from Greenwich.

VIPER *Key*, one of the Tortugas, on the coaſt of Florida; 5 miles N. eaſtward of Duck Key, and 3½ E. of Old Matacombe.—*Morſe.*

VIRGIL, a military townſhip of Onondago county, New-York, having Dryden on the W. Cincinnatus E. Homer N. and on the S. 230,000 acres of land on Suſquehannah river, ceded to the State of Maſſachuſetts. It is under the juriſdiction of Homer, which was incorporated in 1794.—*ib.*

VIRGIN GORDA, one of the principal of the Virgin Iſles, in the Weſt-Indies. It lies 4 leagues to the E. of Tortula, and of a very irregular ſhape. Its greateſt length from E. to W. is about 18 miles; is worſe watered than Tortula, and has fewer inhabitants. A mountain which riſes in the centre, is affirmed to contain a ſilver mine. N. lat. 18 18, W. long. 64.—*ib.*

VIRGIN *Iſlands*, a group of ſmall iſlands in the Weſt-Indies, to the eaſtward of the iſland of Porto Rico, belonging to different European powers. They extend for the ſpace of 24 leagues, from E. to W. and about 16 leagues from N. to S. and nearly approach the eaſt coaſt of Porto Rico. They are every way dangerous to navigators, though there is a baſon in the midſt of them of 6 or 7 leagues in length, and 3 or 4 in breadth, in which ſhips may anchor and be ſheltered and land-locked from all winds; which is named the Bay of Sir Francis Drake, from his having paſſed through them to St Domingo. Thoſe which are occupied and inhabited appear under their reſpective names; but others are deſtitute both of names and inhabitants. The Britiſh and Danes poſſeſs moſt of them; but the Spaniards claim thoſe near Porto Rico. The iſland of *Virgin Gorda*, on which depend Anegada, Nicker, Prickley Pear, Moſquito Iſlands, Camanoes, Dog-Iſlands, the Fallen City, the Round Rock, Ginger, Cooper's, Salt, Peter's and Dead Cheſt, belong to the *Britiſh*; as alſo *Tortola*, on which depend Joſt Van Dykes, Little Van Dykes, Guana, Beef, and Thatch Iſlands. To the *Danes* belong *St Thomas's Iſland*, on which Braſs, Little Saba, Buck Iſland, Great and Little St James, and Bird Iſland are dependant; with *St John's*, to which depend Lavango, Cam, and Witch Iſlands; and they have alſo Santa Iſland, or St Croix.

The *Spaniards* claim Serpent's Iſland, (called by the Britiſh Green Iſland) the Tropic Keys, Great and Little Paſſage Iſland, and particularly Crab Iſland. The Booby birds are ſo tame on Bird Iſland, that a man, it is ſaid, in a ſhort time, may catch ſufficient in his hand to ſupply a fleet. Theſe iſlands lie about lat. 18 20 N. and the courſe through them, with due attention, is perfectly ſafe at weſt by N. and weſt north weſt as far as the weſt end of the fourth iſland. Leave this on the ſtarboard ſide, and the iſland called Foul Cliff, on the larboard, between which there is 16 fathoms, and a free channel to the weſtward, before there is any alteration of the courſe; for though there be but ſix or ſeven fathoms in ſome places, it is no where ſhoaler, and in ſome places there is from 16 to 20 fathoms. The iſland of Anguilla, on the north ſide of St Martin's Iſland, is E. S. E. from them.—*ib.*

VIRGINITY, the teſt or criterion of a virgin; or that which intitles her to the denomination. See HYMEN, *Encycl.*

VIRGIN MARY *Cape*, the N. E. point of the entrance of the ſtraits of Magellan, in the S. Atlantic Ocean, is a ſteep white cliff. S. lat. 52 32, W. long. 67 54. The variation of the compaſs, in 1780, was 24 30, E.—*Morſe.*

VIRGIN *Rocks*, off the S. E. part of the coaſt of Newfoundland Iſland, 20 leagues S. E. of Cape Race. N. lat. 46, according to others, lat. 46 30, and theſe laſt ſay 17 or 18 leagues S. E. by E. of Cape Ballard. —*ib.*

VISION. In the article OPTICS, n° 154. (*Encycl.*), it is ſaid, that as we have a power of contracting or relaxing the *ligamenta ciliaria*, and thereby altering the form of the cryſtalline humour of the eye, we hence ſee objects diſtinctly at different diſtances. It appears, however, from ſome experiments made by Mr Everard Home and Mr Ramſden, in the year 1794, that this power of contracting and relaxing the ligamenta ciliaria is not alone ſufficient to account for the phenomenon. Converſing with Mr Home on the different uſes of the chryſtalline humour, Mr Ramſden ſaid, that as that humour "conſiſts of a ſubſtance of different denſities, the central parts being the moſt compact, and from thence diminiſhing in denſity gradually in every direction, approaching the vitreous humour on one ſide, and the aqueous humour on the other, its refractive power becomes nearly the ſame with that of the two contiguous ſubſtances. That ſome philoſophers have ſtated the uſe of the chryſtalline humour to be, for accommodating the eye to ſee objects at different diſtances; but the firmneſs of the central part, and the very ſmall difference between its refractive power near the circumference and that of the vitreous or the aqueous humour, ſeemed to render it unfit for that purpoſe; its principal uſe rather appearing to be for correcting the aberration ariſing from the ſpherical figure of the cornea, where the principal part of the refraction takes place, producing the ſame effect that, in an achromatic object-glaſs, we obtain in a leſs perfect manner by proportioning the radii of curvature of the different lenſes. In the eye the correction ſeems perfect, which in the object-glaſs can only be an approximation; the contrary aberrations of the lenſes not having the ſame ratio: ſo that, if this aberration be perfectly corrected, at any given diſtance from the centre, in every other it muſt be in ſome degree imperfect.

"Purſuing the ſame compariſon: In the achromatic object-glaſs we may conceive how much an object muſt appear fainter from the great quantity of light loſt by reflection at the ſurfaces of the different lenſes, there being as many primary reflections as there are ſurfaces; and it would be fortunate if this reflected light was totally loſt. Part of it is again reflected towards the eye by the interior ſurfaces of the lenſes; which, by diluting the image formed in the focus of the object glaſs, makes that image appear far leſs bright than it would otherwiſe have done, producing that milky appearance ſo often complained of in viewing lucid objects through this ſort of teleſcope.

"In the eye, the ſame properties that obviate this defect, ſerve alſo to correct the errors from the ſpherical figure, by a regular diminution of denſity, from the centre of the cryſtalline outward. Every appearance ſhews the cryſtalline to conſiſt of laminæ of different denſities; and if we examine the junction of different media, having a very ſmall difference of refraction, we ſhall find that we may have a ſenſible refraction without reflection. Now, if the difference between the contiguous media in the eye, or the laminæ in the cryſtalline, be very ſmall, we ſhall have refraction without having reflection: and this appears to be the ſtate of the eye; for although we have two ſurfaces of the aqueous, two of the cryſtalline, and two of the vitreous humour, yet we have only one reflected image; and that being from the anterior ſurface of the cornea, there can be no ſurface to reflect it back, and dilute an image on the retina.

"This hypotheſis may be put to the teſt whenever accident ſhall furniſh us with a ſubject having the cryſtalline extracted from one eye, the other remaining perfect in its natural ſtate; at the ſame time we may aſcertain whether or no the cryſtalline is that part of the organ which ſerves for viewing objects at different diſtances diſtinctly. Seeing no reflection at the ſurface of the cryſtalline, might lead ſome perſons to infer that its refractive power is very inconſiderable; but many circumſtances ſhew the contrary; yet what it really is may be readily aſcertained by having the focal length and diſtance of a lens from the operated eye, that enables it to ſee objects the moſt diſtinctly; alſo the focal length of a lens, and its diſtance from the perfect eye, that enables it to ſee objects at the ſame diſtance as the imperfect eye: theſe data will be ſufficient whereby to calculate the refractive power of the cryſtalline with conſiderable preciſion.

"Again, having the ſpherical aberration of the different humours of the eye, and having aſcertained the refractive power of the cryſtalline, we have data from whence to determine the proportional increaſe of its denſity as it approaches the central part, on a ſuppoſition that this property corrects the aberration.

"An opportunity preſented itſelf for bringing the obſervations of Mr Ramſden, reſpecting the uſe of the cryſtalline lens, to the proof. A young man came into St George's Hoſpital with a cataract in the right eye. The cryſtalline lens was readily extracted, and the union of the wound in the cornea took place unattended by inflammation; ſo that the eye ſuffered the

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ſmalleſt degree of injury that can attend ſo ſevere an operation. The man himſelf was in health, 21 years of age, intelligent, and his left eye perfect: the other had been an uncommonly ſhort time in a diſeaſed ſtate, and 27 days after the operation appeared to be free from every other defect but the loſs of the cryſtalline lens.

"A number of experiments were made on the imperfect eye, aſſiſted by a lens, and compared with the perfect eye. The aim of theſe trials, which were judiciouſly varied, was to aſcertain whether the eye which had been deprived of the cryſtalline lens was capable of adjuſting itſelf to diſtinct viſion at different diſtances. Among other reſults, the perfect eye, with a glaſs of $6\frac{1}{2}$ inches focus, had diſtinct viſion at 3 inches; the near limit was $1\frac{7}{8}$ inch, the diſtant limit leſs than 7 inches. The imperfect eye, with a glaſs $2\frac{2}{10}$ inches focus, with an aperture $\frac{3}{25}$ths of an inch, had diſtinct viſion at $2\frac{7}{8}$ inches, the near limit $1\frac{7}{8}$ inch, and the diſtant limit 7 inches. The accuracy with which the eye was brought to the ſame point, on repeating the experiment, proved it to be uncommonly correct; and as he did not himſelf ſee the ſcale uſed for admeaſurement, there could be no ſource of fallacy. From the reſult of this experiment, it appears that the range of adjuſtment of the imperfect eye, when the two eyes were made to ſee at nearly the ſame focal diſtance, exceeded that of the perfect eye. Mr Ramſden ſuggeſted a reaſon why the point of diſtinct viſion of the imperfect eye might appear to the man himſelf nearer than it was in reality; namely, that from the imperfection of this organ he might find it eaſier to read the letters when they ſubtended a greater angle than at his real point of diſtinct viſion. The experiments, however, appear to ſhew that the internal power of the eye, by which it is adjuſted to ſee at different diſtances, does not reſide in the cryſtalline lens, at leaſt not altogether; and that if any agency in this reſpect can be proved to reſide in the cryſtalline, the other powers, whatever they may be, are capable of exertion beyond their uſual limits, ſo as to perform its office in this reſpect.

"From theſe conſiderations, and in conſequence of other reflections tending to ſhew that an elongation of the optical axis is not probably the means of adjuſtment, theſe philoſophers directed their enquiries to aſcertain how far the curvature of the cornea might be ſubject to change. They found by trial that this part of the organ poſſeſſes a degree of elaſticity which is very conſiderable, both for its perfection and its range; and by anatomical diſſection it was found that the four ſtraight muſcles of the eye do in effect terminate in the cornea at their tendinous extremities; that the whole external lamina of the cornea could by gentle force be ſeparated, by means of theſe muſcles, from the eye; ſo that the tendons ſeem loſt in the cornea, and this laſt has the appearance of a central tendon. It was alſo ſeen that the central part of the cornea is the thickeſt and the moſt elaſtic.

"Theſe were conſiderable advances towards eſtabliſhing the hypotheſis of adjuſtment by the external curve of the eye. It remained to be ſhewn, by experiments on the living ſubject, that this curve does really vary in the due direction, when the mind perceives the diſtinct viſible ſenſation of objects at different diſtances. For this purpoſe Mr Ramſden provided an apparatus, conſiſting of a thick board ſteadily fixed, in which was a ſquare hole large enough to admit a perſon's face; the forehead and chin reſting againſt the upper and lower bars, and the cheek againſt either of the ſides; ſo that when the face was protruded, the head was ſteadily fixed by reſting on three ſides; and in this poſition the left eye projected beyond the outer ſurface of the board. A microſcope, properly mounted, ſo as with eaſe to be ſet in every requiſite poſition, was applied to view the cornea with a magnifying power of thirty times. In this ſituation, the perſon whoſe eye was the object of experiment was deſired to look at the corner of a chimney, at the diſtance of 235 yards, through a ſmall hole in a braſs plate, fixed for that purpoſe, and afterwards to look at the edge of the hole itſelf, which was only ſix inches diſtant. After ſome management and caution, which the delicate nature of theſe experiments requires, the motion of the cornea, which was immediately perceptible, became very diſtinct and certain. The circular ſection of its ſurface remained in a line with the wire in the field of the microſcope, when the eye was adjuſted to the diſtant object, but projected conſiderably beyond it when adapted to the near one. When the diſtant object was only 90 feet from the obſerver, and the near object ſix inches, the difference in the prominence of the cornea was eſtimated at 1-800th of an inch. Theſe experiments were repeated and varied at different times and on different ſubjects. The obſerver at the microſcope found no difficulty in determining, from the appearance of the cornea, whether the eye was fixed on the remote or the near object.

"From theſe different experiments Mr Home conſiders the following facts to have been aſcertained:

"1. That the eye has a power of adjuſting itſelf to different diſtances when deprived of the cryſtalline lens; and therefore the fibrous and laminated ſtructure of that lens is not intended to alter its form, but to prevent reflections in the paſſage of the rays through the ſurfaces of media of different denſities, and to correct ſpherical aberration.

"2. That the cornea is made up of laminæ; that it is elaſtic, and when ſtretched is capable of being elongated 1-11th part of its diameter, contracting to its former length immediately upon being left to itſelf.

"3. That the tendons of the four ſtraight muſcles of the eye are continued on to the edge of the cornea, and terminate, or are inſerted, in its external laminæ: their action will therefore extend to the edge of the cornea.

"4. That in changing the focus of the eye from ſeeing with parallel rays to a near diſtance, there is a viſible alteration produced in the figure of the cornea, rendering it more convex; and when the eye is again adapted to parallel rays, the alteration by which the cornea is brought back to its former ſtate is equally viſible."

Mr Home made many other experiments with a view to throw light upon this curious ſubject; and the reſult of the whole appears to be, that the adjuſtment of the eye is produced by three different changes in that organ; an increaſe of curvature in the cornea, an elongation of the axis of viſion, and a motion of the cryſtalline lens. Theſe changes, in a great meaſure, depend upon the contraction of the four ſtraight muſcles of the eye.

eye. Mr Ramſden, from computations grounded on the principles of optics and general ſtate of the facts, eſtimates that the increaſe of curvature of the cornea may be capable of producing one-third of the effect, and that the change of place of the lens, and elongation of the axis of viſion, ſufficiently account for the other two-thirds of the quantity of adjuſtment neceſſary to make up the whole.

The following obſervations on Viſion by Doctor David Hoſack of New-York, were read before the Royal Society, May 1, 1794, and the author has politely permitted their inſertion in this work.

" By what power is the eye enabled to view objects diſtinctly at different diſtances? As the pupil is enlarged or diminiſhed according to the greater or leſs quantity of light, and in a certain degree to the diſtance of the object, it would readily occur that theſe different changes of the pupil would account for the phænomena in queſtion. Accordingly anatomiſts and philoſophers, who have written upon this ſubject, have generally had recourſe to this explanation.

" Amuſing myſelf with theſe changes of the pupil, as a matter of curioſity, by preſenting to the eye different objects at different diſtances, I ſoon perceived that its contraction and dilatation were irregular and more limited than had been ſuppoſed; *i. e.* that approaching the object nearer the eye, within a certain diſtance, the pupil not only ceaſed to contract, but became again dilated; and that beyond a few yards diſtance, it alſo ceaſed to dilate: theſe circumſtances immediately occurred as objections to the above explanation; for were it from the contraction and dilatation of the iris alone that we ſee objects at different diſtances, I naturally concluded it ſhould operate regularly to produce its effects; but if to view an object at a few yards diſtance it be enlarged to the utmoſt extent, ſurely it muſt of itſelf be inſufficient to view one at the diſtance of ſeveral miles; for example, the heavenly bodies.

" Another difficulty here preſents itſelf: in viewing the ſun, inſtead of dilating, according to the diſtance, it contracts, obeying rather the quantity or intenſity of the light, than the diſtance of the object. Knowing no other obvious power in the eye itſelf of adapting it to the different diſtances of objects, it occurred to me to inquire, whether the combined action of the external muſcles could not have this effect. I firſt propoſed this query to an optician of eminence in London, and who has written expreſsly on this ſubject. I repeated the ſame queſtion to a celebrated teacher of anatomy. Encouraged by their replies, I have ſince attended more particularly to the ſubject, and hope my inquiries have not been altogether unſucceſsful. As introductory to a more diſtinct view of what I have to advance, it appears neceſſary to premiſe the following obſervations, relative to thoſe general laws of viſion which are more particularly connected with this part of the ſubject, and to which we ſhall have occaſion of frequent reference.

" 1ſt. Let ABC, (plate 3 appendix fig. 1.) be an object placed before the double convex lens DE, at any diſtance greater than the radius of the ſphere whereof the lens is a ſegment; the rays which iſſue from the different points of the object, and fall upon the lens, will be ſo bent by the refractive power of the glaſs as to be made to convene at as many other points behind the lens, and at the place of their concourſe they will form an image or picture of the object. The diſtance of the image behind the glaſs varies in proportion to the diſtance of the object before the glaſs; the image approaching as the object recedes, and receding as that approaches. For if we ſuppoſe, (fig. 2.), A and B two radiating points, from which the rays AC, AD, and BC, BD, fall upon the lens CD, it is manifeſt that the rays from the neareſt point A diverge more than thoſe from the more diſtant point B, the angle at A being greater than that of B (A); conſequently the rays from A, whoſe direction is AE and AF when they paſs through the glaſs, muſt convene at ſome point (as G) more diſtant from the lens than the point H, where the leſs diverging rays BK and BL from the point B are made to convene; which may alſo be proved by experiment with the common convex glaſs (B).

" It will be neceſſary to have this propoſition in view, as we ſhall afterwards have occaſion to uſe it in ſhewing, that by varying the diſtance between the retina and the anterior part of the eye we are enabled to ſee objects at different diſtances.

" 2d. If an object, as AB, (fig. 3.) be placed at a proper diſtance before the eye (E), the rays which fall from the ſeveral points of the object falling upon the cornea paſs through the pupil, and will be brought together by the refractive power of the different parts of the eye on as many correſponding points of the retina, and there paint the image of the object, in the ſame manner as the images of objects placed before a convex lens are painted upon the ſpectrum, placed at a proper diſtance behind it; thus the rays which flow from the point A are united on the retina at C, and thoſe which proceed from B are collected at D, and the rays from all the intermediate points are convened at as many intermediate points of the retina; on this union of the rays at the retina depends diſtinct viſion. But ſuppoſing the eye of a given form, ſhould the point of union lie beyond the retina, as muſt be the caſe with thoſe from the leſs diſtant object, agreeable to the preceding propoſition; or ſhould they be united before they arrive at the retina, as from the more diſtant object, it is evident that the picture at the retina muſt be extremely confuſed. Now as the rays which fall upon the eye from radiating points at different diſtances have different degrees of divergence, and the divergence of the rays increaſing as the diſtance of the radiating point leſſens, and, *vice verſa*, leſſening as that increaſes; again, as thoſe rays which have greater degrees of divergence, viz. from the nearer objects, require a ſtronger refractive power to bring them together at a given diſtance than what is neceſſary to make thoſe meet which diverge leſs, it is manifeſt, that to ſee objects diſtinctly at different diſtances, either the refractive power of the eye muſt be increaſed or diminiſhed, or the diſtance between the iris and retina be varied, correſponding with the different diſtances of the objects; both

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(A) *Euclid*, Book I. Prop. 21.

(B) See *Kepler* Diopt. Poſtul. *Smith's Optics*, *Graveſande*, &c.

both of which probably take place, as will hereafter appear (c).

"Having then eſtabliſhed theſe as our premiſes, we ſhall next examine the different principles which have been employed for explaining viſion at different diſtances.

"Moſt writers upon this ſubject refer this power of the eye to the contraction and dilatation of the iris. Within certain limits this would, upon firſt examination, as already obſerved, appear to be the caſe, ſince the pupil enlarges as the object is further removed from the eye, and again contracts as it is brought near. The extent of this principle I have already pointed out; but I ſuſpect we alſo err in attributing to the difference of diſtance what are only effects of different quantities of light, a circumſtance in which it is the more eaſy to commit error as they are generally proportionate one to the other; *i. e.* as the object is near we require a leſs degree of light, and to exclude what is ſuperfluous the iris contracts; but as it is more diſtant, a greater quantity of light becomes neceſſary, and the iris dilates: thus far we ſee the uſe of the enlargement or diminution of the pupil, as the object is more or leſs diſtant. But diſtinct viſion does not conſiſt in the quantity of light alone, though too much or too little would obſcure the image.

"It is alſo neceſſary that the rays which flow from the object ſhould fall upon the retina in a certain direction, to form a diſtinct picture; but ſurely the greater or leſs quantity of light, the greater or leſs number of rays, which it is only the property of the iris to diminiſh or increaſe, cannot alter the direction.

"But there is ſtill another argument to prove, that the contraction or enlargement of the pupil is not of itſelf ſufficient to produce diſtinct viſion at different diſtances, viz. that the myopes, whoſe pupil contracts and dilates as in other eyes, are ſtill unable to adapt the eye to different diſtances; and the means by which this is remedied certainly does not conſiſt in a larger or ſmaller aperture for the rays to paſs through, but a power of altering their direction, which the change in the ſhape of the eye had rendered too convergent. The ſame fact is alſo obſervable in thoſe who ſquint; the pupil in both eyes equally contracts and dilates, but ſtill the viſion of one eye is leſs perfect than the other. Another principle upon which it has been attempted to explain this power of the eye, is a ſuppoſed change in the convexity of the cryſtalline lens; the ancients had ſome obſcure notion of it, but it has been lately purſued by Mr Thomas Young, in a paper publiſhed in the Philoſophical Tranſactions of London for 1793. He has endeavoured to demonſtrate the exiſtence of muſcles in the cryſtalline lens, and by their action to account for diſtinct viſion at different diſtances. This opinion deſerves here the more particular examination, having met the attention of the Royal Society, and thereby likely to influence the general opinion upon this ſubject.

"That we may not miſtake the meaning of the author, I beg leave to premiſe his deſcription of the ſtructure of the lens. 'The cryſtalline lens of the ox,' he obſerves, 'is an orbicular convex tranſparent body, compoſed of a conſiderable number of ſimilar coats, of which the exterior cloſely adhere to the interior; each of theſe coats conſiſts of ſix muſcles, intermixed with a gelatinous ſubſtance, and attached to ſix membranous tendons. Three of theſe tendons are anterior, three poſterior; their length is about two-thirds of the ſemidiameter of their coat; their arrangement is that of three equal and equidiſtant rays meeting in the axis of the cryſtalline; one of the anterior is directed towards the outer angle of the eye, and one of the poſterior towards the inner angle; ſo that the poſterior are placed oppoſite to the middle of the interſtices of the anterior, and planes paſſing through each of the ſix, and through the axis, would mark on either ſurface ſix regular equidiſtant rays. The muſcular fibres ariſe from both ſides of each tendon, they diverge till they reach the greateſt circumference of the coat, and having paſſed it, they again converge till they are attached reſpectively to the ſides of the neareſt tendons of the oppoſite ſurface. The exterior or poſterior portion of the ſix, viewed together, exhibits the appearance of three penniformiradiated muſcles.'

"In the firſt place, to ſay nothing of the tranſparency of muſcles, as an argument againſt their exiſtence, we muſt unavoidably ſuppoſe, as they have *membranous tendons*, which Mr Young informs us he diſtinctly obſerved, that theſe tendons cannot poſſeſs the ſame degree of tranſparency and denſity with the bellies of theſe muſcles; that is, they muſt poſſeſs ſome degree of opacity, or certainly he could not have pointed out their membranous ſtructure, nor even the tendon itſelf, as diſtinct from the body of the muſcle; and if they have not the ſame denſity, from their ſituation, and being of a penniform ſhape, muſt there not be ſome irregularity from the difference in the refraction of thoſe rays which paſs through the bellies of thoſe muſcles, and thoſe again which paſs through their membranous tendons? This ſtructure then, of conſequence, cannot be well adapted for a body whoſe regular ſhape and tranſparency are of ſo much conſequence.

"Again, Mr Young deſcribes ſix muſcles in each layer; but Leeuwenhoek, whoſe authority he admits as accurate, relative to the muſcularity of the lens, is certainly more to be attended to in his obſervation of bodies leſs minute, viz. as to the layers themſelves, in which theſe muſcles are found, and which of courſe are larger, and more eaſily obſerved; but, with his accuracy of obſervation, he has computed, that there are near 2000 laminæ; and according to Mr Young, ſuppoſing each layer to contain ſix muſcles, we have neceſſarily, in all, 12,000 muſcles; the action of which certainly exceeds human comprehenſion. I hope this will not be deemed trifling minuteneſs, as it is a neceſſary and regular conſequence, if we admit their exiſtence as deſcribed.

"But

(c) "Facile enim intelligitur, quo longius radii adveniunt, eo magis eſſe parallelos; eo minus ergo differre ab axi, et eo minoribus viribus corneæ et lentis cryſtallinæ in focum cogi. Ut enim corpus magis diſtat, ita ſub minori angulo radii adveniunt. Contra ſi corpus conſpicuum valde vicinum fuerit, radiorum ab eo advenientium angulus eſt major, et adeo magis divergentes in oculum incidunt, et viribus egent refringentibus majoribus omnibus denſioribus."—*Haller, Elem. Phyſ.* lib. xvi.

“ But ſecondly, as to the exiſtence of theſe muſcles, I cannot avoid expreſſing a doubt. With the utmoſt accuracy I was capable of, and with the aſſiſtance of the *beſt* glaſſes, to my diſappointment, I cannot bear witneſs to the ſame circumſtances related by Mr Young, but found the lens perfectly tranſparent; at the ſame time, leſt it might be attributed to the want of habit in looking through glaſſes, I beg leave to obſerve, that I have been accuſtomed to the uſe of them in the examination of the more minute objects of natural hiſtory. After failing with the glaſſes in the natural viſcid ſtate of the lens, I had recourſe to another expedient; I expoſed different lenſes before the fire to a moderate degree of heat, by which they became opaque and dry; in this ſtate it is eaſy to ſeparate the layers deſcribed by Mr Young; but although not ſo numerous as noticed by the accurate Leeuwenhoek, ſtill they were too numerous to ſuppoſe each to have contained ſix muſcles; for I could have ſhewn diſtinctly at leaſt fifty layers, without the aſſiſtance of a glaſs, as was readily granted by thoſe to whom I exhibited them.

“ But a circumſtance which would ſeem to prove that theſe layers poſſeſs no diſtinct muſcles is, that in this opaque ſtate they are not viſible, but conſiſt rather of an almoſt infinite number of concentric fibres (if the term be at all appropriate) not divided into particular bundles, but ſimilar to as many of the fineſt hairs of equal thickneſs, arranged in ſimilar order: ſee fig. 4, 5, and 6, where the arrangement of the layers and fibres has been painted from the real lens of an ox, and that without the aſſiſtance of a glaſs. To obſerve this fact, any perſon may try the experiment at pleaſure, and witneſs the ſame with the naked eye, even ſeparating many layers and their fibres with the point of a penknife.

“ This regular ſtructure of layers, and thoſe conſiſting of concentric fibres, is unqueſtionably better adapted for the tranſmiſſion of the rays of light, than the irregular ſtructure of muſcles. It may, perhaps, be urged, that the heat to which I expoſed the lens may have changed its ſtructure: in anſwer to that I obſerve, it was moderate in degree, and regularly applied; of conſequence we may preſume, as it appeared uniformly opaque, that every part was alike acted upon; but by boiling the lens, where the heat is, without doubt, regularly applied, we obſerve the ſame ſtructure.

“ Thirdly, that it is not from any changes of the lens, and that this is not the moſt eſſential organ in viewing objects at different diſtances, we may alſo infer from this undeniable fact, that we can, in a great degree, do without it; as after couching or extraction, by which operations all its parts muſt be deſtroyed, capſule, ciliary proceſſes, muſcles, &c.

“ Mr Young aſſerts, from the authority of Dr Porterfield, that patients, after the operation of couching, have not the power of accommodating the eye to the different diſtances of objects; at preſent, I believe the contrary fact is almoſt univerſally aſſerted (d).

“ Beſides, if the other powers of the eye are inſufficient to compenſate for the loſs of this denſe medium, the lens, a glaſs of the ſame ſhape anſwers the purpoſe, and which certainly does not act by changing its figure. I grant their viſion is not ſo perfect; but we have other circumſtances upon which this can be more eaſily explained; which will be particularly noticed under the next head. It may not be improper alſo to obſerve, that the ſpecific gravity of the cryſtalline compared with that of the vitreous humour, and of conſequence, its denſity and power of refraction, is not ſo great as has been generally believed. Dr Bryant Robinſon, by the hydroſtatic balance, found it to be nearly as 11 to 10. I have alſo examined them with the inſtrument of Mr Schmeiſſer, lately preſented to the Royal Society, and found the ſame reſult; of conſequence the cryſtalline lens is not ſo eſſentially neceſſary for viſion as has been repreſented; eſpecially as it is alſo probable, that upon removing it, the place which it occupied is again filled by the vitreous humour, whoſe power of refraction is nearly equal. At the ſame time we cannot ſuppoſe the lens an unneceſſary organ in the eye, for nature produces nothing in vain; but that it is not of that indiſpenſable importance, writers upon optics have taught us to believe.

“ Fourthly, Mr Young tells us, he has not yet had an opportunity of examining the human cryſtalline; and grants, that from the ſpherical form of it in the fiſh, ſuch a change as he attributes to the lens in quadrupeds cannot take place in that claſs of animals. The lenſes which I have examined in the manner abovementioned were the human, thoſe of the ox, the ſheep, the rabbit, and the fiſh, and in all the ſame lamellated ſtructure is obſervable; even in the ſpherical lens of the fiſh theſe lamellæ are equally diſtinct, but without the ſmalleſt appearance of a muſcle.

“ From theſe circumſtances I cannot avoid the concluſion, that they do not exiſt; at the ſame time I am perſuaded that Mr Young met with appearances which he ſuppoſed were muſcles; but I am ſatisfied he will readily acknowledge, that the examination of the cryſtalline lens in its viſcid glutinous ſtate, is not only attended with much difficulty, but that the ſmalleſt change of circumſtances might lead to error; which I apprehend may, probably, have been the caſe in that inſtance.

“ Upon examining it after boiling, or expoſing it to a gradual degree of heat before the fire, when it may be handled with freedom, he will readily obſerve (without a glaſs) the numerous lamellæ, and the arrangement of their fibres, which I have deſcribed.

“ Another opinion has been ſanctioned by many reſpectable writers, of the effects of the ciliary proceſſes in changing the ſhape and ſituation of the lens; ſome

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(d) “ Et lente ob cataractam extracta vel depoſita oculum tamen ad varias diſtantias videre, ut in nobili viro video abſque ullo experimento quo eam facultatem recuperaverit. Etſi enim tunc ob diminutas vires quæ radios uniunt, æger lente vitrea opus habet, eadem tamen lens in omni diſtantia ſufficit.”—*Haller, El. Phyſ.*

“ La lentille criſtalline n'eſt cependant point de première neceſſité pour la viſion. Aujourd'hui, dans l'opération de la cataracte on l'enlève entièrement, et la viſion n'en ſouffre point.”—*De la Metherie Vues Phyſiologiques.* See alſo *De la Hire, Hamberger Phyſiolog.*

Viſion. ſuppoſed it to poſſeſs the power of changing the figure of the cryſtalline, rendering it more or leſs convex (E); others, that it removed it nearer to the cornea (F); and others, that it removed it nearer the retina (G).

" The advocates for theſe different opinions all agree in attributing theſe effects to a ſuppoſed muſcularity of the ciliary proceſſes.

" Of the ſtructure of theſe proceſſes Haller obſerves, ' In omni certe animalium genere proceſſus ciliares abſque ulla muſculoſa ſunt fabrica, mere vaſculoſi vaſculis ſerpentinis percurſi molli facti membrana.' Which ſtructure, I believe, at preſent is univerſally admitted. But even ſuppoſing them muſcular, ſuch is their delicacy of ſtructure, their attachment, and direction, that we cannot poſſibly conceive them adequate to the effects aſcribed to them. Beſide, what we obſerved of the muſcles of the lens itſelf, alſo applies to the proceſſes, viz. that they may be deſtroyed, as in couching or extraction, and yet the eye be capable of adapting itſelf to the different diſtances of objects. For a more full refutation of theſe opinions, ſee Haller's large work.

The Situation, Structure, and Action of the external Muſcles (H).

" Upon carefully removing the eyelids, with their muſcles, we are preſented with the muſcles of the eye itſelf, which are ſix in number; four called recti, or ſtraight; and two oblique; ſo named from their direction, (ſee Pl. 3. Appen. fig. 4.) AAAA, the tendons of the recti muſcles, where they are inſerted into the ſclerotic coat, at the anterior part of the eye. B, the ſuperior oblique, or trochlearis, as ſometimes called, from its paſſing through the loop or pulley connected to the lower angle of the orbiter notch in the os frontis; it paſſes under the ſuperior rectus muſcle, and backwards to the poſterior part of the eye, where it is inſerted by a broad flat tendon into the ſclerotic coat. C, the inferior oblique, ariſing tendinous from the edge of the orbiter proceſs of the ſuperior maxillary bone, paſſes ſtrong and fleſhy over the inferior rectus, and backwards under the abductor to the poſterior part of the eye, where it is alſo inſerted by a broad flat tendon into the ſclerotic coat. DDD, the fat in which the eye is lodged. In fig. 5. we have removed the bones forming the external ſide of the orbit, with a portion of the fat, by which we have a diſtinct view of the abductor. ABC, three of the recti muſcles, ariſing from the back part of the orbit, paſſing ſtrong, broad, and fleſhy over the ball of the eye, and inſerted by flat, broad tendons into the ſclerotic coat, at its anterior part. D, the tendon of the ſuperior oblique muſcle. E, the inferior oblique, fig. 6. A, the abductor of the eye. B, the fleſhy belly of the ſuperior oblique, ariſing ſtrong, tendinous, and fleſhy from the back part of the orbit. C, the optic nerve. D and E, the recti muſcles.

" The uſe aſcribed to theſe different muſcles, is that of changing the direction of the eye, to turn it upwards, downwards, laterally, or in any of the intermediate directions, accommodated either to the different ſituation of objects, or to expreſs the different paſſions of the mind, for which they are peculiarly adapted. But is it inconſiſtent with the general laws of nature, or even with the animal œconomy, that from their combination they ſhould have a different action, and thus an additional uſe? To illuſtrate this we need only witneſs the action of almoſt any ſet of muſcles in the body; for example, in lifting a weight, the combined action of the muſcles of the arm, ſhoulder, and cheſt, is different from the individual action of either ſet, or of any individual muſcle; or an inſtance nearer our purpoſe may be adduced, viz. the actions of the muſcles of the cheſt and belly, making a compreſſion upon the viſcera, as in the diſcharge of urine, fæces, &c. But to queſtion this fact would be to queſtion the influence of the will in any one of the almoſt infinite variety of motions in the human body.

" I preſume, therefore, it will be admitted that we have the ſame power over theſe muſcles of the eye as of others, and I believe we are no leſs ſenſible of their combined action; for example, after viewing an object at the diſtance of half a mile, if we direct our attention to an object but ten feet diſtance, every perſon muſt be ſenſible of ſome exertion; and if our attention be continued but for a ſhort time, a degree of uneaſineſs and even pain in the ball of the eye is experienced; if again we view an object within the focal diſtance, *i. e.* within ſix or ſeven inches, ſuch is the intenſity of the pain that the exertion can be continued but a very ſhort time, and we again relieve it by looking at the more diſtant objects; this, I believe, muſt be the experience of every perſon, whoſe eyes are in the natural and healthy ſtate, and accordingly has been obſerved by almoſt every writer upon optics.

" But the power of this combination, even from analogy, appears too obvious to need further illuſtration. I ſhall therefore next endeavour to point out their preciſe action.

" Suppoſing the eye in its horizontal natural poſition; I ſee an object diſtinctly at the diſtance of ſix feet, the picture of the object falls exactly upon the retina; I now direct my attention to an object at the diſtance of ſix inches, as nearly as poſſible in the ſame line; although the rays from the firſt object ſtill fall upon my eye, while viewing the ſecond, it does not form a diſtinct picture on the retina, although at the ſame diſtance as before, which ſhews that the eye has undergone ſome change; for while I was viewing the firſt object I did not ſee the ſecond diſtinctly, although in the ſame line: and now, *vice verſa*, I ſee the ſecond diſtinctly, and not the firſt; the rays from the firſt, therefore, as they ſtill fall upon the eye, muſt either meet before or behind the retina; but we have ſhewn that the rays from the more diſtant object convene ſooner than thoſe from the leſs

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(E) *Des Cartes*, *Scheinerus*, *Bidious*, *Mollinettus*, *Sanctorius*, *Jurin*.

(F) *Kepler*, *Zinn*, *Porterfield*.

(G) *La Chariere*, *Perrault*, *Hartſocker*, *Briſſeau*, and *Derham*.

(H) For the accuracy of the repreſentation I have annexed (in Pl. 3. Appen.) I can vouch, having been at much pains in the diſſection; from which I had the painting taken by a moſt accurate hand, Mr S. Edwards, a gentleman well known for his abilities in the plates of that admirable work, the Flora Londinenſis.

leſs diſtant object, therefore the picture of the object at ſix feet falls before, while the other forms a diſtinct image upon the retina; but as my eye is ſtill in the ſame place as at firſt, the retina has by ſome means or other been removed to a greater diſtance from the fore part of the eye to receive the picture of the nearer object, agreeable to the principle page 455. From which it is evident, that to ſee the leſs diſtant object either the retina ſhould be removed to a greater diſtance, or the refracting power of the media ſhould be increaſed: but I hope we have ſhewn that the lens, which is the greateſt refracting medium, has no power of changing itſelf. Let us next inquire, if the external muſcles, the only remaining power the eye poſſeſſes, are capable of producing thoſe changes. With reſpect to the anterior part of the eye, we have ſeen the ſituation of thoſe muſcles; the recti ſtrong, broad, and flat, ariſing from the back part of the orbit, paſſing over the ball as over a pulley, and inſerted by broad flat tendons at the anterior part of the eye; the oblique inſerted toward the poſterior part, alſo by broad flat tendons; when they act jointly, the eye being in its horizontal poſition, it is obvious, as every muſcle in action contracts itſelf, the four recti by their combination muſt neceſſarily make a compariſon upon the different parts of the eye, and thus elongate its axis, while the oblique muſcles ſerve to keep the eye in its proper direction and ſituation. For my own part, I have no more difficulty in conceiving of this combination of thoſe muſcles than I have at preſent of the different flexors of my fingers in holding my pen. But other correſponding effects are alſo produced by this action; not only the diſtance between the anterior and poſterior parts of the eye is increaſed, but of conſequence the convexity of the cornea, from its great elaſticity, is alſo increaſed, and that in proportion to the degree of preſſure, by which the rays of light paſſing through it are thence neceſſarily more converged. But another effect, and one not inconſiderable, is, that by this elongation of the eye, the media, viz. the aqueous, cryſtalline, and vitreous humours through which the rays paſs, are alſo lengthened, of conſequence their powers of refraction are proportionably increaſed; all which correſpond with the general principle. It may however be ſaid, that as the four recti muſcles are larger and ſtronger than the two oblique, the action of the former would overcome that of the latter, and thus draw back the whole globe of the eye; but does not the fat at the poſterior part of the orbit alſo afford a reſiſtance to the too great action of the recti muſcles, eſpecially as it is of a firm conſiſtence, and the eye reſts immediately upon it? Admitting then that this is the operation of the external muſcles when in a ſtate of contraction, it is alſo to be obſerved, we have the ſame power of relaxing them, in proportion to the greater diſtance of the object, until we arrive at the utmoſt extent of indolent viſion.

" But, as a further teſtimony of what has been advanced, I had recourſe to the following experiment, which will ſhew that the eye is eaſily compreſſible, and that the effects produced correſpond with the principles I have endeavoured to illuſtrate.

" With the common *ſpeculum oculi* I made a very moderate degree of preſſure upon my eye, while directing my attention to an object at the diſtance of about twenty yards; I ſaw it diſtinctly, as alſo the different intermediate objects; but endeavouring to look beyond it, every thing appeared confuſed. I then increaſed the preſſure conſiderably, in conſequence of which I was enabled to ſee objects diſtinctly at a much nearer than the natural focal diſtance; for example, I held before my eye, at the diſtance of about two inches, a printed book; in the natural ſtate of the eye I could neither diſtinguiſh the lines nor letters; but upon making preſſure with the ſpeculum I was enabled to diſtinguiſh both lines and letters of the book with eaſe.

" Such then I conceive to be the action and effects of the external muſcles, and which I apprehend will alſo apply in explaining many other phænomena of viſion; ſome of thoſe it will not be improper at preſent briefly to notice.

" Firſt, may not the action of thoſe muſcles have more or leſs effect in producing the changes of viſion which take place in the different periods of life? At the ſame time the original conformation of the eye, the diminution of its humours, and, probably, of the quantity of fat upon which the eye is lodged, are alſo to be taken into the account. But the external muſcles becoming irregular and debilitated by old age, in common with every other muſcle of the body, are not only incapable of compenſating for theſe loſſes, but cannot even perform their wonted action, and thus neceſſarily have conſiderable influence in impairing viſion. Again, does not the habit of long ſight ſo remarkable in ſailors and ſportſmen, who are much accuſtomed to view objects at a great diſtance, and that of ſhort ſight, as of watchmakers, ſeal-cutters, &c. admit of an eaſy ſolution upon this principle? as we know of no part of the body ſo ſuſceptible of an habitual action as the muſcular fibre.

" Secondly. How are we to account for the weaker action of one eye in the caſe of ſquinting? That this is the fact has been well aſcertained; Dr Reid(1) upon this ſubject obſerves, that he has examined above twenty perſons that ſquinted, and found in all of them a defect in the ſight of one eye. Porterfield and Jurin have made the ſame obſervation.

" The diſtorted poſition of the eye has, I believe, been generally attributed to the external muſcles; but no ſatisfactory reaſon has ever been given why the eye, directed towards an object, does not ſee it diſtinctly at the ſame diſtance as with the other. The ſtate of the iris here cannot explain it, as it contracts and dilates in common with the other; nor can we ſuppoſe any muſcles the lens might poſſeſs could have any effect, as they are not at all connected with the nature of this diſeaſe.

" But the action of the external muſcles, I apprehend, will afford us a ſatisfactory explanation. When the eye is turned from its natural direction, for example, towards the inner canthus, it is obvious that the *adductor* muſcle is ſhortened, and its antagoniſt, the *abductor*, lengthened; conſequently, as the abductor has not the ſame power of contracting itſelf with the adductor, when the eye is directed towards an object, their power of action being different and irregular, the

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(1) See his Inquiry into the Human Mind, page 322.

compreſſion made upon the eye and its humours muſt alſo be equally irregular, and therefore inſufficient to produce the regular changes in the refraction and ſhape of the eye we have ſhewn to be neceſſary in adapting it to the different diſtances of objects. The effects produced by making a partial preſſure upon the eye with the finger, or *ſpeculum oculi*, before noticed, would alſo appear to favour this explanation.

“ Thirdly. May it not in part be owing to the loſs of this combined action of the external muſcles, and the difficulty of recovering it, that the operation of couching is ſometimes unſucceſsful, eſpecially when the cataract has been of long ſtanding? This cannot be attributed to the iris, for it perhaps, dilates and contracts as before: nor to the muſcles of the lens, for they are removed; nor to the ſtate of the nerve, for it is ſtill ſenſible to light; and yet the patient cannot ſee objects diſtinctly; and it is not an uncommon circumſtance, even when the operation ſucceeds, that the ſight is ſlowly and gradually recovered. Inſtances have occurred, Mr Bell (k) obſerves, of the ſight becoming gradually better for ſeveral months after the operation.

“ When we have been long out of the habit of combining our muſcles in almoſt any one action of life, as walking, dancing, or playing upon a muſical inſtrument, we in a great meaſure loſe the combination, and find a difficulty in recovering it, in proportion to the length of time we had been deprived of it; but the individual action of each muſcle remains as before. Thus, probably, with the muſcles of the eye. A variety of facts of a ſimilar nature muſt preſent themſelves to every perſon converſant in the ſcience of optics, which may admit of a ſimilar explanation.

“ I have thus endeavoured, firſt, to point out the limited action of the iris, and of conſequence the inſufficiency of this action for explaining viſion. Secondly, to prove that the lens poſſeſſes no power of changing its form to the different diſtances of objects. Thirdly, that to ſee objects at different diſtances, correſponding changes of diſtance ſhould be produced between the retina and the anterior part of the eye, as alſo in the refracting powers of the media through which the rays of light are to paſs. And, fourthly, that the combined action of the external muſcles is not only capable of producing theſe effects, but that from their ſituation and ſtructure they are alſo peculiarly adapted to produce them.

“ It is not then conſiſtent with every principle in the œconomy of nature and of philoſophy, ſeeing the imperfections of the principles which have hitherto been employed in explaining the phænomena in queſtion, to adopt the one before us, until (agreeable to one of the eſtabliſhed rules in philoſophizing) other phænomena occur, by which it may be rendered either more general, or liable to objections?

“ I have now finiſhed what was propoſed. I have declined entering into an extenſive view of the ſtructure of the eye, or any of the general principles of optics, as thoſe ſubjects have been more ably treated in the works already cited, and thus would certainly have deſtroyed every claim to attention, which theſe few pages in their preſent form may poſſibly poſſeſs; and if I ſhould be ſo fortunate as to ſucceed in eſtabliſhing the principle I have propoſed, for explaining the phænomena dependent upon this more important organ of our body (if any part poſſeſſes a pre-eminence in nature), I alſo hope it may, in abler hands, admit of ſome practical application, in alleviating the diſeaſes to which its delicate organization ſo particularly expoſes it (l).”

VITALITY, the power of ſubſiſting in life, which the faſhionable philoſophers of the French and German ſchools attribute to *chemiſtry*. For a confutation of their abſurd and impious jargon on this ſubject, we refer our readers, with ſome degree of confidence, to the articles PHYSIOLOGY (*Encycl.*), and *Animal* SUBSTANCES (*Suppl.*)

VITTORIA, *St Juan de*, a city of Peru.—*Morſe.*

VIVERRA (ſee *Encycl.*) A new ſpecies of this genus of animals was diſcovered by Vaillant during his laſt travels in Africa; at leaſt he ranks under the generic name *Viverra*, the animal of which he gives the following deſcription. Its body was of the ſize of that of a kitten ſix months old: it had a very large noſe, the upper jaw exceeding the lower near two-thirds of an inch in length, and forming a ſort of moveable ſnout reſembling that of the *coati* of Guiana. The fore feet were armed with four large claws, very ſharp and curved; the hind ones have each five, but they are ſhort and blunt. All the fur on the upper part of the body is marked with croſs bands of a deep brown colour, on a ground of light brown with which many white hairs are intermixed. The lower part of the body and inſides of the legs are of a reddiſh white. The tail, which is very fleſhy, and more than two-thirds longer than the body, is black at the tip, and the reſt brown, intermixed with white hairs.

This animal employs its fore paws to dig very deep holes in the earth, in which it remains concealed during the day, not going out till ſun-ſet in queſt of food.

The Hottentots who accompanied our traveller called it *muys-hond* (a mouſe dog); a general name among the inhabitants of the Cape for all the ſmaller carnivorous quadrupeds.

VIVES (Ludovicus), the contemporary and friend of Eraſmus, was a native of Valentia in Spain. Though well trained in all the ſubtleties of the ſcholaſtic philoſophy at Paris, he had the good ſenſe to diſcover its futility, and diligently applied himſelf to more uſeful ſtudies. At Louvain he undertook the office of a preceptor, and exerted himſelf with great ability and ſucceſs in correcting barbariſm, chaſtiſing the corrupters of learning,

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(k) See his Syſtem of Surgery.

(l) Since the above pages have been written, I have found, upon conſulting ſome of the earlieſt writers, that the effects of the external muſcles did not altogether eſcape their attention; at the ſame time they had no diſtinct idea of their action: I muſt therefore diſclaim the originality of the thought, although I had never met with it before the circumſtances already noticed, of the inſufficiency of the iris, had ſuggeſted it. If, however, I have ſucceeded in pointing out the preciſe action of thoſe muſcles, and its application to the general principles of viſion, in which, I believe, I have never been anticipated, it will be the height of my wiſhes.

learning, and reviving a taſte for true ſcience and elegant letters. Eraſmus, with whom he lived upon the footing of intimate friendſhip, ſpeaking of Vives when he was only 26 years of age, ſays, that there was no part of philoſophy in which he did not excel; and that he had made ſuch proficiency in learning, and in the arts of ſpeaking and writing, that he ſcarcely knew his equal. He wrote a commentary upon Auguſtine's treatiſe *De Civitate Dei*, which diſcovers an extenſive acquaintance with ancient philoſophy. Henry VIII. of England, to whom he dedicated this work, was ſo pleaſed with it, that he invited the author to his court, and made him preceptor to his daughter Mary. Though he diſcharged his office with great fidelity, yet in conſequence of his oppoſition to the king's divorce, he fell under his diſpleaſure; and it was not without difficulty that he eſcaped to Bruges, where he devoted the remainder of his days to ſtudy. He died in the year 1537, or, according to Thuanus, in 1541. With Eraſmus and Buddæus he formed a triumvirate of literature which did honour to the age. He wrote *De Prima Philoſophia*, "On the Firſt Philoſophy;" *De Explanatione Eſſentiarum*, "On the Explanation of Eſſences;" *De Cenſura Veri*, "On the Teſt of Truth;" *De Initiis, Sectis, et Laudibus Philoſophiæ*, "On the Origin, Sects, and Praiſes of Philoſophy;" and *De Corruptis Artibus et Tradendis Diſciplinis;* "On the Corruption of Science, and on Education." Theſe writings, of which the two laſt are the moſt valuable, diſcover great ſtrength of judgment, an extenſive knowledge of philoſophy, much enlargement of conception, uncommon ſagacity in detecting the errors of ancient and modern philoſophers, particularly of Ariſtotle and his followers, and, in fine, a mind capable of attempting things beyond the ſtandard of the age in which he lived. To all this he added great perſpicuity and elegance of ſtyle, not unworthy of the friend of Eraſmus.

ULIETEA, one of the Society Iſlands in the S. Pacific Ocean, is about 7 or 8 leagues from the iſland of Huaheine, at S. W. by W. There are 9 uninhabited iſlands weſt of it. The ſouth end lies in lat. 16 55 S. and long. 151 20 W.—*Morſe.*

ULSTER, a mountainous and hilly county of New-York, containing all that part of the State bounded eaſterly by the middle of Hudſon's river, ſoutherly by the county of Orange, weſterly by the ſtate of Pennſylvania, and the weſt branch of Delaware river, and northerly by the county of Albany. In 1790, it contained 29,397 inhabitants, including 2,906 ſlaves. In 1796, there were 4,429 of the inhabitants qualified to be electors. It is divided into 16 townſhips. Chief town, Kingſton. A part of this county and that of Otſego, were erected into a ſeparate county, January, 1797.—*ib.*

ULTRAMARINE is a very fine blue powder, almoſt of the colour of the corn flower or blue-bottle, which has this uncommon property, that, when expoſed to the air or a moderate heat, it neither fades nor becomes tarniſhed. On this account it is uſed in painting; but it was employed formerly for that purpoſe much more than at preſent, as ſmalt, a far cheaper article, was not then known. (See Cobalt, in this *Suppl.*) Ultramarine is made of the blue parts of the lapis lazuli, by ſeparating them as much as poſſible from the other coloured particles with which they are mixed, and reducing them to a fine powder. The real lapis lazuli is found in the mountains of that part of Tartary called Bucharia, which extends eaſtward from the Caſpian ſea, and particularly at Kalab and Budukſchu. It is ſent thence to the Eaſt Indies, and from the Eaſt Indies to Europe. Good ultramarine muſt be of a beautiful dark colour, and free from ſand as well as every other mixture. It muſt unite readily with oil; it muſt not become tarniſhed on a red-hot tile or plate of iron, and it ought to diſſolve in ſtrong acids, almoſt like the zeolite, without cauſing an effervеſcence. In the year 1763, an ounce of it at Paris coſt four pounds ſterling, and an ounce of *cendre d'outremer* which is the refuſe, two pounds. The baſis of this colour was long ſuſpected to be copper, but the experiments of Margraff ſhewed that it was iron, in ſome unknown ſtate of combination. New light has been thrown on this ſubject by Morveau, who has diſcovered that ſelenite loaded with iron, when decompoſed by carbonaceous matter, yields a blue ſulphuret of iron of equal permanency with the true ultramarine.

At preſent, ſmalt of a good colour is often purchaſed at a dear rate and ſubſtituted for ultramarine; and it is found that the colour of this preparation of cobalt is more durable in the fire than even that of the lapis lazuli. For the analyſis of lapis lazuli, ſee Mineralogy, n° 69. *Suppl.*

ULYSSES, one of the military townſhips in Onondago county, New-York, ſituated at the ſouthern end of Cayuga Lake, having Hector on the weſt, and Dryden on the eaſt, which laſt townſhip is included within the juriſdiction of Ulyſſes, which was incorporated in 1794. In 1796, 38 of the inhabitants were electors.—*Morſe.*

UMBAGOG, a large lake of New-Hampſhire, next in ſize to Lake Winipiſeogee. It lies in Grafton county, and a ſmall part of it in the Diſtrict of Maine.—*ib.*

UNADILLA, a river of the ſtate of New-York, called alſo *Tianaderha*, runs ſouthward, and joining the Main Branch, forms Chenengo river.—*ib.*

Unadilla, a townſhip of New-York, Otſego county, on the northern ſide of the main branch of Chenengo river. It is about 110 miles ſouth-weſt of Albany; and, in 1796, 502 of its inhabitants were electors. In the ſame year, the townſhips of Suffrage, Otſego, and Butternuts, were taken from this townſhip, and incorporated.—*ib.*

UNAMI, a tribe of the Delaware Indians, conſidered to be the head of that nation.—*ib.*

UNDERHILL, a townſhip of Vermont, Chittenden county, 12 miles eaſt of Colcheſter, and contains 65 inhabitants.—*ib.*

UNION, a county of South-Carolina, Pinckney diſtrict, containing 7,693 inhabitants, of whom 6,430 are whites, and 1,215 ſlaves. It ſends two repreſentatives and one ſenator to the ſtate legiſlature. Chief town, Pinckneyville.—*ib.*

Union, a rocky townſhip in Tolland county, Connecticut, weſt of Woodſtock, and about 12 miles N. E. of Tolland.—*ib.*

Union, a townſhip of the Diſtrict of Maine, Lincoln county, containing 200 inhabitants. It was incorporated in 1786, and lies 290 miles from Boſton.—*ib.*

Union, a poſt-town of the ſtate of New-York, Tioga county, on the N. ſide of Suſquehannah river, and weſt of the mouth of the Chenengo, 122 miles S. E. by E.

of Williamſburg, on Geneſſee river, 24 E. N. E. of Athens, or Tioga Point, 92 S. W. of Cooperſtown, and 340 N. by W. of Philadelphia. In 1796, there were in the townſhip, 284 of the inhabitants qualified electors. —*ib*.

UNION *River*, or *Plantation No.* 6, in the Diſtrict of Maine, is ſituated in Hancock county, 25 miles N. E. of Penobſcot.—*ib*.

UNION *River*, in the county of Hancock, Diſtrict of Maine, empties into Blue Hill Bay, on the E. ſide of Penobſcot Bay. Long-Iſland, in this bay, is in lat. 44 25, and long. 67 45.—*ib*.

UNION-TOWN, a poſt-town of Pennſylvania, Fayette county, on Redſtone Creek. It contains a church, a ſtone gaol, and a brick court-houſe, and about 80 dwelling-houſes. Near it are two valuable merchant mills. It is the ſeat of the county courts, and is 14 miles S. by E. of Brownſville, where Redſtone Creek enters the Monongahela, 58 miles S. of Pittſburg, 24 N. E. of Morgantown, in Virginia, and 327 W. of Philadelphia.—*ib*.

UNITAS, a village of N. Carolina, ſituated at the head of Gargal's Creek.—*ib*.

UNITED STATES OF AMERICA, ſituated between 31° and 46° north latitude, 8° E. and 24° W. lon. from Philadelphia, 64° and 96° W. lon. from London, is in length 1250 miles, and in breadth 1040. It is bounded north and eaſt, by Britiſh America, or the Provinces of Upper and Lower Canada, and New Brunſwick; ſouth-eaſt, by the Atlantic Ocean; ſouth by Eaſt and Weſt Florida; weſt, by the river Miſſiſſippi.

The American Republic, conſiſts of three grand diviſions, denominated the *Northern*, or more properly *Eaſtern*, *Middle* and *Southern* States. The *firſt* diviſion, (the Northern or Eaſtern States) comprehends Vermont, New Hampſhire, Diſtrict of Maine, (belonging to Maſſachuſetts) Maſſachuſetts, Rhode Iſland, and Connecticut. Theſe are called the New England States, and comprehend that part of America, which, ſince the year 1614, has been known by the name of New England. The *ſecond* diviſion (the Middle States) comprehends New York, New Jerſey, Pennſylvania, Delaware, and Territory N. W. of Ohio. The *third* diviſion (the Southern States) comprehends Maryland, Virginia, Kentucky, North Carolina, Tenneſſee, South Carolina, Georgia, and Miſſiſſippi Territory.

In the treaty of peace, concluded in 1783, the limits of the American United States are more particularly defined in the words following: " And that all diſputes which might ariſe in future on the ſubject of the boundaries of the ſaid United States may be prevented, it is hereby agreed and declared, that the following are and ſhall be their boundaries, viz. From the north-weſt angle of Nova Scotia, viz. that angle which is formed by a line drawn due north from the ſource of St Croix River to the Highlands, along the ſaid Highlands, which divide thoſe rivers that empty themſelves into the river St Lawrence from thoſe which fall into the Atlantic Ocean, to the north-weſternmoſt head of Connecticut river; thence down along the middle of that river to the forty-fifth degree of north latitude; from thence by a line due weſt on ſaid latitude, until it ſtrikes the river Iroquois or Cataraquie; thence along the middle of the ſaid river into Lake Ontario; through the middle of ſaid lake, until it ſtrikes the communication by water between that lake and Lake Erie; thence along the middle of ſaid communication into Lake Erie, through the middle of ſaid lake, until it arrives at the water communication between that lake and Lake Huron; thence through the middle of ſaid lake to the water communication between that lake and Lake Superior; thence through Lake Superior, northward of the Iſles Royal and Phillipeaux, to the Long Lake; thence through the middle of ſaid Long Lake, and the water communication between it and the Lake of the Woods, to the ſaid Lake of the Woods; thence through the ſaid lake to the moſt northweſtern point thereof, and from thence, on a due weſt courſe, to the River Miſſiſſippi; thence by a line to be drawn along the middle of ſaid River Miſſiſſippi, until it ſhall interſect the northernmoſt part of the thirty-firſt degree of north latitude.

" South, by a line to be drawn due eaſt from the determination of the line laſt mentioned, in the latitude of thirty-one degrees north of the equator, to the middle of the River Apalachicola, or Catahouche; thence along the middle thereof to its junction with the Flint River; thence ſtraight to the head of St Mary's River; and thence down along the middle of St Mary's River to the Atlantic Ocean.

" Eaſt, by a line to be drawn along the middle of the River St Croix, from its mouth, in the Bay of Fundy, to its ſource, and from its ſource directly north, to the aforeſaid Highlands, which divide the rivers that fall into the Atlantic Ocean from thoſe which fall into the River St Lawrence; comprehending all iſlands within twenty leagues of any part of the ſhores of the United States, and lying between lines to be drawn due eaſt from the points where the aforeſaid boundaries between Nova Scotia on the one part, and Eaſt Florida on the other, ſhall reſpectively touch the Bay of Fundy and the Atlantic Ocean, excepting ſuch iſlands as now are, or heretofore have been, within the limits of the ſaid province of Nova Scotia."

The territory of the United States, according to Mr Hutchins, contains, by computation, a million of ſquare miles, in which are 640,000,000 acres.
Deduct for water 51,000,000

Acres of land in the United States 589,000,000

That part of the United States, comprehended between the weſt boundary line of Pennſylvania, on the eaſt; the boundary line between Great Britain and the United States, extending from the northweſt corner of Pennſylvania, to the northweſt extremity of the Lake of the Woods, on the north; the river Miſſiſſippi, to the mouth of the Ohio, on the weſt; and the river Ohio on the ſouth, to the aforementioned bounds of Pennſylvania, contains, by computation, about 411,000 ſquare miles, in which are 263,040,000 acres
Deduct for water 43,040,000

To be diſpoſed of by order of Congreſs, when purchaſed of the Indians } 220,000,000

The whole of this immenſe extent of unappropriated weſtern territory, containing as above ſtated, 220,000,000 of acres, and ſeveral large tracts ſouth of the

the Ohio, (A) have been, by the ceſſion of ſome of the original thirteen ſtates, and by the treaty of peace, transferred to the federal government, and are pledged as a fund for ſinking the debt of the United States. Of this territory the Indians now poſſeſs a very large proportion. Mr Jefferſon, in his report to Congreſs, November 8, 1791, deſcribes the boundary line between us and the Indians, as follows: "Beginning at the mouth of the Cayahoga (which falls into the ſouthernmoſt part of the Lake Erie) and running up the river to the portage, between that and the Tuſcarora (or N. E.) branch of the Muſkingum; then down the ſaid branch to the forks, at the croſſing place above Fort Lawrence; then weſtwardly, towards the portage of the Great Miami, to the main branch of that river; then down the Miami, to the fork of that river, next below the old fort which was taken by the French, in 1752; thence due weſt to the river De la Panſe (a branch of the Wabaſh) and down that river to the Wabaſh. So far the line is preciſely determined, and cleared of the claims of the Indians. The tract comprehending the whole country within the above deſcribed line, the Wabaſh, the Ohio, and the weſtern limits of Pennſylvania, contains about 55,000 ſquare miles. How far on the weſtern ſide of the Wabaſh, the ſouthern boundary of the Indians has been defined, we know not. It is only underſtood in general, that their title to the lower country, between that river and the Illinois, was formerly extinguiſhed by the French, while in their poſſeſſion."

Eſtimate of the number of acres of water, north and weſtward of the river Ohio, within the territory of the United States.

		Acres.
In Lake Superior,		21,952,780
Lake of the Woods,		1,133,800
Lake Rain, &c.		165,200
Red Lake,		551,000
Lake Michigan		10,368,000
Bay Puan,		1,216,000
Lake Huron,		5,009,920
Lake St Clair,		89,500
Lake Erie, weſtern part,		2,252,800
Sundry ſmall lakes and rivers,		301,000
In Lake Erie, weſtward of the line extended from the north-weſt corner of Pennſylvania, due north to the boundary between the Britiſh territory and the United States,	410,000	
In Lake Ontario,	2,390,000	
Lake Champlaine,	500,000	
Cheſapeak Bay,	1,700,000	
Albemarle Bay,	330,000	
Delaware Bay,	630,000	
All the rivers within the thirteen States, including the Ohio,	2,000,000	
		7,990,000
Total,		51,000,000

It may in truth be ſaid, that no part of the world is ſo well watered with ſprings, rivulets, rivers, and lakes, as the territory of the United States. By means of theſe various ſtreams and collections of water, the whole country is checkered into iſlands and peninſulas. The United States, and indeed all parts of North America, ſeem to have been formed by nature for the moſt intimate union. The facilities of navigation render the communication between the ports of Georgia and New-Hampſhire far more expeditious and practicable, than between thoſe of Provence and Picardy in France; Cornwall and Caithneſs, in Great-Britain; or Gallicia and Catalonia, in Spain. The canals opening between Suſquehannah and Delaware, between Paſquetank and Elizabeth Rivers, in Virginia, and between the Schuylkill and Suſquehannah, will open a communication from the Carolinas to the weſtern counties of Pennſylvania and New-York. The improvement of the Patowmak, will give a paſſage from the ſouthern States to the weſtern parts of Virginia, Maryland, Pennſylvania, and even to the lakes. From Detroit, to Alexandria, on the Potowmak, ſix hundred and ſeven miles, are but two carrying places, which together do not exceed the diſtance of forty miles. The canals of Delaware and Cheſapeak will open the communication from South Carolina to New Jerſey, Delaware, the moſt populous parts of Pennſylvania, and the midland counties of New York. Were theſe, and the canal between Aſhley and Cooper Rivers, in South Carolina—the canals in the northern parts of the ſtate of New-York, and thoſe of Maſſachuſetts and New-Hampſhire, all opened, and many of them are in great forwardneſs, North America would thereby be converted into a cluſter of large and fertile iſlands, communicating with each other with eaſe and little expenſe, and in many inſtances without the uncertainty or danger of the ſeas.

There is nothing in other parts of the globe which reſembles the prodigious chain of lakes in this part of the world. They may properly be termed inland ſeas of freſh water; and even thoſe of the ſecond or third claſs in magnitude, are of larger circuit than the greateſt lake in the eaſtern continent, the Caſpian Sea excepted. Some of the moſt northern lakes belonging to the United States, have never been ſurveyed, or even viſited till lately by white people; of courſe we have no deſcription of them which can be relied on as accurate. Others have been partially ſurveyed, and their relative ſituation determined. The beſt account of them which we have been able to procure is as follows:

The Lake of the Woods, the moſt northern in the United States, is ſo called from the large quantities of wood growing on its banks; ſuch as oaks, pines, firs, ſpruce, &c. This lake lies nearly eaſt of the ſouth end of Lake Winnepeck, and is ſuppoſed to be the ſource or conductor of one branch of the river Bourbon, if there be ſuch a river. Its length from eaſt to weſt is ſaid to be about ſeventy miles, and in ſome places it is forty miles wide. The Killiſtino Indians encamp on its borders to fiſh and hunt. This lake is the communication between the Lakes Winnepeek and Bourbon, and Lake Superior.

(A) Ceded by North Carolina, South Carolina, and Georgia, with certain reſervations for the Indians and other purpoſes.

Rainy, or Long Lake, lies eaſt of the Lake of the Woods, and is ſaid to be nearly an hundred miles long, and in no part more than twenty miles wide.

Eaſtward of this lake, lie ſeveral ſmall ones, which extend in a ſtring to the great carrying place, and thence into Lake Superior. Between theſe little lakes are ſeveral carrying places, which render the trade to the north-weſt difficult, and exceedingly tedious, as it takes two years to make one voyage from Michillimakkinac to theſe parts.

Lake Superior, formerly termed the Upper Lake, from its northern ſituation, is ſo called from its magnitude, it being the largeſt on the continent. It may juſtly be termed the Caſpian of America, and is ſuppoſed to be the largeſt body of freſh water on the globe. According to the French charts, it is 1500 miles in circumference (B). A great part of the coaſt is bounded by rocks and uneven ground. The water is pure and tranſparent, and appears generally, throughout the lake, to lie upon a bed of huge rocks. It has been remarked, in regard to the waters of this lake, (with how much truth we cannot ſay) that although their ſurface, during the heat of ſummer, is impregnated with no ſmall degree of warmth, yet, on letting down a cup to the depth of about a fathom, the water drawn from thence is cool and refreſhing.

The ſituation of this lake, from the moſt accurate obſervations which have come to our knowledge, lies between lat. 46° and 48° 30′ N. and lon. 84° and 91° 30′ W. from London.

There are many iſlands in this lake, two of them have each land enough, if proper for cultivation, to form a conſiderable province; eſpecially Iſle Royal, near the N. W. coaſt of the lake, which is not leſs than an hundred miles long, and in many places forty broad. The natives ſuppoſe theſe iſlands are the reſidence of the Great Spirit.

Two large rivers empty themſelves into this lake, on the north and north-eaſt ſide; one is called the Nipegon, which leads to a tribe of the Chipeways, who inhabit a lake of the ſame name, and the other is the Michipicooton river, the ſource of which is towards James's Bay, from whence there is ſaid to be but a ſhort portage to another river which empties itſelf into that bay.

Not far from the Nipegon is a ſmall river, that juſt before it enters the lake, has a perpendicular fall from the top of a mountain of ſix hundred feet. [*Carver*.] It is very narrow, and appears at a diſtance like a white garter ſuſpended in the air. There are upwards of thirty other rivers, which empty into this lake, ſome of which are of a conſiderable ſize. On the ſouth ſide of it is a remarkable point or cape of about ſixty miles in length, called point Chegomegan. About an hundred miles weſt of this cape, a conſiderable river falls into the lake, the head of which is compoſed of a great aſſemblage of ſmall ſtreams. This river is remarkable for the abundance of virgin copper that is found on and near its banks. Many ſmall iſlands, particularly on the eaſtern ſhores, abound with copper ore lying in beds, with the appearance of copperas. This metal might be eaſily made a very advantageous article of commerce. This lake abounds with fiſh, particularly trout and ſturgeon; the former weigh from twelve to fifty pounds, and are caught almoſt any ſeaſon of the year in great plenty. Storms affect this lake as much as they do the Atlantic Ocean; the waves run as high, and the navigation is equally dangerous. It diſcharges its waters from the ſouth-eaſt corner, through the Straits of St Marie, which are about forty miles long. Near the upper end of theſe ſtraits is a rapid, which, though it is impoſſible for canoes to aſcend, yet, when conducted by careful pilots, may be deſcended without danger.

Though Lake Superior is ſupplied by near forty rivers, many of which are large, yet it does not appear that one tenth part of the waters which are conveyed into it by theſe rivers is diſcharged by the abovementioned ſtraits. Such a ſuperabundance of water can be diſpoſed of only by evaporation (C). The entrance into this lake from the ſtraits of St Marie, affords one of the moſt pleaſing proſpects in the world. On the left may be ſeen many beautiful little iſlands that extend a conſiderable way before you; and on the right, an agreeable ſucceſſion of ſmall points of land, that project a little way into the water, and contribute, with the iſlands, to render this delightful baſon calm, and ſecure from thoſe tempeſtuous winds, by which the adjoining lake is frequently troubled.

Lake Huron, into which you enter through the Straits of St Marie, is next in Magnitude to Lake Superior. It

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(B) Carver ſuppoſes it exceeds 1600 miles.

(C) That ſuch a ſuperabundance of water ſhould be diſpoſed of by evaporation is no ſingular circumſtance. "There are ſome ſeas," ſays an ingenious correſpondent who has not obliged me with his name, "in which there is a pretty juſt balance between the waters received from rivers, brooks, &c. and the waſte by evaporation. Of this the Caſpian Sea in Aſia affords an inſtance; which though it receives ſeveral large rivers, has no outlet. There are others, (to ſpeak in borrowed language) whoſe expenſe exceeds their income; and theſe would ſoon become bankrupt, were it not for the ſupplies which they conſtantly receive from larger collections of water, with which they are connected; ſuch are the Black and Mediterranean ſeas; into the former of which there is a conſtant current from the Mediterranean through the Boſphorus of Thrace; and into the latter, from the Atlantic, through the Straits of Gibraltar. Others again derive more from their tributary ſtreams than they loſe by evaporation. Theſe give riſe to large rivers. Of this kind are the Dambea, in Africa, the Winnipiſeogee, in New Hampſhire, Lake Superior and other waters in North America; and the quantity they diſcharge is only the difference between the influx and the evaporation. It is obſervable that on the ſhores the evaporation is much greater than at a diſtance from them on the ocean. The remarkable cluſter of lakes in the middle of North America, of which Lake Superior is one, was doubtleſs deſigned by a wiſe Providence, to furniſh the interior parts of the country with that ſupply of vapours, without which, like the interior parts of Africa, they muſt have been a mere deſert. It may be thought equally ſurpriſing that there ſhould be any water at all diſcharged from them, as that the quantity ſhould bear ſo ſmall a proportion to what they receive." [*Anonymous* MS.]

It lies between lat. 43° 30′ and 46° 30′ N. and between long. 80° and 84° 30′ W. from London. Its circumference is about one thouſand miles. On the north ſide of this lake is an iſland called Manatou, ſignifying a place of ſpirits, and is conſidered as ſacred by the Indians. On the ſouth-weſt part of this lake is Saganaum Bay, about eighty miles in length, and about eighteen or twenty miles broad. On its banks are great quantities of ſand cherries. Thunder Bay, ſo called from the thunder that is frequently heard here, lies about half way between Saganaum Bay and the north-weſt corner of the lake. It is about nine miles acroſs either way. The fiſh are the ſame as in Lake Superior. At the north-weſt corner this lake communicates with Lake Michigan, by the Straits of Michillimakkinac.

The Chippeway Indians live ſcattered around this lake; particularly near Saganaum Bay. Their country, however, is to the eaſtward of this lake.

Michigan Lake lies between latitude 42° 10′ and 46° 30′ north; and between 11° and 13° weſt long. from Philadelphia. Its computed length is 280 miles, from north to ſouth; its breadth from 60 to 70 miles. It is navigable for ſhipping of any burthen; and at the northeaſtern part communicates with Lake Huron, by a ſtrait ſix miles broad, on the ſouth ſide of which ſtands fort Michillimakkinac, which is the name of the ſtrait. In this lake are ſeveral kinds of fiſh, particularly trout of an excellent quality, weighing from 20 to 60 pounds, and ſome have been taken in the Straits of Michillimakkinac of 90 pounds. Weſtward of this lake are large meadows, ſaid to extend to the Miſſiſſippi. It receives a number of rivers from the weſt and eaſt, among which is the river St Joſeph, very rapid and full of iſlands. It ſprings from a number of ſmall lakes, a little to the north-weſt of the Miami village, and runs north-weſt into the ſouth-eaſt part of the lake. On the north ſide of this river is fort St Joſeph, from which there is a road bearing north of eaſt, to Detroit. The Powtewatimie Indians, who have about 200 fighting men, inhabit this river oppoſite fort St Joſeph.

Between Lake Michigan on the weſt, and Lakes Huron, St Clair, and the weſt end of Erie on the eaſt, is a fine tract of country, peninſulated, more than 250 miles in length, and from 150 to 200 in breadth. The banks of the lakes, for a few miles inland, are ſandy and barren, producing a few pines, ſhrub oaks and cedars. Back of this from either lake, the timber is heavy and good, and the ſoil luxuriant.

Lake St Clair lies about half way between Lake Huron and Lake Erie, and is about 90 miles in circumference. It receives the waters of the three great Lakes, Superior, Michigan and Huron, and diſcharges them through the river or ſtrait called Detroit, (or the Strait) into Lake Erie. This lake is of an oval form, and navigable for large veſſels. The fort of Detroit is ſituated on the weſtern bank of the river of the ſame name, about nine miles below Lake St Clair. The ſettlements are extended on both ſides of the ſtrait or river for many miles towards Lake Erie, and ſome few above the fort.

United States.

Lake Erie is ſituated between forty-one and forty-three degrees of north latitude, and between 3° 40′ and 8° weſt longitude. It is nearly three hundred miles long, from eaſt to weſt, and about forty in its broadeſt part. A point of land projects from the north ſide into this lake, ſeveral miles, towards the ſouth-eaſt called Long Point. The iſlands and banks towards the weſt end of the lake are ſo infeſted with rattle-ſnakes, as to render it dangerous to land on them. The lake is covered near the banks of the iſlands with large pond lily, the leaves of which lie on the ſurface of the water ſo thick, as to cover it entirely for many acres together; on theſe in the ſummer ſeaſon lie myriads of water-ſnakes baſking in the ſun. Of the venomous ſerpents which infeſt this lake, the hiſſing ſnake is the moſt remarkable. It is about eighteen inches long, ſmall and ſpeckled. When you approach it, it flattens itſelf in a moment, and its ſpots, which are of various colours, become viſibly brighter through rage; at the ſame time it blows from its mouth, with great force, a ſubtile wind, ſaid to be of a nauſeous ſmell; and if drawn in with the breath of the unwary traveller, will infallibly bring on a decline, that in a few months muſt prove mortal. No remedy has yet been found to counteract its baneful influence. This lake is of a more dangerous navigation than any of the others, on account of the craggy rocks which project into the water, in a perpendicular direction, many miles together from the northern ſhore, affording no ſhelter from ſtorms.

Preſque Iſle is on the ſouth-eaſt ſhore of this lake, about lat. 42° 10′. From this to Fort Le Beuf, on French Creek, is a portage of $15\frac{1}{5}$ miles. About 20 miles north-eaſt of this is another portage of $9\frac{1}{4}$ miles, between Chataughque Creek, emptying into Lake Erie, and Chataughque Lake, a water of Allegany river.

Fort Erie ſtands on the northern ſhore of Lake Erie, and the weſt bank of Niagara river, in Upper Canada. This lake, at its north-eaſt end, communicates with Lake Ontario, by the river Niagara, which runs from ſouth to north, about 30 miles, including its windings, embracing in its courſe, Grand Iſland, and receiving Tonewanto Creek, from the eaſt. About the middle of this river, are the celebrated Falls of Niagara, which are reckoned one of the greateſt natural curioſities in the world. The waters which ſupply the river Niagara riſe near two thouſand miles to the north-weſt, and paſſing through the lakes Superior, Michigan, Huron, and Erie, receiving in their courſe conſtant accumulations, at length, with aſtoniſhing grandeur, ruſh down a ſtupendous precipice of 137 feet perpendicular; and in a ſtrong rapid, that extends to the diſtance of eight or nine miles below, fall nearly as much more; the river then loſes itſelf in Lake Ontario. The water falls 57 feet in the diſtance of one mile, before it falls perpendicularly (d). A ſpectator ſtanding on the bank of the river oppoſite theſe falls, would not imagine them to be more than 40 or 50 feet perpendicular height. The noiſe of theſe falls, in a clear day and fair wind, may be heard between forty and fifty miles. When the water ſtrikes the bottom,

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(d) It is believed by the inhabitants in the neighbourhood of theſe falls, that formerly they were ſix miles lower down than they now are, and that the change has been produced by the conſtant operation of the water. But on a careful examination of the banks of the river, there appears to be no good foundation for this opinion. [*Gen. Lincoln.*]

tom, its ſpray riſes to a great height in the air, occaſioning a thick cloud of vapours, in which, when the ſun ſhines, may be ſeen, morning and evening, a beautiful rainbow. Fort Niagara, built by the French about the year 1725, is ſituated on the eaſt ſide of Niagara river, at its entrance into Lake Ontario, about 43° 20′ N. lat.

Lake Ontario is ſituated between forty-three and forty-five degrees north lat. and between one and five degrees W. long. Its form is nearly oval. Its greateſt length is from ſouth-weſt to north-eaſt, and its circumference about ſix hundred miles. It abounds with fiſh of an excellent flavour, among which are the Oſwego baſs, weighing three or four pounds. Its banks in many places are ſteep, and the ſouthern ſhore is covered principally with beech trees, and the lands appear good. It receives the waters of the Cheneſſee river from the ſouth, and of Onondago, at Fort Oſwego, from the ſouth-eaſt, by which it communicates, through Lake Oneida, and Wood Creek, with Mohawk river. On the north-eaſt, this lake diſcharges itſelf through the river Cataraqui, (which at Montreal, takes the name of St Lawrence) into the Atlantic Ocean. "It is aſſerted that theſe lakes fill once in ſeven years, and that 1794 was the year when they would be full; but as we are unacquainted with any laws of nature, by which this periodical effect ſhould be produced, we may with propriety doubt the fact." [*Gen. Lincoln.*]

About 8 miles from the weſt end of Lake Ontario, is a curious cavern, which the Meſſiſaugas Indians call *Manito' ah wigwam*, or *houſe of the Devil*. The mountains which border on the lake, at this place, break off abruptly, and form a precipice of 200 feet perpendicular deſcent; at the bottom of which the cavern begins. The firſt opening is large enough for three men conveniently to walk abreaſt. It continues of this bigneſs for 70 yards in a horizontal direction. Then it falls almoſt perpendicularly 50 yards, which may be deſcended by irregular ſteps from one to four feet diſtant from each other. It then continues 40 yards horizontally, at the end of which is another perpendicular deſcent, down which there are no ſteps. The cold here is intenſe. In ſpring and autumn, there are, once in about a week, exploſions from this cavern, which ſhake the ground for 16 miles round.

Lake Champlaine is next in ſize to Lake Ontario, and lies nearly eaſt from it, forming a part of the dividing line between the State of New York and the State of Vermont. It took its name from a French Governor, whoſe name was Champlaine, who was drowned in it. It was before called Corlaer's Lake. It is about 100 miles in length from north to ſouth, and in its broadeſt parts 12 or 14. It is well ſtored with fiſh, and the land on its borders and on the banks of its rivers is good. Crown Point and Ticonderoga are ſituated on the bank of this lake, near the ſouthern part of it.

Lake George lies to the ſouthward of Champlaine, and is a moſt clear, beautiful collection of water, 36 miles long, and from 1 to 7 miles wide. It emboſoms more than 200 iſlands, ſome ſay 365; very few of which are any thing more than barren rock, covered with heath, and a few cedar, ſpruce and hemlock trees and ſhrubs, and abundance of rattle-ſnakes. On each ſide it is ſkirted by prodigious mountains, from which large quantities of red cedar are every year carried to New York for ſhip timber. The lake is full of fiſhes, and ſome of the beſt kind; among which are the black or Oſwego baſs and large ſpeckled trouts. The water of this lake is about 100 feet above the level of Lake Champlaine. The portage between the two lakes is one mile and a half; but with a ſmall expenſe might be reduced to 60 yards; and with a ſufficient number of locks might be made navigable through for batteaux. This lake, in the French charts, is called Lake St Sacrament; and it is ſaid that the Roman Catholicks, in former times, were at the pains to procure this water for ſacramental uſes in all their churches in Canada: hence probably it derived its name.

The Miſſiſſippi receives the waters of the Ohio and Illinois, and their numerous branches from the eaſt; and of the Miſſouri and other rivers from the weſt. Theſe mighty ſtreams united are borne down with increaſing majeſty through vaſt foreſts and meadows, and diſcharged into the Gulf of Mexico. The great length and uncommon depth of this river, ſays Mr Hutchins, and the exceſſive muddineſs and ſalubrious quality of its waters, after its junction with the Miſſouri, are very ſingular (E). The direction of the channel is ſo crooked, that from New Orleans to the mouth of the Ohio, a diſtance which does not exceed four hundred and ſixty miles in a ſtrait line, is about eight hundred and fifty-ſix by water. It may be ſhortened at leaſt two hundred and fifty miles, by cutting acroſs eight or ten necks of land, ſome of which are not thirty yards wide. Charlevoix relates that in the year 1722, at Point Coupee, or Cut Point, the river made a great turn, and ſome Canadians, by deepening the channel of a ſmall brook, diverted the waters of the river into it. The impetuoſity of the ſtream was ſo violent, and the ſoil of ſo rich and looſe a quality, that in a ſhort time the point was entirely cut through, and travellers ſaved fourteen leagues of their voyage. The old bed has no water in it, the times of the periodical overflowing only excepted. The new channel has been ſince ſounded with a line of thirty fathoms without finding bottom. Several other points, of great extent, have, in like manner, been ſince cut off, and the river diverted into new channels.

In the ſpring floods the Miſſiſſippi is very high, and the current ſo ſtrong that it is with difficulty it can be aſcended; but this diſadvantage is remedied in ſome meaſure by eddies or counter-currents, which are generally found in the bends cloſe to the banks of the river, and aſſiſt the aſcending boats. The current at this ſeaſon deſcends at the rate of about five miles an hour. In autumn, when the waters are low, it does not run faſter than two miles, but it is rapid in ſuch parts of the river as have cluſters of iſlands, ſhoals and ſand-banks. The circumference

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(E) In a half pint tumbler of this water has been found a ſediment of one inch of impalpable marle-like ſubſtance. It is notwithſtanding, extremely wholeſome and well taſted, and very cool in the hotteſt ſeaſons of the year; the rowers, who are there employed, drink of it when they are in the freeſt perſpiration, and never receive any bad effects from it. The inhabitants of New Orleans uſe no other water than that of the river, which, by being kept in jars, becomes perfectly clear.

cumference of many of theſe ſhoals being ſeveral miles, the voyage is longer, and in ſome parts more dangerous than in the ſpring. The merchandiſe neceſſary for the commerce of the upper ſettlements on or near the Miſſiſſippi, is conveyed in the ſpring and autumn in batteaux, rowed by eighteen or twenty men, and carrying about forty tons. From New Orleans to the Illinois, the voyage is commonly performed in eight or ten weeks. A prodigious number of iſlands, ſome of which are of great extent, interſperſe that mighty river. Its waters, after overflowing its banks below the river Ibberville on the eaſt, and the river Rouge on the weſt, never return within them again, there being many outlets or ſtreams, by which they are conducted into the Bay of Mexico, more eſpecially on the weſt ſide of the Miſſiſſippi, dividing the country into numerous iſlands. Theſe ſingularities diſtinguiſh it from every other known river in the world. Below the Ibberville, the land begins to be very low on both ſides of the river, acroſs the country, and gradually declines as it approaches nearer to the ſea. The iſland of New Orleans, and the lands oppoſite, are to all appearance of no long date; for in digging ever ſo little below the ſurface, you find water and great quantities of trees. The many beaches and breakers as well as inlets, which have ariſen out of the channel ſince 1650, at the ſeveral mouths of the river, are convincing proofs that this peninſula was wholly formed in the ſame manner. And it is certain that when La Salle ſailed down the Miſſiſſippi to the ſea, the opening of that river was very different from what it is at preſent.

The nearer you approach to the ſea, this truth becomes more ſtriking. The bars that croſs moſt of theſe ſmall channels, opened by the current, have been multiplied by means of the trees carried down with the ſtreams; one of which, ſtopped by its roots or branches in a ſhallow part, is ſufficient to obſtruct the paſſage of thouſands more, and to fix them at the ſame place. Aſtoniſhing collections of trees are daily ſeen in paſſing between the Balize and the Miſſouri. No human force is ſufficient to remove them, and the mud carried down by the river ſerves to bind and cement them together. They are gradually covered, and every inundation not only extends their length and breadth, but adds another layer to their height. In leſs than ten years time, canes, ſhrubs and aquatic timber grow on them, and form points and iſlands, which forcibly ſhift the bed of the river.

Nothing can be aſſerted with certainty, reſpecting the length of this river. Its ſource is not known, but ſuppoſed to be upwards of three thouſand miles from the ſea as the river runs. We only know, that from St Anthony's Falls in lat. 45° it glides with a pleaſant clear current, and receives many large and very extenſive tributary ſtreams, before its junction with the Miſſouri, without greatly increaſing the breadth of the Miſſiſſippi, though they do its depth and rapidity. The muddy waters of the Miſſouri diſcolour the lower part of the river, till it empties into the Bay of Mexico. The Miſſouri is a longer, broader, and deeper river than the Miſſiſſippi, and affords a more extenſive navigation; it is in fact the principal river, contributing more to the common ſtream than does the Miſſiſſippi. It has been aſcended by French traders about twelve or thirteen hundred miles, and from the depth of water, and breadth of the river at that diſtance, it appeared to be navigable many miles further.

From the Miſſouri river, to nearly oppoſite the Ohio, the weſtern bank of the Miſſiſſippi is (ſome few places excepted) higher than the eaſtern. From Mine-au-fer to the Ibberville, the eaſtern bank is higher than the weſtern, on which there is not a ſingle diſcernible riſing or eminence, the diſtance of ſeven hundred and fifty miles. From the Ibberville to the ſea, there are no eminences on either ſide, though the eaſtern bank appears rather the higheſt of the two, as far as the Engliſh turn. Thence the banks gradually diminiſh in height to the mouths of the river, where they are but a few feet higher than the common ſurface of the water.

The ſlime which the annual floods of the river Miſſiſſippi leave on the ſurface of the adjacent ſhores, may be compared with that of the Nile, which depoſits a ſimilar manure, and for many centuries paſt has inſured the fertility of Egypt. When its banks ſhall have been cultivated, as the excellency of its ſoil and temperature of the climate deſerves, its population will equal that of any other part of the world. The trade, wealth and power of America, may, at ſome future period, depend, and perhaps centre upon the Miſſiſſippi. This alſo reſembles the Nile in the number of its mouths, all iſſuing into a ſea that may be compared to the Mediterranean, which is bounded on the north and ſouth by the two continents of Europe and Africa, as the Mexican Bay is by North and South America. The ſmaller mouths of this river might be eaſily ſtopped up, by means of thoſe floating trees with which the river, during the floods, is always covered. The whole force of the channel being united, the only opening then left would probably grow deep, and the bar be removed.

Whoever for a moment will caſt his eye over a map of the town of New Orleans, and the immenſe country around it, and view its advantageous ſituation, muſt be convinced that it or ſome place near it, muſt in proceſs of time become one of the greateſt marts in the world.

The Falls of St Anthony, in about lat. 45°, received their name from Father Lewis Hennipin, a French miſſionary, who travelled into theſe parts about the year 1680, and was the firſt European ever ſeen by the natives. The whole river, which is more than 250 yards wide, falls perpendicularly about thirty feet, and forms a moſt pleaſing cataract. The rapids below, in the ſpace of three hundred yards render the deſcent conſiderably greater; ſo that when viewed at a diſtance, they appear to be much higher than they really are. In the middle of the falls is a ſmall iſland, about forty feet broad, and ſomewhat longer, on which grow a few cragged hemlock and ſpruce trees; and about half way between this iſland and the eaſtern ſhore is a rock, lying at the very edge of the fall, in an oblique poſition, five or ſix feet broad, and thirty or forty long. Theſe falls are peculiarly ſituated, as they are approachable without the leaſt obſtruction from any intervening hill or precipice, which cannot be ſaid of any other conſiderable falls perhaps in the world. The country around is exceedingly beautiful. It is not an uninterrupted plain, where the eye finds no relief, but compoſed of many gentle aſcents, which, in the ſpring and ſummer, are covered with verdure, and interſperſed with little groves, that give a pleaſing variety to the proſpect.

A little diſtance below the falls, is a ſmall iſland of about an acre and an half, on which grow a great number of oak trees, almoſt all the branches of which, able to bear the weight, are, in the proper ſeaſon of the year, loaded with eagles neſts. Their inſtinctive wiſdom has taught them to chooſe this place, as it is ſecure on account of the rapids above, from the attacks of either man or beaſt.

From the beſt accounts that can be obtained from the Indians, we learn that four of the largeſt rivers on the continent of North America, among which are the St Lawrence, the Miſſiſſippi, and the Oregon, or the River of the Weſt, have their ſources in the ſame neighbourhood. The waters of three of them are ſaid to be within 30 miles of each other. If the above information is correct, it ſhews that theſe parts are the higheſt lands in North America: And it is an inſtance not to be parallelled in the other three quarters of the globe, that four rivers of ſuch magnitude ſhould take their riſe together, and each, after running ſeparate courſes, diſcharge their waters into different oceans, at the diſtance of more than two thouſand miles from their ſources. For in their paſſage from this ſpot to the bay of St Lawrence, eaſt; to the bay of Mexico, ſouth; and to the bay at the Straits of Annian, weſt, where the river Oregon is ſuppoſed to empty, each of them traverſes upwards of two thouſand miles.

The Ohio is a moſt beautiful river. Its current gentle, waters clear, and boſom ſmooth and unbroken by rocks and rapids, a ſingle inſtance only excepted. It is one quarter of a mile wide at Fort Pitt; five hundred yards at the mouth of the Great Kanhaway: 1200 yards at Louiſville; and the rapids, half a mile, in ſome few places below Louiſville: but its general breadth does not exceed 600 yards. In ſome places its width is not 400, and in one place particularly, far below the rapids, it is leſs than 300. Its breadth in no one place exceeds 1200 yards, and at its junction with the Miſſiſippi, neither river is more than 900 yards wide.

Its length, as meaſured according to its meanders by Captain Hutchins, is 1188 miles.

In common winter and ſpring floods, it affords 30 or 40 feet water to Louiſville, 25 or 30 feet to La Tarte's Rapids, forty miles above the mouth of the Great Kanhaway, and a ſufficiency at all times for light batteaux and canoes to Fort Pitt. The Rapids are in latitude 38° 8′. The inundations of this river begin about the laſt of March, and ſubſide in July, although they frequently happen in other months; ſo that boats which carry 300 barrels of flour, from the Monongahela, or Yohogany, above Pittſburg, have ſeldom long to wait for water only. During theſe floods a firſt rate man-of-war may be carried from Louiſville to New Orleans, if the ſudden turns of the river and the ſtrength of its current will admit a ſafe ſteerage; and it is the opinion of Col. Morgan, who has had all the means of information, that a veſſel properly built for the ſea, to draw 12 feet water, when loaded, and carrying from 12 to 1600 barrels of flour, may be more eaſily, cheaply and ſafely navigated from Pittſburgh to the ſea, than thoſe now in uſe; and that this matter only requires one man of capacity and enterprize to aſcertain it. He obſerves, that a veſſel intended to be rigged as a brigantine, ſnow, or ſhip, ſhould be double decked, take her maſts on deck, and be rowed to the Ibberville, below which are no iſlands, or to New Orleans, with 20 men, ſo as to afford reliefs of 10 and 10 in the night. Such a veſſel without the uſe of oars, he ſays would float to New Orleans, from Pittſburgh, in 20 times 24 hours. If this be ſo, what agreeable proſpects are preſented to our brethren and fellow citizens in the weſtern country.

The rapids at Louiſville deſcend about 10 feet in a length of a mile and a half. The bed of the river there is a ſolid rock, and is divided by an iſland into two branches, the ſouthern of which is about two hundred yards wide, but impaſſable in dry ſeaſons. The bed of the northern branch is worn into channels by the conſtant courſe of the water and attrition of the pebble-ſtones carried on with that, ſo as to be paſſable for batteaux through the greater part of the year. Yet it is thought that the ſouthern arm may be moſt eaſily opened for conſtant navigation. The riſe of the waters in theſe rapids does not exceed 20 or 25 feet. We have a fort, ſituated at the head of the falls. The ground on the ſouth ſide riſes very gradually.

At Fort Pitt the river Ohio looſes its name, branching into the Monongahela and Allegany.

The Monongahela is four hundred yards wide at its mouth. From thence is twelve or fifteen miles to the mouth of Yohogany, where it is 300 yards wide. Thence to Redſtone by water is 50 miles; by land 30. Then to the mouth of Cheat River, by water 40 miles; by land 28; the width continuing at 300 yards, and the navigation good for boats. Thence the width is about 200 yards to the weſtern fork, fifty miles higher, and the navigation is frequently interrupted by rapids; which, however, with a ſwell of two or three feet, become very paſſable for boats. It then admits light boats, except in dry ſeaſons, 65 miles further, to the head of Tygart's valley, preſenting only ſome ſmall rapids and falls of one or two feet perpendicular, and leſſening in its width to twenty yards. The weſtern fork is navigable in the winter ten or fifteen miles towards the northern of the Little Kanhaway, and will admit a good waggon road to it. The Yohogany is the principal branch of this river. It paſſes through the Laurel Mountain, about thirty miles from its mouth; is ſo far, from 300 to 150 yards wide, and the navigation much obſtructed in dry weather by rapids and ſhoals. In its paſſage through the mountain it makes very great falls, admitting no navigation for ten miles, to the Turkey Foot. Thence to the Great Croſſing, about twenty miles it is again navigable, except in dry ſeaſons, and at this place is two hundred yards wide. The ſources of this river are divided from thoſe of the Potomak by the Allegany Mountain. From the falls, where it interſects the Laurel Mountain, to Fort Cumberland, the head of the navigation on the Potomak, is 40 miles of very mountainous road. Will's Creek, at the mouth of which was Fort Cumberland, is 30 or 40 yards wide, but affords no navigation as yet. Cheat River, another conſiderable branch of the Monongahela, is 200 yards wide at its mouth, and 100 yards at the Dunkard's ſettlement, fifty miles higher. It is navigable for boats, except in dry ſeaſons. The boundary between Virginia and Pennſylvania croſſes it about three or four miles above its mouth.

The Allegany river affords navigation at all ſeaſons for light batteaux to Venango, at the mouth of French Creek,

Creek, where it is two hundred yards wide; and it is practiſed even to Le Bœuf, from whence there is a portage of fifteen miles and a half to Preſque-Iſle on Lake Erie.

The country watered by the Miſſiſſippi and its eaſtern branches, conſtitutes five-eighths of the United States; two of which five-eighths are occupied by the Ohio and its waters: the reſiduary ſtreams, which run into the Gulf of Mexico, the Atlantic, and the St Lawrence, water the remaining three eighths.

Before we quit the ſubject of the weſtern waters, we will take a view of their principal connexions with the Atlantic. Theſe are four; the Hudſon's river, the Patomak, St Lawrence, and Miſſiſſippi. Down the laſt will paſs all the heavy commodities. But the navigation through the Gulf of Mexico is ſo dangerous, and that up the Miſſiſſippi ſo difficult and tedious, that it is thought probable that European merchandize will not be conveyed through that channel. It is moſt likely that flour, timber, and other heavy articles will be floated on rafts, which will themſelves be an article for ſale, as well as their loading, the navigators returning by land, as at preſent. There will therefore be a competition between the Hudſon, the Patomak, and the St Lawrence rivers, for the reſidue of the commerce of all the country weſtward of Lake Erie, on the waters of the lakes of the Ohio, and upper parts of Miſſiſſippi. To go to New York, that part of the trade which comes from the lakes or their waters, muſt firſt be brought into Lake Erie. Between Lake Superior and its waters, and Huron, are the Rapids of St Marie, which will permit boats to paſs, but not larger veſſels. Lakes Huron and Michigan afford communication with Lake Erie by veſſels of eight feet draught. That part of the trade which comes from the waters of the Miſſiſſippi, muſt paſs from them through ſome portage into the waters of the lakes. The portage from the Illinois river into a water of Michigan, is of one mile only. From the Wabaſh, Miama, Muſkingum, or Allegany, are portages into the waters of Lake Erie, of from one to fifteen miles. When the commodities are brought into, and have paſſed through Lake Erie, there is between that and Ontario, an interruption by the Falls of Niagara, where the portage is of eight miles; and between Ontario and the Hudſon's river are portages of the falls of Onondago, a little above Oſwego, of a quarter of a mile; from Wood Creek to the Mohawks river two miles; at the little falls of the Mohawks river half a mile; and from Schenectady to Albany ſixteen miles. Beſides the increaſe of expenſe occaſioned by frequent change of carriage, there is an increaſed riſk of pillage produced by committing merchandize to a greater number of hands ſucceſſively. The Patomak offers itſelf under the following circumſtances: For the trade of the lakes and their waters weſtward of Lake Erie, when it ſhall have entered that lake, muſt coaſt along its ſouthern ſhore, on account of the number and excellence or its harbours; the northern, though ſhorteſt, having few harbours, and theſe unſafe. Having reached Cayahoga, to proceed on to New York, it will have eight hundred and twenty-five miles and five portages; whereas it is but four hundred and twenty-five miles to Alexandria, its emporium on the Patomak, if it turns into the Cayahoga, and paſſes through that, Big Beaver, Ohio, Yohegany, (or Monongalia and Cheat) and Patomak, and there are but two portages; the firſt of which between Cayahoga and Beaver, may be removed by uniting the ſources of theſe waters, which are lakes in the neighbourhood of each other, and in a champaign country; the other, from the waters of Ohio to Patomak, will be from fifteen to forty miles, according to the trouble which ſhall be taken to approach the two navigations. For the trade of the Ohio, or that which ſhall come into it from its own waters or the Miſſiſſippi, it is nearer through the Patomak to Alexandria than to New York, by five hundred and eighty miles, and it is interrupted by one portage only. There is another circumſtance of difference too. The lakes themſelves never freeze, but the communications between them freeze, and the Hudſon's river is itſelf ſhut up by the ice three months in the year; whereas the channel to the Cheſapeak leads directly into a warmer climate. The ſouthern parts of it very rarely freeze at all, and whenever the northern do, it is ſo near the ſources of the rivers, that the frequent floods, to which they are there liable, break up the ice immediately, ſo that veſſels may paſs through the whole winter, ſubject only to accidental and ſhort delays. Add to all this, that in caſe of a war with our neighbours of Canada, or the Indians, the route to New York becomes a frontier through almoſt its whole length, and all commerce through it ceaſes from that moment. But the channel to New York is already known to practice; whereas, the upper waters of the Ohio and the Patomak, and the great falls of the latter, are yet to be cleared of their obſtructions.

The route by St Lawrence is well known to be attended with many advantages, and with ſome diſadvantages. But there is a fifth route, which the enlightened and enterprizing Pennſylvanians contemplate, which, if effected, will be the eaſieſt, cheapeſt and ſureſt paſſage from the lakes, and Ohio river, by means of the Suſquehannah, and a canal from thence to Philadelphia. The latter part of this plan, viz. the canal between Suſquehannah and the Schuylkill rivers, is now actually in execution. Should they accompliſh their whole ſcheme, and they appear confident of ſucceſs, Philadelphia, in all probability, will become, in ſome future period, one of the largeſt cities that has ever yet exiſted.

Particular deſcriptions of the other rivers in the United States, are given in the geographical accounts of thoſe ſtates, through which they reſpectively flow. One general obſervation reſpecting the rivers will, however, be naturally introduced here; and that is, that the entrance into almoſt all the rives, inlets and bays, from New-Hampſhire to Georgia, are from ſouth-eaſt to north-weſt.

The coaſt of North America is indented with numerous bays, ſome of which are equal in ſize to any in the known world. Beginning at the northeaſterly part of the continent, and proceeding ſouthweſterly, you find among the *largeſt* of theſe bays, (for we do not pretend to a complete enumeration of them) firſt the Bay or Gulf of St Lawrence, which receives the waters of the river of the ſame name. Next are Chedebucto, and Chebucto Bays, in Nova-Scotia, the latter diſtinguiſhed by the loſs of a French fleet in a former war between France and Great Britain. The Bay of Fundy, between Nova-Scotia and New-Brunſwick, is remarkable for its tides, which riſe to the height of fifty or ſixty feet,

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feet, and flow ſo rapidly as to overtake animals which feed upon the ſhore. Paſſamaquoddy, Penobſcot, Broad and Caſco Bays, lie along the coaſt of the Diſtrict of Maine. Maſſachuſetts Bay ſpreads eaſtward of Boſton, and is comprehended between Cape Ann on the north, and Cape Cod on the ſouth. The points of Boſton harbour are Nahant and Alderton points. Paſſing by Narraganſet and other bays in the ſtate of Rhode Iſland, you enter Long Iſland Sound, between Montauk Point and the main. This *Sound*, as it is called, is a kind of inland ſea, from three to twenty-five miles broad, and about one hundred and forty miles long, extending the whole length of the iſland, and dividing it from Connecticut. It communicates with the ocean at both ends of Long Iſland, and affords a very ſafe and convenient inland navigation.

The celebrated ſtrait, called *Hell Gate*, is near the weſt end of this Sound, about eight miles eaſtward of New-York city, and is remarkable for its whirlpools, which make a tremendous roaring at certain times of tide. Theſe whirlpools are occaſioned by the narrowneſs and crookedneſs of the paſs, and a bed of rocks which extend quite acroſs it; and not by the meeting of the tides from eaſt to weſt, as has been conjectured, becauſe they meet at Frogs Point, ſeveral miles above. A ſkilful pilot may, with ſafety, conduct a ſhip of any burden through this ſtrait with the tide, or, at ſtill water, with a fair wind (F).

Delaware Bay is ſixty miles long, from the Cape to the entrance of the river Delaware at Bombay Hook, and ſo wide in ſome parts, as that a ſhip in the middle of it cannot be ſeen from the land. It opens into the Atlantic north-weſt and ſouth-eaſt, between Cape Henlopen on the right, and Cape May on the left. Theſe Capes are eighteen or twenty miles apart.

The Cheſapeak is a very ſpacious bay, 150 (ſome ſay 170) miles in length from north to ſouth, and from 7 to 18 miles broad. It is generally as much as 9 fathoms deep, and affords many commodious harbours, and a ſafe and eaſy navigation. Its entrance, which is 12 miles wide, is nearly E. N. E. and S. S. W. between Cape Charles, lat. 37° 12′, and Cape Henry, lat. 37° in Virginia. It ſeparates the eaſtern parts of Virginia and Maryland, leaving a ſmall part of the former, and a large portion of the latter of theſe ſtates on its eaſtern ſhore. It receives the waters of the Suſquehannah, Patomak, Rappahannok, York and James Rivers, which are all large and navigable.

The tract of country belonging to the United States, is happily variegated with plains and mountains, hills and vallies. Some parts are rocky, particularly New England, the north parts of New York and New Jerſey, and a broad ſpace, including the ſeveral ridges of the long range of mountains which run ſouth-weſtward through Pennſylvania, Virginia, North Carolina, and part of Georgia, dividing the waters which flow into the Atlantic, from thoſe which fall into the Miſſiſſippi. In the parts eaſt of the Allegany mountains, in the ſouthern ſtates, the country for ſeveral hundred miles in length, and ſixty or ſeventy, and ſometimes more, in breadth, is level and entirely free from ſtone. It has been a queſtion, agitated by the curious, whether the extenſive tract of low, flat country, which fronts the ſeveral ſtates ſouth of New York, and extends back to the hills, has remained in its preſent form and ſituation ever ſince the flood; or, whether it has been made by the particles of earth which have been waſhed down from the adjacent mountains, and by the accumulation of ſoil from the decay of vegetable ſubſtances; or, by earth waſhed out of the Bay of Mexico by the Gulf Stream, and lodged on the coaſt; or, by the receſs of the ocean, occaſioned by a change in ſome other parts of the earth; or, from other cauſes unknown to us. Several phenomena deſerve conſideration in forming an opinion on this queſtion.

1. It is a fact well known to every perſon of obſervation who has lived in, or travelled through the ſouthern ſtates, that marine ſhells and other ſubſtances which are peculiar to the ſea ſhore, are almoſt invariably found by digging eighteen or twenty feet below the ſurface of the earth. A gentleman of veracity told the author, that in ſinking a well many miles from the ſea, he found, at the depth of twenty feet, every appearance of a ſalt marſh, that is, marſh graſs, marſh mud, and brackiſh water. In all this flat country, until you come to the hilly land, wherever you dig a well, you find the water, at a certain depth, freſh and tolerably good; but if you exceed that depth two or three feet, you come to a ſaltiſh or brackiſh water that is ſcarcely drinkable; and the earth dug up, reſembles, in appearance and ſmell, that which is dug up on the edges of the ſalt marſhes.

2. On and near the margin of the rivers are frequently found ſand hills, which appear to have been drifted into ridges by the force of water. At the bottom of ſome of the banks in the rivers, fifteen or twenty feet below the ſurface of the earth, are waſhed out from the ſolid ground, logs, branches and leaves of trees; and the whole bank, from bottom to top, appears ſtreaked with layers of logs, leaves and ſand. Theſe appearances are ſeen far up the rivers, from eighty to an hundred miles from the ſea, where, when the rivers are low, the banks are from fifteen to twenty feet high. As you proceed down the rivers towards the ſea, the banks decreaſe in height, but ſtill are formed of layers of ſand, leaves and logs, ſome of which are entirely ſound, and appear to have been ſuddenly covered to a conſiderable depth.

3. It has been obſerved that the rivers in the ſouthern ſtates, frequently vary their channels; that the ſwamps and low grounds are conſtantly filling up; and that the land, in many places, annually infringes upon the ocean. It is an authenticated fact, that no longer ago than 1771, at Cape Lookout, on the coaſt of North Carolina, in about latitude 34° 50′, there was an excellent harbour, capacious enough to receive an hundred ſail of ſhipping at a time, in a good depth of water. It is now entirely filled up, and is ſolid ground. Inſtances of this kind are frequent along the coaſt.

It is obſervable, likewiſe, that there is a gradual deſcent

(F) There is a tradition that Long Iſland and the adjacent Continent were, in former days, ſeparated only by a ſmall river, and that the aboriginal inhabitants of this place could ſtep from rock to rock, and croſs this "arm of the ſea," as it may now be called, at *Hell Gate*. *Dr Mitchill*.

deſcent of about eight hundred feet, by meaſurement, from the foot of the mountains to the ſea board. This deſcent continues, as is demonſtrated by ſoundings, far into the ſea.

4. It is worthy of obſervation, that the ſoil on the banks of the rivers is proportionably coarſe or fine according to its diſtance from the mountains. When you firſt leave the mountains, and for a conſiderable diſtance, it is obſervable, that the ſoil is coarſe, with a large mixture of ſand and ſhining heavy particles. As you proceed toward the ſea, the ſoil is leſs coarſe, and ſo on, in proportion as you advance, the ſoil is finer and finer, until, finally, is depoſited a ſoil ſo fine, that it conſolidates into perfect clay; but a clay of a peculiar quality, for a great part of it has intermixed with it reddiſh ſtreaks and veins, like a ſpecies of *ochre*, brought probably from the *red lands* which lie up towards the mountains. This clay, when dug up and expoſed to the weather, will diſſolve into a fine mould, without the leaſt mixture of ſand or any gritty ſubſtance whatever. Now we know that running waters, when turbid, will depoſit, firſt, the coarſeſt and heavieſt particles, mediately, thoſe of the ſeveral intermediate degrees of fineneſs, and ultimately, thoſe which are the moſt light and ſubtle; and ſuch in fact is the general quality of the ſoil on the banks of the ſouthern rivers.

5. It is a well known fact, that on the banks of Savannah river, about ninety miles from the ſea, in a direct line, and one hundred and fifty or two hundred, as the river runs, there is a very remarkable collection of oyſter-ſhells of an uncommon ſize. They run in a north-eaſt and ſouth-weſt direction, nearly parallel to the ſea coaſt, in three diſtinct ridges, which together occupy a ſpace of ſeven miles in breadth. The ridges commence at Savannah river, and have been traced as far ſouth as the northern branches of the Alatamaha river. They are found in ſuch quantities, as that the Indigo planters carry them away in large boat loads for the purpoſe of making lime water, to be uſed in the manufacture of indigo. There are thouſands and thouſands of tons ſtill remaining (G). The queſtion is, how came they here? It cannot be ſuppoſed that they were carried by land. Neither is it probable that they were conveyed in canoes or boats to ſuch a diſtance from the place where oyſters are now found. The uncivilized natives, agreeably to their roving manner of living, would rather have removed to the ſea ſhore, than have been at ſuch immenſe labour in procuring oyſters. Beſides, the difficulties of conveying them would have been inſurmountable. They would not only have had a ſtrong current in the river againſt them, an obſtacle which would not have been eaſily overcome by the Indians, who have ever had a great averſion to labour; but could they have ſurmounted this difficulty, oyſters conveyed ſuch a diſtance, either by land or water, in ſo warm a climate, would have ſpoiled on the paſſage, and have become uſeleſs. The circumſtance of theſe ſhells being found in ſuch quantities, at ſo great a diſtance from the ſea, can be rationally accounted for in no other way, than by ſuppoſing that the ſea ſhore was formerly near this bed of ſhells, and that the ocean has ſince, by the operation of certain cauſes not yet fully inveſtigated, receded. Theſe phenomena, as they cannot be otherwiſe accounted for, prove as far as it can be proved, that a great part of the flat country which ſpreads eaſterly of the Allegany mountains, had, in ſome paſt period, a ſuperincumbent ſea or water; but it is beyond the abilities of man to account for the change in a ſatisfactory manner.

The tract of country eaſt of Hudſon's river, comprehending part of the State of New York, the four New England States, and Vermont, is rough, hilly, and in ſome parts mountainous. In all parts of the world, and particularly on this weſtern continent, it is obſervable, that as you depart from the ocean or from a river, the land gradually riſes: and the height of land, in common, is about equally diſtant from the water on either ſide. The *Andes*, in South America, form the height of land between the Atlantic and Pacific Oceans. The Highlands between the diſtrict of Maine and the Province of Lower Canada, divide the rivers which fall into the St Lawrence, north, and into the Atlantic, ſouth. The Green Mountains, in Vermont, divide the waters which flow eaſterly into Connecticut river from thoſe which fall weſterly into Lake Champlaine, Lake George, and Hudſon's river.

Between the Atlantic, the Miſſiſſippi, and the Lakes, runs a long range of mountains, made up of a number of ridges. Theſe mountains extend north-eaſterly and ſouth-weſterly, nearly parallel to the ſea coaſt, about nine hundred miles in length, and from ſixty to one hundred and fifty, and two hundred miles in breadth. Mr Evans obſerves, with reſpect to that part of theſe mountains which he travelled over, viz. in the back parts of Pennſylvania, that ſcarcely one acre in ten is capable of culture. This, however, is not the caſe in all parts of this range. Numerous tracts of fine arable and

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(G) " On the Georgia ſide of the river, about 15 miles below Silver Bluff, the high road croſſes a ridge of high ſwelling hills of uncommon elevation, and perhaps 70 feet higher than the ſurface of the river. Theſe hills are from three feet below the common vegetative ſurface, to the depth of 20 or 30 feet, compoſed entirely of foſſil oyſter-ſhells, internally of the colour and conſiſtency of clear white marble: They are of an incredible magnitude, generally 15 or 20 inches in length; from 6 to 8 wide, and from 2 to 4 in thickneſs, and their hollows ſufficient to receive an ordinary man's foot. They appear all to have been opened before the period of petrifaction; a tranſmutation they ſeem evidently to have ſuffered. They are undoubtedly very ancient, or perhaps antediluvian. The adjacent inhabitants burn them to lime, for building, for which purpoſe they ſerve very well; and would undoubtedly afford an excellent manure, when their lands require it, theſe hills now being remarkably fertile. The heaps of ſhells lie upon a *ſtratum* of yellowiſh ſand mould, of ſeveral feet in depth, upon a foundation of ſoft white rocks, that has the outward appearance of free ſtone, but on ſtrict examination is really a teſtaceous concrete, or compoſition of ſand and pulveriſed ſea ſhells. In ſhort, this teſtaceous rock approaches near in quality and appearance to the Bahama or Bermudian white rock." [*Bartram's Travels, p.* 318.]

and grazing land intervene between the ridges. The different ridges which compoſe this immenſe range of mountains have different names in different ſtates.

As you advance from the Atlantic, the firſt ridge in Pennſylvania, Virginia, and North Carolina, is the Blue Ridge, or South Mountain, which is from one hundred and thirty to two hundred miles from the ſea. Between this and the North Mountain ſpreads a large fertile vale; next lies the Allegany ridge; next beyond this is the Long Ridge, called the Laurel Mountains, in a ſpur of which, about latitude 36°, is a ſpring of water, fifty feet deep, very cold, and it is ſaid, as blue as indigo. From theſe ſeveral ridges, proceed innumerable nameleſs branches or ſpurs. The Kittatinny Mountains run through the northern parts of New Jerſey and Pennſylvania. All theſe ridges, except the Allegany, are ſeparated by rivers, which appear to have forced their paſſages through ſolid rocks.

The principal ridge is the Allegany, which has been deſcriptively called the *back bone* of the United States. The general name for theſe mountains, taken collectively, ſeems not yet to have been determined. Mr Evans calls them the *Endleſs Mountains*: others have called them the *Appalachian* mountains, from a tribe of Indians, who live on a river which proceeds from this mountain, called the Appalachicola. But the moſt common name is the *Allegany Mountains*, ſo called, either from the principal ridge of the range, or from their running nearly parallel to the Allegany or Ohio River; which, from its head waters till it empties into the Miſſiſſippi, is known and called by the name of *Allegany River*, by the Seneca and other tribes of the Six Nations, who once inhabited it. Theſe mountains are not confuſedly ſcattered and broken, riſing here and there into high peaks, overtopping each other, but ſtretch along in uniform ridges, ſcarcely half a mile high. They ſpread as you proceed ſouth, and ſome of them terminate in high perpendicular bluffs. Others gradually ſubſide into a level country, giving riſe to the rivers which run ſoutherly into the Gulf of Mexico.

They afford many curious phenomena, from which naturaliſts have deduced many theories of the earth; ſome of them have been very whimſical. Mr Evans ſuppoſes that the moſt obvious of the theories which have been formed of the earth is, that it was originally made out of the ruins of another. "Bones and ſhells which eſcaped the fate of ſofter animal ſubſtances, we find mixed with the old materials, and elegantly preſerved in the looſe ſtones and rocky baſes of the higheſt of theſe hills." With deference, however, to Mr Evans's opinion, theſe appearances have been much more rationally accounted for by ſuppoſing the reality of the flood, of which Moſes has given us an account. Mr Evans thinks this too great a miracle to obtain belief. But whether is it a greater miracle for the Creator to alter a globe of earth by a deluge, when made, or to create one new from the ruins of another? The former certainly is not leſs credible than the latter. "Theſe mountains," ſays our author, "exiſted in their preſent elevated height before the deluge, but not ſo bare of ſoil as now." How Mr Evans came to be ſo circumſtantially acquainted with theſe pretended facts, is difficult to determine, unleſs we ſuppoſe him to have been an Antediluvian, and to have ſurveyed them accurately before the convulſions of the deluge; and until we can be fully aſſured of this, we muſt be excuſed in not aſſenting to his opinion, and in adhering to the old philoſophy of Moſes and his advocates. We have every reaſon to believe that the primitive ſtate of the earth was totally metamorphoſed by the firſt convulſion of nature, at the time of the deluge; that *the fountains of the great deep were indeed broken up*, and that the various *ſtrata* of the earth were diſſevered, and thrown into every poſſible degree of confuſion and diſorder. Hence thoſe vaſt piles of mountains which lift their craggy cliffs to the clouds, were probably thrown together from the floating ruins of the earth: And this conjecture is remarkably confirmed by the vaſt number of foſſils and other marine *exuviæ* which are found imbedded on the tops of the mountains, in the interior parts of continents remote from the ſea, in all parts of the world hitherto explored. The various circumſtances attending theſe marine bodies, leave us to conclude, that they were actually generated, lived, and died in the very beds wherein they were found, and therefore theſe beds muſt have originally been at the bottom of the ocean, though now in many inſtances elevated ſeveral miles above its ſurface. Hence it has been ſuppoſed that mountains and continents were not primary productions of nature, but of a very diſtant period of time from the creation of the world; a time long enough for the *ſtrata* to have acquired their greateſt degree of coheſion and hardneſs; and for the teſtaceous matter of marine ſhells to become changed to a ſtony ſubſtance; for in the fiſſures of the lime-ſtone and other ſtrata, fragments of the ſame ſhell have been frequently found adhering to each ſide of the cleft, in the very ſtate in which they were originally broken; ſo that if the ſeveral parts were brought together, they would apparently tally with each other exactly. A very conſiderable time therefore muſt have elapſed between the chaotic ſtate of the earth and the deluge, which agrees with the account of Moſes, who makes it a little upwards of ſixteen hundred years. Theſe obſervations are intended to ſhow, in one inſtance out of many others, the agreement between revelation and reaſon, between the account which Moſes gives us of the creation and deluge, and the preſent appearances of nature.

In the United States are to be found every ſpecies of ſoil that the earth affords. In one part of them or another, they produce all the various kinds of fruits, grain, pulſe and hortuline plants and roots, which are found in Europe, and have been thence tranſplanted to America. Beſides theſe, a great variety of native, vegetable productions.

The natural hiſtory of the American States, is yet in its infancy. The productions of the ſouthern ſtates and of Canada, have not been well deſcribed by any one author, in a work profeſſedly for that purpoſe; but are moſtly intermixed with the productions of other parts of the world, in the large works of European Botaniſts. This renders it difficult to ſelect them, and to give an accurate connected account of them. To remedy this inconvenience, and to reſcue this country from the reproach of not having any authentic and ſcientific account of its Natural Hiſtory, Rev. Dr Cutler, who has already examined nearly all the vegetables of New England, has for ſome time contemplated the publication of a botanical work of conſiderable magnitude, confined principally to the productions of the New England

States. Dr Barton, of Philadelphia, has been collecting materials for a work of a ſimilar nature, to comprehend the middle and ſouthern ſtates; when finiſhed, both together, will form a complete Natural Hiſtory of the American States.

The birds of America, ſays Cateſby, generally exceed thoſe of Europe in the beauty of their plumage, but are much inferior to them in the melody of their notes.

The middle ſtates, including Virginia, appear to be the climates, in North America, where the greateſt number and variety of birds of paſſage celebrate their nuptials and rear their offspring, with which they annually return to more ſouthern regions. Moſt of our birds are birds of paſſage from the ſouthward. The eagle, the pheaſant, grous and partridge of Pennſylvania, ſeveral ſpecies of woodpeckers, the crow, blue jay, robin, marſh wren, ſeveral ſpecies of ſparrows or ſnow birds, and the ſwallow, are perhaps nearly all the land birds that continue the year round to the northward of Virginia.

Very few tribes of birds build or rear their young in the ſouth or maritime parts of Virginia, in Carolina, Georgia and Florida; yet all thoſe numerous tribes, particularly of the ſoft billed kind, which breed in Pennſylvania, paſs, in the ſpring ſeaſon, through theſe regions in a few weeks time, making but very ſhort ſtages by the way; and again, but few of them winter there on their return ſouthwardly.

It is not known how far to the ſouth they continue their route, during their abſence from the northern and middle ſtates.

Among amphibious reptiles are the mud tortoiſe or turtle (Teſtudo denticulata.) Speckled land tortoiſe (Teſtudo carolina.) Great ſoft ſhelled tortoiſe of Florida (Teſtudo naſo cylindracea elongato, truncato. Bartram.) When full grown it weighs from 30 to 40 pounds, (ſome ſay 70 pounds) extremely fat and delicious food. Great land tortoiſe, called gopher; its upper ſhell is about 18 inches long, and from 10 to 12 broad.—Found ſouth of Savannah river.

Two ſpecies of freſh water tortoiſes inhabit the tide water rivers in the ſouthern States; one is large, weighing from 10 to 12 pounds, the back ſhell nearly of an oval form; the other ſpecies ſmall; but both are eſteemed delicious food. The tortoiſes of the northern ſtates are of ſeveral ſpecies, but have not been ſcientifically deſignated.

Of the frog kind there are many ſpecies and in great numbers. Alſo of lizards, from the alligator to the ſmall blue lizard.

Snakes are numerous, and of a great variety of kinds, ſome of which, as the rattle ſnake, are venomous and others not. They are not ſo numerous nor ſo venomous in the northern as in the ſouthern ſtates. In the latter, however, the inhabitants are furniſhed with a much greater variety of plants and herbs, which afford immediate relief to perſons bitten by theſe venomous creatures. It is an obſervation worthy of perpetual and grateful remembrance, that wherever venomous animals are found, the God of nature has kindly provided ſufficient antidotes againſt their poiſon.

Of fiſhes a vaſt variety are found in the ſeas and rivers of the United States, from the whale down to the ſmalleſt ſpecies.

United States.

A vaſt variety of inſects are found in the United States, of which ſome catalogues have been publiſhed by Dr Belknap and others.

According to the cenſus, taken by order of Congreſs, in 1790, the number of inhabitants in the United States of America, was three millions, nine hundred thirty thouſand, nearly. In this number none of the inhabitants of the Territory N. W. of the river Ohio, and but a part of the inhabitants of Tenneſſee were included. Theſe added would undoubtedly have increaſed the number to 3,950,000, at the period the cenſus was taken. According to the cenſus taken in 1800, the total number of inhabitants in the United States was five millions three hundred and five thouſand ſix hundred and ſixty ſix, including eight hundred and ninety three thouſand ſix hundred and five ſlaves.

The American Republic is compoſed of almoſt all nations, languages, characters and religions which Europe can furniſh; the greater part however, are deſcended from Britain and Ireland.

The Americans, collected together from various countries, of different habits, formed under different governments, and of different languages, cuſtoms, manners and religion, have not yet aſſimilated to that degree as to form a *national* character. We are yet an infant empire, riſing faſt to maturity, with proſpects of a vigorous and powerful manhood.

Until the revolution of 1783, Europeans were ſtrangely ignorant of America and its inhabitants. They concluded that the new world *muſt* be inferior to the old. The count de Buffon ſuppoſed that the animals in this country were uniformly leſs than in Europe, and thence concluded, that, "on this ſide of the Atlantic there is a tendency in nature to diminiſh the ſize of her productions." The Abbe Raynal, in a former edition of his works, ſuppoſed this tendency or influence had its effect on the race of whites tranſplanted from Europe, and thence had the preſumption to aſſert that "America had not yet produced one good poet, one able mathematician, one man of genius in a ſingle art or ſcience." Had the Abbe been juſtly informed, we preſume he would not have hazarded an aſſertion ſo falſe, ungenerous and injurious to the genius and character of Americans. The fact is, the United States of America have produced their full proportion of genius in the ſcience of war, in phyſics, aſtronomy and mathematics; in mechanic arts, in government, in fiſcal ſcience, in divinity, in hiſtory, in oratory, in poetry, in painting, in muſic, and the plaſtic art. So many have diſtinguiſhed themſelves in ſome of theſe branches of ſcience, and ſuch numbers are now living, that it would be an impracticable and invidious taſk to attempt an enumeration of them.

The two late important revolutions in America, which have been ſcarcely exceeded in any former period of the world, viz. that of the declaration and eſtabliſhment of independence, and that of the adoption of a new and excellent form of government without blood ſhed, have called to hiſtoric fame many great and diſtinguiſhed characters who might otherwiſe have ſlept in oblivion.

One of the moſt unamiable traits in the character of Americans, has been produced by the unjuſtifiable practice of enſlaving the negroes. The influence of ſlavery upon the morals, manners, induſtry and liberties of

United States.

a people, is extremely pernicious. But under the federal government, from the meaſures already adopted, we have reaſon to indulge the pleaſing hope, that all ſlaves in the United States, will in time be emancipated, in a manner moſt conſiſtent with their own happineſs and the true intereſt of their proprietors.

In the middle and northern ſtates there are comparatively but few ſlaves; and of courſe there is leſs difficulty in giving them their freedom. In Maſſachuſetts alone, and we mention it to their diſtinguiſhed honour, there are NONE. Societies for the manumiſſion of ſlaves have been inſtituted in Philadelphia, New York, Providence and New Haven, and laws have been enacted in the New England ſtates, to accompliſh the ſame purpoſe. And it is with pleaſure we can aſſert, from the beſt information, that the condition of the negroes in the ſouthern ſtates is much ameliorated of late, and that no further importation is likely ever to take place. The Friends, (commonly called Quakers) have evinced the propriety of their name, by their goodneſs in originating, and their vigorous exertions in executing the truly humane and benevolent deſign of freeing the negroes. It is earneſtly hoped, however, that no meaſures will be adopted or purſued, which may hazard effects ſo ſhocking as have recently taken place in the Weſt India Iſlands, or which may produce a convulſion as unfavourable to the blacks as to their owners. The evil of ſlavery, if left pretty much to its own courſe, will beſt cure itſelf. At any rate, benevolence dictates that its abolition ſhould be gradual.

The Engliſh language is univerſally ſpoken in the United States, and in it buſineſs is tranſacted, and the records are kept. It is ſpoken with great purity, and pronounced with propriety in New England, by perſons of education; and, excepting ſome corruptions in pronunciation, by all ranks of people. In the middle and ſouthern ſtates, where they have had a great influx of foreigners, the language, in many inſtances, is corrupted, eſpecially in pronunciation. Attempts are making to introduce a uniformity of pronunciation throughout the ſtates, which for political as well as other reaſons, it is hoped will meet the approbation and encouragement of all literary and influential characters (H).

Intermingled with the Americans, are the Dutch, French, Germans, Swedes and Jews; all theſe retain, in a greater or leſs degree, their native language, in which they perform their public worſhip, converſe and tranſact their buſineſs with each other.

The time, however, is anticipated, at leaſt earneſtly wiſhed for, when all improper diſtinctions ſhall be aboliſhed; and when the language, manners, cuſtoms, political and religious ſentiments of the mixed maſs of people who inhabit the United States, ſhall have become ſo aſſimilated, as that all nominal and party diſtinctions ſhall be loſt in the general and honourable name of AMERICANS.

Until the fourth of July, 1776, the preſent United States were Britiſh colonies. On that memorable day, the Repreſentatives of the United States of America, in Congreſs aſſembled, made a ſolemn declaration, in which they aſſigned their reaſons for withdrawing their allegiance from the King of Great Britain. Appealing to the Supreme Judge of the world for the rectitude of their intentions, they did, in the name and by the authority of the good people of the colonies, ſolemnly publiſh and declare, That theſe United Colonies were, and of right ought to be FREE and INDEPENDENT States; that they were abſolved from all allegiance to the Britiſh crown, and that all political connexion between them and Great Britain was, and ought to be, totally diſſolved; and that as Free and Independent States, they had full power to levy war, conclude peace, contract alliances, eſtabliſh commerce, and do all other acts and things which Independent States may of right do. For the ſupport of this declaration, with a firm reliance on the protection of divine Providence, the delegates then in Congreſs, fifty-five in number, mutually pledged to each other their lives, their fortunes, and their ſacred honour.

At the ſame time they publiſhed Articles of Confederation and Perpetual Union between the ſtates, in which they took the ſtyle of "THE UNITED STATES OF AMERICA," and agreed, that each ſtate ſhould retain its ſovereignty, freedom, and independence, and every power, juriſdiction and right not expreſsly delegated to Congreſs by the confederation. By theſe articles, the Thirteen United States ſeverally entered into a firm league of friendſhip with each other for their common defence, the ſecurity of their liberties, and their mutual and general welfare, and bound themſelves to aſſiſt each other, againſt all force offered to, or attacks that might be made upon all, or any of them, on account of religion, ſovereignty, commerce or any other pretence whatever. But for the more convenient management of the general intereſts of the United States, it was determined, that Delegates ſhould be annually appointed, in ſuch manner as the Legiſlature of each ſtate ſhould direct, to meet in Congreſs the firſt Monday in November of every year, with a power reſerved to each ſtate to recal its delegates, or any of them, at any time within the year, and to ſend others in their ſtead for the remainder of the year. No ſtate was to be repreſented in Congreſs by leſs than two, or more than ſeven members; and no perſon could be a delegate for more than three years, in any term of ſix years, nor was any perſon, being a delegate, capable of holding any office under the United States, for which he, or any other for his benefit, ſhould receive

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(H) "The northern and ſouthern ſtates differ widely in their cuſtoms, climate, produce, and in the general face of the country. The middle ſtates preſerve a medium in all theſe reſpects; they are neither ſo level and hot as the ſtates ſouth, nor ſo hilly and cold as thoſe north and eaſt. The inhabitants of the north are hardy, induſtrious, frugal, and in general well informed; thoſe of the ſouth, owing to the warmth of their climate, are more effeminate, indolent and luxurious. The fiſheries and commerce are the ſinews of the north; tobacco, rice, wheat and indigo of the ſouth. The northern ſtates are commodiouſly ſituated for trade and manufactures; the ſouthern to furniſh proviſions and raw materials; and the probability is, that the ſouthern ſtates will one day be ſupplied with northern manufactures, inſtead of European, and make their remittances in proviſions and raw materials." *MS. Journal of E. Watſon Eſq.*

receive any ſalary, fees or emolument of any kind. In determining queſtions in Congreſs, each ſtate was to have one vote. Every ſtate was bound to abide by the determinations of Congreſs in all queſtions which were ſubmitted to them by the confederation. The articles of confederation were to be invariably obſerved by every ſtate, and the Union to be perpetual; nor was any alteration at any time hereafter to be made in any of the articles, unleſs ſuch alterations be agreed to in Congreſs, and be afterwards confirmed by the legiſlatures of every ſtate. The articles of confederation were ratified by Congreſs, July 9th, 1778.

Theſe articles of confederation, being found inadequate to the purpoſes of a federal government, for obvious reaſons, delegates were choſen in each of the United States, to meet and fix upon the neceſſary amendments. They accordingly met in convention at Philadelphia, in the ſummer of 1787, and agreed to propoſe the following CONSTITUTION for the conſideration of their conſtituents, and which we here inſert at length for the general information of the people, whom it concerns to be well acquainted with the nature of their own government.

We, the People of the United States, in order to form a more perfect union, eſtabliſh juſtice, inſure domeſtic tranquiility, provide for the common defence, promote the general welfare, and ſecure the bleſſings of liberty to ourſelves and our poſterity, do ordain and eſtabliſh this Conſtitution for the United States of America.

Art. 1. Sect. 1. All legiſlative powers herein granted ſhall be veſted in a Congreſs of the United States, which ſhall conſiſt of a Senate and Houſe of Repreſentatives.

Sect. 2. The Houſe of Repreſentatives ſhall be compoſed of members choſen every ſecond year by the people of the ſeveral ſtates, and the electors in each ſtate ſhall have the qualifications requiſite for electors of the moſt numerous branch of the ſtate legiſlature.

No perſon ſhall be a Repreſentative who ſhall not have attained the age of twenty-five years, and been ſeven years a citizen of the United States, and who ſhall not, when elected, be an inhabitant of that ſtate in which he ſhall be choſen.

Repreſentatives and direct taxes ſhall be apportioned among the ſeveral ſtates which may be included within this union, according to their reſpective numbers, which ſhall be determined by adding to the whole number of free perſons, including thoſe bound to ſervice for a term of years, and excluding Indians not taxed, three-fifths of all other perſons. The actual enumeration ſhall be made within three years after the firſt meeting of the Congreſs of the United States, and within every ſubſequent term of ten years, in ſuch manner as they ſhall by law direct. The number of repreſentatives ſhall not exceed one for every thirty thouſand, but each ſtate ſhall have at leaſt one repreſentative; and until ſuch enumeration ſhall be made, the ſtate of New Hampſhire ſhall be entitled to chooſe three, Maſſachuſetts eight, Rhode Iſland and Providence Plantations one, Connecticut five, New York ſix, New Jerſey four, Pennſylvania eight, Delaware one, Maryland ſix, Virginia ten, North Carolina five, South Carolina five, and Georgia three.

When vacancies happen in the repreſentation from any ſtate, the executive authority thereof ſhall iſſue writs of election to fill ſuch vacancies.

The Houſe of Repreſentatives ſhall chooſe their Speaker and other officers; and ſhall have the ſole power of impeachment.

Sect. 3. The Senate of the United States ſhall be compoſed of two ſenators from each ſtate, choſen by the legiſlature thereof, for ſix years; and each ſenator ſhall have one vote.

Immediately after they ſhall be aſſembled, in conſequence of the firſt election, they ſhall be divided as equally as may be into three claſſes. The ſeats of the ſenators of the firſt claſs ſhall be vacated at the expiration of the ſecond year, of the ſecond claſs at the expiration of the fourth year, and of the third claſs at the expiration of the ſixth year, ſo that one third may be choſen every ſecond year; and if vacancies happen by reſignation, or otherwiſe, during the receſs of the legiſlature of any ſtate, the executive thereof may make temporary appointments until the next meeting of the legiſlature, which ſhall then fill ſuch vacancies.

No perſon ſhall be a ſenator who ſhall not have attained to the age of thirty years, and been nine years a citizen of the United States, and who ſhall not, when elected, be an inhabitant of that ſtate for which he ſhall be choſen.

The Vice Preſident of the United States ſhall be Preſident of the Senate, but ſhall have no vote, unleſs they be equally divided.

The Senate ſhall chooſe their other officers, and alſo a Preſident pro tempore in the abſence of the Vice Preſident, or when he ſhall exerciſe the office of Preſident of the United States.

The Senate ſhall have the ſole power to try all impeachments. When ſitting for that purpoſe, they ſhall be on oath or affirmation. When the Preſident of the United States is tried, the Chief Juſtice ſhall preſide; and no perſon ſhall be convicted without the concurrence of two-thirds of the members preſent.

Judgment in caſe of impeachment ſhall not extend further than to removal from office, and diſqualification to hold and enjoy any office of honour, truſt or profit under the United States; but the party convicted ſhall nevertheleſs be liable and ſubject to indictment, trial, judgment and puniſhment, according to law.

Sect. 4. The times, places and manner of holding elections for ſenators and repreſentatives, ſhall be preſcribed in each ſtate by the legiſlature thereof; but the Congreſs may at any time by law make or alter ſuch regulations, except as to the places of chooſing Senators.

The Congreſs ſhall aſſemble at leaſt once in every year, and ſuch meeting ſhall be on the firſt Monday in December, unleſs they ſhall by law appoint a different day.

Sect. 5. Each houſe ſhall be the judge of the elections, returns and qualifications of its own members, and a majority of each ſhall conſtitute a quorum to do buſineſs; but a ſmaller number may adjourn from day to day, and may be authoriſed to compel the attendance of abſent members, in ſuch manner, and under ſuch penalties as each houſe may provide.

Each houſe may determine the rules of its proceedings, puniſh its members for diſorderly behaviour, and, with the concurrence of two-thirds, expel a member.

Each houſe ſhall keep a journal of its proceedings, and from time to time publiſh the ſame, excepting ſuch parts as may in their judgment require ſecrecy; and the yeas and nays of the members of either houſe on any queſtion, ſhall, at the deſire of one-fifth of thoſe preſent, be entered on the journal.

Neither houſe, during the ſeſſion of Congreſs, ſhall, without the conſent of the other, adjourn for more than three days, nor to any other place than that in which the two houſes ſhall be ſitting.

Sect. 6. The Senators and Repreſentatives ſhall receive a compenſation for their ſervices to be aſcertained by law, and paid out of the treaſury of the United States. They ſhall in all caſes except treaſon, felony and breach of the peace, be privileged from arreſt during their attendance at the ſeſſion of their reſpective houſes, and in going to and returning from the ſame; and for any ſpeech or debate in either houſe, they ſhall not be queſtioned in any other place.

No Senator or Repreſentative ſhall, during the time for which he was elected, be appointed to any civil office under the authority of the United States, which ſhall have been created, or the emoluments whereof ſhall have been increaſed during ſuch time; and no perſon holding any office under the United States, ſhall be a member of either houſe during his continuance in office.

Sect. 7. All bills for raiſing revenue ſhall originate in the Houſe of Repreſentatives; but the Senate may propoſe or concur with amendments as on other bills.

Every bill which ſhall have paſſed the Houſe of Repreſentatives and the Senate ſhall, before it becomes a law, be preſented to the Preſident of the United States; if he approve, he ſhall ſign it, but if not, he ſhall return it, with his objections, to that houſe in which it ſhall have originated, who ſhall enter the objections at large on their journal, and proceed to re-conſider it. If, after ſuch re-conſideration, two-thirds of that houſe ſhall agree to paſs the bill, it ſhall be ſent, together with the objections to the other houſe, by which it ſhall likewiſe be re-conſidered, and if approved by two-thirds of that houſe it ſhall become a law. But in all ſuch caſes the votes of both houſes ſhall be determined by yeas and nays, and the names of the perſons voting for and againſt the bill ſhall be entered on the journal of each houſe reſpectively. If any bill ſhall not be returned by the Preſident within ten days, (Sundays excepted) after it ſhall have been preſented to him, the ſame ſhall be a law, in like manner as if he had ſigned it, unleſs the Congreſs, by their adjournment, prevent its return, in which caſe it ſhall not be a law.

Every order, reſolution, or vote, to which the concurrence of the Senate and Houſe of Repreſentatives may be neceſſary (except on a queſtion of adjournment) ſhall be preſented to the Preſident of the United States; and before the ſame ſhall take effect, ſhall be approved by him, or, being diſapproved by him, ſhall be re-paſſed by two-thirds of the Senate and Houſe of Repreſentatives, according to the rules and limitations preſcribed in the caſe of a bill.

Sect. 8. The Congreſs ſhall have power

To lay and collect taxes, duties, impoſts and exciſes; to pay the debts and provide for the common defence and general welfare of the United States; but all duties, impoſts and exciſes ſhall be uniform throughout the United States;

To borrow money on the credit of the United States:

To regulate commerce with foreign nations, and among the ſeveral ſtates, and with the Indian tribes;

To eſtabliſh an uniform rule of naturalization, and uniform laws on the ſubject of bankruptcies throughout the United States;

To coin money, regulate the value thereof, and of foreign coin, and fix the ſtandard of weights and meaſures;

To provide for the puniſhment of counterfeiting the ſecurities and current coin of the United States;

To eſtabliſh poſt offices and poſt roads;

To promote the progreſs of ſcience and uſeful arts, by ſecuring for limited times, to authors and inventors, the excluſive right to their reſpective writings and diſcoveries;

To conſtitute tribunals inferior to the ſupreme court;

To define and puniſh piracies and felonies committed on the high ſeas, and offences againſt the law of nations;

To declare war, grant letters of marque and repriſal, and make rules concerning captures on land and water;

To raiſe and ſupport armies, but no appropriation of money to that uſe ſhall be for a longer term than two years;

To provide and maintain a navy;

To make rules for the government and regulation of the land and naval forces;

To provide for calling forth the militia to execute the laws of the union, ſuppreſs inſurrections, and repel invaſions;

To provide for organizing, arming, and diſciplining the militia, and for governing ſuch part of them as may be employed in the ſervice of the United States, reſerving to the ſtates reſpectively the appointment of the officers, and the authority of training the militia according to the diſcipline preſcribed by Congreſs;

To exerciſe excluſive legiſlation in all caſes whatſoever over ſuch diſtrict (not exceeding ten miles ſquare) as may by ceſſion of particular ſtates, and the acceptance of Congreſs, become the ſeat of the government of the United States, and to exerciſe like authority over all places purchaſed by the conſent of the legiſlature of the ſtate in which the ſame ſhall be, for the erection of forts, magazines, arſenals, dockyards, and other needful buildings:—And

To make all laws which ſhall be neceſſary and proper for carrying into execution the foregoing powers, and all other powers veſted by this conſtitution in the government of the United States, or in any department or officer thereof.

Sect. 9. The migration or importation of ſuch perſons as any of the ſtates now exiſting ſhall think proper to admit, ſhall not be prohibited by the Congreſs prior to the year one thouſand eight hundred and eight, but a tax or duty may be impoſed on ſuch importation, not exceeding ten dollars for each perſon.

The privilege of the writ of habeas corpus ſhall not be ſuſpended, unleſs when in caſes of rebellion or invaſion the public ſafety may require it.

No bill of attainder or ex poſt facto law ſhall be paſſed.

No capitation, or other direct tax, ſhall be laid, unleſs in proportion to the cenſus or enumeration herein before directed to be taken.

No tax or duty ſhall be laid on articles exported from any ſtate.—

No preference ſhall be given by any regulation of commerce or revenue to the ports of one ſtate over thoſe of another; nor ſhall veſſels bound to or from one ſtate, be obliged to enter, clear, or pay duties in another.

No money ſhall be drawn from the treaſury, but in conſequence of appropriations made by law; and a regular ſtatement and account of the receipts and expenditures of all public money ſhall be publiſhed from time to time.

No title of nobility ſhall be granted by the United States; and no perſon holding any office of profit or truſt under them, ſhall, without the conſent of Congreſs, accept of any preſent, emolument, office or title of any kind whatever, from any king, prince or foreign ſtate.

Sect. 10. No ſtate ſhall enter into any treaty, alliance or confederation; grant letters of marque and repriſal; coin money; emit bills of credit; make any thing but gold and ſilver coin a tender in payment of debts; paſs any bill of attainder, ex poſt facto law, or law impairing the obligation of contracts, or grant any title of nobility.

No ſtate ſhall, without the conſent of Congreſs, lay any impoſt or duties on imports or exports, except what may be abſolutely neceſſary for executing its inſpection laws; and the net produce of all duties and impoſts, laid by any ſtate on imports or exports, ſhall be for the uſe of the treaſury of the United States; and all ſuch laws ſhall be ſubject to the reviſion and control of the Congreſs. No ſtate ſhall, without the conſent of Congreſs, lay any duty of tonnage, keep troops, or ſhips of war, in time of peace, enter into any agreement or compact with another ſtate, or with a foreign power, or engage in war, unleſs actually invaded, or in ſuch imminent danger as will not admit of delay.

Art. 2. Sect. 1. The executive power ſhall be veſted in a Preſident of the United States of America. He ſhall hold his office during the term of four years, and, together with the Vico Preſident, choſen for the ſame term, be elected as follows:

Each ſtate ſhall appoint, in ſuch manner as the legiſlature thereof may direct, a number of electors, equal to the whole number of Senators and Repreſentatives to which the ſtate may be entitled in the Congreſs; but no Senator or Repreſentative, or perſon holding an office of truſt or profit under the United States, ſhall be appointed an elector.

The electors ſhall meet in their reſpective ſtates, and vote by ballot for two perſons, of whom one at leaſt ſhall not be an inhabitant of the ſame ſtate with themſelves. And they ſhall make a liſt of all the perſons voted for, and of the number of votes for each; which liſt they ſhall ſign and certify, and tranſmit, ſealed, to the ſeat of the government of the United States, directed to the Preſident of the Senate. The Preſident of the Senate ſhall, in the preſence of the Senate and Houſe of Repreſentatives, open all the certificates, and the votes ſhall then be counted. The perſon having the greateſt number of votes ſhall be the Preſident, if ſuch number be a majority of the whole number of electors appointed; and if there be more than one who have ſuch majority, and have an equal number of votes, then the Houſe of Repreſentatives ſhall immediately chooſe by ballot one of them for Preſident; and if no perſon have a majority, then from the five higheſt on the liſt, the ſaid Houſe ſhall in like manner chooſe the Preſident. But in chooſing the Preſident, the votes ſhall be taken by ſtates, the repreſentation from each ſtate having one vote; a quorum for this purpoſe ſhall conſiſt of a member or members from two-thirds of the ſtates, and a majority of all the ſtates ſhall be neceſſary to a choice. In every caſe, after the choice of the Preſident, the perſon having the greateſt number of votes of the electors ſhall be the Vice Preſident. But if there ſhould remain two or more who have equal votes, the Senate ſhall chooſe from them by ballot the Vice Preſident.

The Congreſs may determine the time of chooſing the electors, and the day on which they ſhall give their votes; which day ſhall be the ſame throughout the United States.

No perſon, except a natural born citizen, or a citizen of the United States at the time of the adoption of this conſtitution, ſhall be eligible to the office of Preſident; neither ſhall any perſon be eligible to that office who ſhall not have attained to the age of thirty-five years, and been fourteen years a reſident within the United States.

In caſe of the removal of the Preſident from office, or of his death, reſignation, or inability to diſcharge the powers and duties of the ſaid office, the ſame ſhall devolve on the Vice Preſident, and the Congreſs may by law provide for the caſe of removal, death, reſignation or inability, both of the Preſident and Vice Preſident, declaring what officer ſhall then act as Preſident, and ſuch officer ſhall act accordingly, until the diſability be removed, or a Preſident ſhall be elected.

The Preſident ſhall, at ſtated times, receive for his ſervices a compenſation, which ſhall neither be increaſed or diminiſhed during the period for which he ſhall have been elected, and he ſhall not receive within that period any other emolument from the United States, or any of them.

Before he enter on the execution of his office, he ſhall take the following oath or affirmation.

"I do ſolemnly ſwear (or affirm) that I will faithfully execute the office of Preſident of the United States, and will, to the beſt of my ability, preſerve, protect, and defend the conſtitution of the United States."

Sect. 2. The Preſident ſhall be commander in chief of the army and navy of the United States and of the militia of the ſeveral ſtates, when called into the actual ſervice of the United States; he may require the opinion, in writing, of the principal officer in each of the executive departments, upon any ſubject relating to the duties of their reſpective offices, and he ſhall have power to grant reprieves and pardons for offences againſt the United States, except in caſes of impeachment.

He ſhall have power, by and with the advice and conſent of the Senate, to make treaties, provided two-thirds of the ſenators preſent concur; and he ſhall nominate, and by and with the advice and conſent of the Senate, ſhall appoint ambaſſadors, other public miniſters and conſuls, judges of the ſupreme court, and all other officers of the United States, whoſe appointments are not herein otherwiſe provided for, and which ſhall be eſtab-

United States.

liſhed by law. But the Congreſs may by law veſt the appointment of ſuch inferior officers as they think proper in the Preſident alone, in the courts of law, or in the heads of departments.

The Preſident ſhall have power to fill up all vacancies that may happen during the receſs of the Senate, by granting commiſſions which ſhall expire at the end of their next ſeſſion.

Sect. 3. He ſhall from time to time give to the Congreſs information of the ſtate of the Union, and recommend to their conſideration ſuch meaſures as he ſhall judge neceſſary and expedient; he may, on extraordinary occaſions, convene both houſes, or either of them, and in caſe of diſagreement between them, with reſpect to the time of adjournment, he may adjourn them to ſuch time as he ſhall think proper; he ſhall receive ambaſſadors and other public miniſters; he ſhall take care that the laws be faithfully executed, and ſhall commiſſion all the officers of the United States.

Sect. 4. The Preſident, Vice Preſident, and all civil officers of the United States, ſhall be removed from office on impeachment for, and conviction of, treaſon, bribery, or other high crimes and miſdemeanors.

Art. 3. Sect. 1. The Judicial power of the United States ſhall be veſted in one ſupreme court, and in ſuch inferior courts as the Congreſs may from time to time ordain and eſtabliſh. The Judges, both of the ſupreme and inferior courts, ſhall hold their offices during good behaviour, and ſhall, at ſtated times, receive for their ſervices a compenſation, which ſhall not be diminiſhed during their continuance in office.

Sect. 2. The judicial power ſhall extend to all caſes, in law and equity, ariſing under this conſtitution, the laws of the United States, and treaties made, or which ſhall be made, under their authority; to all caſes affecting ambaſſadors, other public miniſters and conſuls; to all caſes of admiralty and maritime juriſdiction; to controverſies to which the United States ſhall be a party; to controverſies between two or more ſtates, between a ſtate and citizens of another ſtate, between citizens of different ſtates, between citizens of the ſame ſtate claiming lands under grants of different ſtates, and between a ſtate, or the citizens thereof, and foreign ſtates, citizens or ſubjects.

In all caſes affecting ambaſſadors, other public miniſters and conſuls, and thoſe in which a ſtate ſhall be a party, the ſupreme court ſhall have original juriſdiction. In all the other caſes before mentioned, the ſupreme court ſhall have appellate juriſdiction, both as to law and fact, with ſuch exceptions, and under ſuch regulations as the Congreſs ſhall make.

The trial of all crimes, except in caſes of impeachment, ſhall be by jury; and ſuch trials ſhall be held in the ſtate where the ſaid crime ſhall have been committed; but when not committed within any ſtate, the trial ſhall be at ſuch place or places as the Congreſs may by law have directed.

Sect. 3. Treaſon againſt the United States ſhall conſiſt only in levying war againſt them, or in adhering to their enemies, giving them aid and comfort. No perſon ſhall be convicted of treaſon unleſs on the teſtimony of two witneſſes to the ſame overt act, or on confeſſion in open court.

The Congreſs ſhall have power to declare the puniſhment of treaſon, but no attainder of treaſon ſhall work corruption of blood, or forfeiture, except during the life of the perſon attainted.

Unite State

Art. 4. Sect. 1. Full faith and credit ſhall be given in each ſtate to the public acts, records, and judicial proceedings of every other ſtate. And the Congreſs may by general laws preſcribe the manner in which ſuch acts, records and proceedings ſhall be proved, and the effect thereof.

Sect. 2. The citizens of each ſtate ſhall be entitled to all privileges and immunities of citizens in the ſeveral ſtates.

A perſon charged in any ſtate with treaſon, felony, or other crime, who ſhall flee from juſtice, and be found in another ſtate, ſhall, on demand of the executive authority of the ſtate from which he fled, be delivered up, to be removed to the ſtate having juriſdiction of the crime.

No perſon held to ſervice or labour in one ſtate, under the laws thereof, eſcaping into another, ſhall in conſequence of any law or regulation therein, be diſcharged from ſuch ſervice or labour, but ſhall be delivered up on claim of the party to whom ſuch ſervice or labour may be due.

Sect. 3. New States may be admitted by the Congreſs into this union, but no new ſtate ſhall be formed or erected within the juriſdiction of any other ſtate; nor any ſtate be formed by the junction of two or more ſtates, or parts of ſtates, without the conſent of the legiſlatures of the ſtates concerned as well as of the Congreſs.

The Congreſs ſhall have power to diſpoſe of and make all needful rules and regulations reſpecting the territory or other property belonging to the United States; and nothing in this conſtitution ſhall be ſo conſtrued as to prejudice any claims of the United States, or of any particular ſtate.

Sect. 4. The United States ſhall guarantee to every ſtate in this union a republican form of government, and ſhall protect each of them againſt invaſion; and on application of the legiſlature, or of the executive (when the legiſlature cannot be convened) againſt domeſtic violence.

Art. 5. The Congreſs, whenever two-thirds of both Houſes ſhall deem it neceſſary, ſhall propoſe amendments to this conſtitution, or, on the application of the legiſlatures of two-thirds of the ſeveral ſtates, ſhall call a convention for propoſing amendments, which in either caſe, ſhall be valid to all intents and purpoſes, as part of this conſtitution, when ratified by the legiſlatures of three-fourths of the ſeveral ſtates, or by Conventions in three-fourths thereof, as the one or the other mode of ratification may be propoſed by the Congreſs: Provided, that no amendment which may be made prior to the year one thouſand eight hundred and eight ſhall in any manner affect the firſt and fourth clauſes in the ninth ſection of the firſt article; and that no ſtate, without its conſent, ſhall be deprived of its equal ſuffrage in the Senate.

Art. 6. All debts contracted and engagements entered into, before the adoption of this conſtitution, ſhall be as valid againſt the United States under this conſtitution, as under the confederation.

This conſtitution, and the laws of the United States which ſhall be made in purſuance thereof; and all treaties made, or which ſhall be made, under the authority of of the United States, ſhall be the ſupreme law of the land; and the judges in every ſtate ſhall be bound thereby, any thing in the conſtitution or laws of any ſtate to the contrary notwithſtanding.

The Senators and Repreſentatives before mentioned, and the members of the ſeveral State Legiſlatures, and all Executive and Judicial officers, both of the United States and of the ſeveral ſtates, ſhall be bound by oath or affirmation, to ſupport this conſtitution; but no religious teſt ſhall ever be required as a qualification to any office or public truſt under the United States.

Art. 7. The ratification of the conventions of nine ſtates, ſhall be ſufficient for the eſtabliſhment of this conſtitution between the ſtates ſo ratifying the ſame.

DONE in Convention, by the unanimous conſent of the ſtates preſent, the ſeventeenth day of September, in the year of our Lord one thouſand ſeven hundred and eighty-ſeven, and of the Independence of the United States of America, the Twelfth. In Witneſs whereof, we have hereunto ſubſcribed our names.

GEORGE WASHINGTON, PRESIDENT.

Signed alſo by all the Delegates which were preſent from twelve ſtates.

Atteſt. WILLIAM JACKSON, SECRETARY.

The foregoing Conſtitution has ſince been adopted by all the ſtates in the Union, as is hereafter more particularly mentioned.

The Conventions of a number of the ſtates having at the time of their adopting the Conſtitution expreſſed a deſire, in order to prevent miſconſtruction or abuſe of its powers, that further declaratory and reſtrictive clauſes ſhould be added: And as extending the ground of public confidence in the government will beſt enſure the beneficent ends of its inſtitution,

Reſolved by the Senate and Houſe of Repreſentatives of the United States of America in Congreſs aſſembled, two-thirds of both houſes concurring, That the following articles be propoſed to the legiſlatures of the ſeveral ſtates, as amendments to the Conſtitution of the United States, all or any of which articles, when ratified by three-fourths of the ſaid legiſlatures, to be valid to all intents and purpoſes, as part of the ſaid conſtitution, viz.

Articles in addition to, and amendment of, the Conſtitution of the United States of America, propoſed by Congreſs, and ratified by the Legiſlatures of the ſeveral ſtates, purſuant to the fifth Article of the original conſtitution.

Art. 1. After the firſt enumeration required by the firſt article of the Conſtitution, there ſhall be one Repreſentative for every thirty thouſand, until the number ſhall amount to one hundred, after which the proportion ſhall be ſo regulated by Congreſs, that there ſhall be not leſs than one hundred Repreſentatives, nor leſs then one Repreſentative for every forty thouſand perſons, until the number of Repreſentatives ſhall amount to two hundred, after which the proportion ſhall be ſo regulated by Congreſs, that there ſhall not be leſs than two hundred Repreſentatives, nor more than one Repreſentative for every fifty thouſand perſons.

Art. 2. No law varying the compenſation for the ſervices of the Senators and Repreſentatives ſhall take effect, until an election of Repreſentatives ſhall have intervened.

Art. 3. Congreſs ſhall make no law reſpecting an eſtabliſhment of religion, or prohibiting the free exerciſe thereof; or abridging the freedom of ſpeech, or of the preſs; or the right of the people peaceably to aſſemble, and to petition the government for a redreſs of grievances.

Art. 4. A well regulated militia being neceſſary to the ſecurity of a free ſtate, the right of the people to keep and bear arms, ſhall not be infringed.

Art. 5. No ſoldier ſhall in time of peace be quartered in any houſe without the conſent of the owner, nor in time of war, but in a manner to be preſcribed by law.

Art. 6. The right of the people to be ſecure in their perſons, houſes, papers and effects againſt unreaſonable ſearches and ſeizures, ſhall not be violated; and no warrants ſhall iſſue, but upon probable cauſe, ſupported by oath or affirmation, and particularly deſcribing the place to be ſearched, and the perſons or things to be ſeized.

Art. 7. No perſon ſhall be held to anſwer for a capital, or otherwiſe infamous crime, unleſs on a preſentment or indictment of a grand jury, except in caſes ariſing in the land or naval forces, or in the militia when in actual ſervice in time of war or public danger: nor ſhall any perſon be ſubject for the ſame offence to be twice put in jeopardy of life or limb; nor ſhall be compelled in any criminal caſe to be a witneſs againſt himſelf, nor be deprived of life, liberty or property, without due proceſs of law; nor ſhall private property be taken for public uſe without juſt compenſation.

Art. 8. In all criminal proſecutions the accuſed ſhall enjoy the right to a ſpeedy and public trial, by an impartial jury of the ſtate and diſtrict wherein the crime ſhall have been committed, which diſtrict ſhall have been previouſly aſcertained by law, and to be informed of the nature and cauſe of the accuſation; to be confronted with the witneſſes againſt him; to have compulſory proceſs for obtaining witneſſes in his favour, and to have the aſſiſtance of counſel for his defence.

Art. 9. In ſuits at common law, where the value in controverſy ſhall exceed twenty dollars, the right of trial by jury ſhall be preſerved, and no fact, tried by a jury, ſhall be otherwiſe re-examined in any court of the United States, than according to the rules of the common law.

Art. 10. Exceſſive bail ſhall not be required, nor exceſſive fines impoſed, nor cruel and unuſual puniſhments inflicted.

Art. 11. The enumeration in the Conſtitution, of certain rights, ſhall not be conſtrued to deny or diſparage others retained by the people.

Art. 12. The powers not delegated to the United States by the Conſtitution, nor prohibited by it to the States, are reſerved to the States reſpectively, or to the people.

How many of the foregoing articles have become parts of the Conſtitution, by conſent of three-fourths of the States, is not known to the writer. The following ſtates in 1796, had ratified all of them, viz. Maryland, North Carolina, South Carolina, New York, Virginia and Vermont. New Hampſhire, New Jerſey and Pennſylvania had rejected the ſecond article, and Delaware the firſt. Other amendments have ſince been propoſed.

The *Society of the Cincinnati* was inſtituted immediately on the cloſe of the war in 1783. At their firſt general meeting in Philadelphia, in May, 1784, they altered and amended the original inſtitution, and reduced

duced it to its preſent form. They denominated themſelves, "*The Society of the Cincinnati*," from the high veneration they poſſeſſed for the character of that illuſtrious Roman, *Lucius Quintus Cincinnatus.*

The perſons who conſtitute this ſociety, are all the commiſſioned and brevet officers of the army and navy of the United States, who ſerved three years, and who left the ſervice with reputation; all officers who were in actual ſervice at the concluſion of the war; all the principal ſtaff officers of the continental army; and the officers who have been deranged by the ſeveral reſolutions of Congreſs, upon the different reforms of the army.

The motives which originally induced the officers of the American army to form themſelves into a ſociety of friends, are ſummed up in a maſterly manner, in their circular letter. "Having," ſay they, "lived in the ſtricteſt habits of amity through the various ſtages of a war, unparalleled in many of its circumſtances; having ſeen the objects for which we have contended, happily attained; in the moment of triumph and ſeparation, when we were about to act the laſt pleaſing, melancholy ſcene in our military drama; pleaſing, becauſe we were to leave our country poſſeſſed of independence and peace; melancholy, becauſe we were to part, perhaps never to meet again; while every breaſt was penetrated with feelings which can be more eaſily conceived than deſcribed; while every little act of tenderneſs recurred freſh to the recollection, it was impoſſible not to wiſh our friendſhips ſhould be continued, it was extremely natural to deſire they might be perpetuated by our poſterity to the remoteſt ages. With theſe impreſſions, and with ſuch ſentiments, we candidly confeſs we ſigned the inſtitution. We knew our motives were irreproachable."

They reſt their inſtitution upon the two great pillars of Friendship and Charity. Their benevolent intentions are, to diffuſe comfort and ſupport to any of their unfortunate companions who have ſeen better days, and have merited a milder fate; to wipe the tear from the eye of the widow, who muſt have been conſigned, with her helpleſs infants, to indigence and wretchedneſs, but for this charitable inſtitution; to ſuccour the fatherleſs; to reſcue the female orphan from deſtruction; and to enable the ſon to emulate the virtues of the father. "Let us, then," they conclude, "proſecute with ardor what we have inſtituted in ſincerity; let Heaven and our own conſciences approve our conduct; let our actions be our beſt comment on our words; and let us leave a leſſon to poſterity, That the glory of Soldiers cannot be completed, without acting well the part of Citizens."

The Society have an order, viz. a Bald Eagle of gold, bearing on its breaſt the emblems deſcribed as follows:

The principal figure is Cincinnatus; three ſenators preſenting him with a ſword and other military enſigns: On a field in the back ground, his wife ſtanding at the door of their cottage; near it a plough and other inſtruments of huſbandry. Round the whole, *omnia reliquit ſervare rempublicam.* On the reverſe, the ſun riſing, a city with open gates, and veſſels entering the port; fame crowning *Cincinnatus* with a wreath, inſcribed, *virtutis premium.* Below, hands joining, ſupporting a heart; with the motto, *eſto perpetua.* Round the whole, *Societas Cincinnatorum, inſtituta, A. D.* 1783.

The three important objects of attention in the United States, are agriculture, commerce and manufactures. The richneſs of the ſoil, which amply rewards the induſtrious huſbandman; the temperature of the climate, which admits of ſteady labour; the cheapneſs of land, which tempts the foreigner from his native home; and the extenſive tracts of unſettled lands, leads us to fix on agriculture as the preſent great leading intereſt of this country. This furniſhes outward cargoes not only for all our own ſhips, but for thoſe alſo which foreign nations ſend to our ports; or in other words it pays all our importations; it ſupplies a great part of the clothing of the inhabitants, and food for them and their cattle. What is conſumed at home, including the materials for manufacturing, has been eſtimated at four or five times the value of what is exported.

The number of people employed in agriculture, is at leaſt three parts in four of the inhabitants of the United States. It follows of courſe that they form the body of the militia, who are the bulwark of the nation. The value of the property occupied by agriculture, is many times greater than the property employed in every other way. The ſettlement of waſte lands, the ſubdiviſion of farms, and the numerous improvements in huſbandry, annually increaſe the preeminence of the agricultural intereſt. The reſources we derive from it, are at all times certain and indiſpenſably neceſſary. Beſides, the rural life promotes health, by its active nature; and morality, by keeping people from the luxuries and vices of the populous towns. In ſhort, agriculture is the ſpring of our commerce, and the parent of our manufactures. It is friendly, nay it is neceſſary, to the exiſtence of a republican form of government.

The vaſt extent of ſea coaſt, which ſpreads before theſe confederated ſtates; (1) the number of excellent harbours and ſea-port towns; the numerous creeks and immenſe bays, which indent the coaſt; and the rivers, lakes and canals, which peninſulate the whole country; added to its agricultural advantages and improvements, give this part of the world ſuperior advantages for trade. Our commerce, including our exports, imports, ſhipping, manufactures and fiſheries, may properly be conſidered

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(1) When the extent of America is conſidered, boldly fronting the old world, bleſſed with every climate, capable of every production, abounding with the beſt harbours and rivers on the globe, and already overſpread with five millions of ſouls, moſtly deſcendants of Engliſhmen, inheriting all their ancient enthuſiaſm for liberty, and enterprizing almoſt to a fault; what may be expected from ſuch a people in ſuch a country? The partial hand of nature has laid off America upon a much larger ſcale than any other part of the world. Hills in America are mountains in Europe, brooks are rivers, and ponds are ſwelled into lakes. In ſhort, the map of the world cannot exhibit a country uniting ſo many natural advantages, ſo pleaſingly diverſified, and that offers ſuch abundant and eaſy reſources to agriculture, commerce and manufactures.

"In contemplating *future America*, the mind is loſt in the din of cities, in harbours and rivers clouded with ſails, and in the immenſity of her population." [*MS. Journal of Elkanah Watſon, Eſq.*]

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conſidered as forming one intereſt. This has been conſidered as the great object, and the moſt important intereſt of the New England States.

The late war, which brought about our ſeparation from Great Britain, threw our commercial affairs into great confuſion. The powers of the old confederation were unequal to the complete execution of any meaſures, calculated effectually to recover them from their deranged ſituation. Through want of power in the old Congreſs to collect a revenue for the diſcharge of our foreign and domeſtic debt, our credit was deſtroyed, and trade of conſequence greatly embarraſſed. Each ſtate, in her deſultory regulations of trade, regarded her own intereſt, while that of the union was neglected. And ſo different were the intereſts of the ſeveral ſtates, that their laws reſpecting trade often claſhed with each other, and were productive of unhappy conſequences. The large commercial ſtates had it in their power to oppreſs their neighbours; and in ſome inſtances this power was directly or indirectly exerciſed. Theſe impolitic and unjuſtifiable regulations, formed on the impreſſion of the moment, and proceeding from no uniform or permanent principles, excited unhappy jealouſies between the claſhing ſtates, and occaſioned frequent ſtagnations in their trade, and in ſome inſtances, a ſecrecy in their commercial policy. But the wiſe meaſures which have been adopted by Congreſs, under the preſent government, have extricated us from theſe embarraſſments, and put a new and pleaſing face upon our affairs. Inveſted with the adequate powers, Congreſs have formed a ſyſtem of commercial regulations, which has placed our commerce on a reſpectable, uniform and intelligible footing, adapted to promote the general intereſts of the union, with the ſmalleſt injury to the individual ſtates.

The value of the exports of theſe ſtates before the revolution is not preciſely aſcertained; but the whole exportation of North America, including the remaining Britiſh Colonies, and Newfoundland, (whoſe fiſhery alone was eſtimated at more than 2,200,000 dollars in 1775) Bermuda, and the Bahamas, were computed to have been in 1771 15,280,000 dollars. In theſe were compriſed the ſhipments between thoſe iſlands and the main, and from province to province, as every veſſel which departed from one American port to another, was obliged to clear out her cargo as if deſtined for a foreign country.

The amount of exports of the United States in the year 1799 was 33,142,187 dollars in domeſtic produce, and 45,523,335 dollars in foreign produce, total 78,665,522 dollars. In time of peace however, ſo great an amount cannot be expected.

In reſpect to the commercial intercourſe between the United States and foreign nations, as regulated by exiſting treaties, or by the laws of the land, the ſubject is too extenſive, complex and important to be embraced to advantage within a compaſs proportioned to the nature of this work.

It is aſſerted that the value of the manufactures of the United State is more than double the value of their exports in native commodities, and alſo much greater than the groſs value of all their imports, including the value of goods exported again. The American manufacturers confine their attention chiefly to articles of neceſſity, comfort and utility. Since the eſtabliſhment of the preſent federal government the manufactures have increaſed with great rapidity; and particularly thoſe of the houſehold kind, which are carried on more or leſs in the families of almoſt all the farmers and planters in the ſeveral ſtates.

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States.

Standing armies are deemed inconſiſtent with a republican government; we of courſe have none. Our military ſtrength lies in a well diſciplined militia. According to the cenſus of 1790, there were in the United States, 814,000 men of 16 years old and upwards, whites. Suppoſe that the ſuperanuated, the officers of government, and the other claſſes of people who are excuſed from military duty, amounted to 114,000, there remained at that period a militia of 700,000 men. The increaſe of this number has been in proportion to the increaſe of the whole number of inhabitants ſince the year 1790. Of the militia a great proportion are well-diſciplined, vetran troops. No nation or kingdom in Europe, can bring into the field an army of equal numbers, more formidable than can be raiſed in the United States.

The Revenue of the United States is raiſed from duties on the tonnage of veſſels entered in the United States, and on imported goods, wares and merchandize, and from an exciſe on various articles of conſumption. The amount of the duties ariſing on the tonnage of veſſels, for the year commencing October 1ſt, 1790, and ending September 30th, 1791, amounted to 145,347 dollars. The duties ariſing on goods, wares and merchandize, for the ſame year amounted to 3.006,722 dollars. The amount of the revenue from the exciſe was then eſtimated in round numbers at 400,000 dollars.

	Dols.	Cts.
Amount of the *Permanent* Revenue of the United States, 1795, ariſing from duties on imports and tonnage, on diſtilled ſpirits, poſtage of letters, patent fees, and intereſt of bank ſtock,	4,692,673	83
Temporary Revenue for the ſame period,	1,859,626	91
Total,	6,552 300	74
The Expenditures for the ſame year, for intereſt of foreign and public debt, civil and naval departments, &c.	5.481,843	84
Exceſs of Revenue beyond Expenditure,	1,070.456	90

At the cloſe of the year 1794, the debt of the United States amounted to 64,825.538 dollars and 70 cents, excluſive of the public ſtock purchaſed by means of the ſinking fund, and ſome other debts hereafter mentioned, which, if added, would have increaſed it to about 74,000,000 dollars.

The act, making proviſion for the debt of the United States, has appropriated the proceeds of the weſtern lands as a fund for the diſcharge of the public debt. And the act, making proviſion for the reduction of the public debt, has appropriated all the ſurplus of the duties on imports and tonnage, to the end of the year 1790, to the purpoſe of purchaſing the debt at the market price; and has authoriſed the Preſident to borrow the further ſum of two millions of dollars for the ſame object. Theſe meaſures ſerve to indicate the intention of the legiſlature, as early and as faſt as poſſible, to provide for the extinguiſhment of the exiſting debt.

"The foreign and domeſtic debts of the United States of America," ſays Mr. Coxe, (M) "as they appeared upon their public books on the firſt day of the current year, 1794, amounted to a little more than ſeventy-four millions of dollars. From this ſum, ſeven or eight millions are to be deducted, being different kinds of ſtock purchaſed in by means of the ſinking fund, or due upon the books or upon certificates from the United States to ſeveral of the members of the union: that is to themſelves. Of the entire balance, about fourteen millions will not bear intereſt until the year 1800. Much of the debt bears an intereſt at one half of the eſtabliſhed rate of this country. Some of it bears an intereſt of two-thirds, ſome of three-fourths, and ſome of four-fifths of the medium of the legal intereſt of the ſtates. It therefore reſults that forty-eight millions of dollars in ſpecie, about £.11,000,000 ſterling, would purchaſe or diſcharge all the debts of the United States, which they owe to individuals, or to bodies politic other than themſelves."

The preſent eligible ſituation of the United States, compared with that of Europe at large, as it reſpects taxes or contributions for the payment of all public charges, appears from the following ſtatement, furniſhed (1792) by a gentleman of acknowledged abilities. In the United States, the average proportion of his earnings which each citizen pays for the ſupport of the civil, military and naval eſtabliſhments, and for the diſcharge of the intereſt of the public debts of his country, is about *one dollar and a quarter;* equal to *two day's* labour, nearly; that is, 5 millions of dollars to 4 millions of people. In Great Britain, France, Holland, Spain, Portugal, Germany, &c. the taxes for theſe objects, on an average, amount to about *ſix dollars and a quarter*, to each perſon. Hence it appears that in the United States we enjoy the bleſſings of free government and mild laws; of perſonal liberty, and protection of property, for one-fifth part of the ſum for each individual, which is paid in Europe for the purchaſe of public benefits of a ſimilar nature, and too generally without attaining their objects: For leſs than *one-fifth*, indeed, as in European countries, in general, 10 days labour, on an average, do not amount to 6¼ dollars. In this eſtimate proper allowances are made for public debts. The Indian war in the United States, at preſent, requires nearly half a million of dollars, annually, extra; but this, being temporary only, is not taken into the eſtimate.

From the beſt data that can be collected, the taxes in the United States, for county, town and pariſh purpoſes; for the ſupport of ſchools, the poor, roads, &c. appear to be conſiderably leſs than in thoſe countries; and perhaps the objects of them, except in roads, is attained in a more perfect degree. Great preciſion is not to be expected in theſe calculations; but we have ſufficient documents to prove that we are not far from the truth. The proportion in the United States is well aſcertained; and with equal accuracy in France by Mr Neckar; and in England, Holland, Spain and other kingdoms in Europe, by him, Zimmerman, and other writers on the ſubject.

For the objects of the late war and civil government in the United States, nearly 12 millions of dollars were annually raiſed, for nine years ſucceſſively, apportioned on the number of inhabitants at that period, which amounted to a little ſhort of *four dollars* to each perſon. This was raiſed principally by direct taxes. Perhaps a contribution of *ſix dollars* a perſon would not have been ſo ſeverely felt, had a part of it been raiſed by impoſt and exciſe. Theſe ſums, raiſed for the war, by the free exertions of the people, obviate all ſuch objections as aſſert that the United States are poor; at the ſame time they evince that their ſituation is eligible and proſperous, by ſhewing how large a proportion of their earnings the people in general can apply to their private purpoſes.

A national mint was eſtabliſhed in 1791. It has ſince been provided by law that the purity and intrinſic value of the ſilver coin ſhall be equal to that of Spain; and of the gold coins, to thoſe of the ſtricteſt European nations. The government of the United States derives no profit from the coinage.

The Bank of the United States was incorporated by act of Congreſs, February 25th, 1791, by the name and ſtyle of *The Preſident, Directors and Company of the Bank of the United States.* The amount of the capital ſtock is 10 million dollars, one-fourth of which is in gold and ſilver; the other three-fourths, in that part of the public debt of the United States, which, at the time of payment, bears an accruing intereſt of 6 per cent. per annum. Two millions of this capital ſtock of 10 millions, was ſubſcribed by the Preſident, in behalf of the United States. The ſtockholders are to continue a corporate body, by the act, until the 4th day of March, 1811; and are capable, in law, of holding property to an amount not exceeding, in the whole, 15 million dollars, including the aforeſaid 10 million dollars, capital ſtock. The corporation may not at any time owe, whether by bond, bill or note, or other contract, more than 10 million dollars, over and above the monies then actually depoſited in the bank for ſafe keeping, unleſs the contracting of any greater debt ſhall have been previouſly authoriſed by a law of the United States. The corporation is not at liberty to receive more than 6 per cent. per annum for or upon its loans or diſcounts; nor to purchaſe any public debt whatever, or to deal or trade, directly or indirectly, in any thing except bills of exchange, gold or ſilver bullion, or in the ſale of goods really and truly pledged, for money lent, and not redeemed in due time, or of goods which ſhall be the produce of its bonds; they may ſell any part of the public debt of which its ſtock ſhall be compoſed. Loans not exceeding 100,000 dollars, may be made to the United States, and to particular ſtates, of a ſum not exceeding 50,000 dollars.

Offices for the purpoſes of diſcount and depoſit only, may be eſtabliſhed within the United States, upon the ſame terms, and in the ſame manner, as ſhall be practiſed at the bank. Five of theſe offices, called *Branch Banks*, have been already eſtabliſhed, viz. at Boſton, New-York, Baltimore, Charleſton, and Waſhington.

(K) View of the United States, p. 496.

The faith of the United States is pledged that no other bank ſhall be eſtabliſhed by any future law of the United States, during the continuance of the above corporation. The great benefits of this Bank, as it reſpects public credit and commerce, have already been experienced.

The conſtitution of the United States provides againſt the making of any law reſpecting an eſtabliſhment of religion, or prohibiting the free exerciſe of it. And in the conſtitutions of the reſpective ſtates, religious liberty is a fundamental principle. In this important article, our government is diſtinguiſhed from that of any of the nations in Europe. Religion here is placed on its proper baſis; without the feeble and unwarranted aid of the civil power, it is left, to be ſupported by its own evidence, by the lives of its profeſſors, and the Almighty care of its Divine Author. Its public teachers are maintained by an equal tax on property, by pew rents, monies at intereſt, marriage and burial fees, ſmall glebes, land rents, and voluntary contributions.

All being left at liberty to chooſe their own religion, the people, as might eaſily be ſuppoſed, have varied in their choice. The bulk of the people would denominate themſelves Chriſtians; a ſmall portion of them are Jews; ſome plead the ſufficiency of natural religion, and reject revelation as unneceſſary and fabulous; and many have yet their religion to chooſe. Chriſtians profeſs their religion under various forms, and with different ideas of its doctrines, ordinances and precepts. The following denominations of Chriſtians are more or leſs numerous in the United States, viz. Congregationaliſts, Preſbyterians, Dutch Reformed Church, Epiſcopalians, Baptiſts, Quakers or Friends, Methodiſts, Roman Catholics, German Lutherans, German Calviniſts or Preſbyterians, Moravians, Tunkers, Mennoniſts, Univerſaliſts and Shakers. For a particular account of theſe ſeveral ſects of Chriſtians, the reader is referred to Miſs H. Adams's "View of Religions."

Of theſe ſects of Chriſtians, Congregationaliſts are the moſt numerous. In New England alone, beſides thoſe which are ſcattered through the middle and ſouthern ſtates, there are about 1200 congregations of this denomination.

Next to Congregationaliſts, Preſbyterians are the moſt numerous denomination of Chriſtians in the United States. They have a conſtitution, by which they regulate all their eccleſiaſtical proceedings, and a confeſſion of faith, which all church officers and church members are required to ſubſcribe. Hence they have preſerved a ſingular uniformity in their religious ſentiments, and have conducted their eccleſiaſtical affairs with a great degree of order and harmony.

The body of the preſbyterians inhabit the middle and ſouthern ſtates, and are united under the ſame conſtitution. By this conſtitution, the Preſbyterians, who are governed by it, in 1796 were divided into four ſynods and eighteen preſbyteries; viz. 1. Synod of New York, 5 preſbyteries; 94 congregations; 61 ſettled miniſters.—2 Synod of Philadelphia, 6 preſbyteries; 92 congregations; 60 ſettled miniſters, beſides the miniſters and congregations belonging to Baltimore preſbytery.—3. Synod of Virginia, 4 preſbyteries; 70 congregations; 49 ſettled miniſters, excluſive of the congregations and miniſters of Tranſylvania preſbytery.—4. Synod of the Carolinas, 3 preſbyteries; 82 congregations; 42 ſettled miniſters; the miniſters and congregations in Abbington preſbytery not included. If we ſuppoſe the number of congregations in the preſbyteries which made no returns to their Synods to be 100, and the number of ſettled miniſters in the ſame to be 40, the whole number of preſbyterian congregations in this connexion, will be 438, which are ſupplied by 223 ſettled miniſters, and between 70 and 80 candidates, beſides a number of ordained miniſters who have no particular charges. Each of the four Synods meet annually; beſides which they have a joint meeting by their commiſſioners, once a year, in General Aſſembly at Philadelphia.

The Preſbyterian churches are governed by congregational, preſbyterial and ſynodical aſſemblies. Theſe aſſemblies poſſeſs no civil juriſdiction. Their power is wholly moral or ſpiritual, and that only miniſterial and declarative. They poſſeſs the right of requiring obedience to the laws of Chriſt, and of excluding the diſobedient from the privileges of the church; and the powers requiſite for obtaining evidence and inflicting cenſure; but the higheſt puniſhment to which their authority extends, is to exclude the contumacious and impenitent from the congregation of believers.

The Dutch Reformed churches in the United States, who maintain the doctrine of the ſynod of Dort, held in 1618, are between 70 and 80 in number, conſtituting ſix claſſes, which form one ſynod, ſtyled "The Dutch Reformed Synod of New York and New Jerſey." The claſſes conſiſt of miniſters and ruling elders; each claſſis delegates two miniſters and an elder to repreſent them in ſynod.

The number of Proteſtant Epiſcopal churches in the United States is not aſcertained; in New England there are between forty and fifty; but in the ſouthern ſtates they are much more numerous. Biſhops of Connecticut, New York, Pennſylvania, Virginia, Maſſachuſetts, Vermont, Maryland and South Carolina have been elected by the conventions of their reſpective ſtates, and have been duly conſecrated.

The Baptiſts, with ſome exceptions, are upon the Calviniſtic plan as to doctrines, and independents as to church government and diſcipline.

Of this denomination there were in 1793—45 Aſſociates, 1032 Churches, 1291 Miniſters, and 73471 Members.

Friends, commonly called Quakers.(L) This denomination of Chriſtians aroſe about the year 1648, and were firſt collected into religious ſocieties by their highly

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(L) They received their appellation from this circumſtance—In the year 1650, George Fox, being brought before two juſtices in Derbyſhire, one of them, ſcoffing at him, for having bidden him and thoſe about him, to *tremble* at the word of the Lord, gave to him and his followers, the name of *Quakers*; a name by which they have ſince been uſually denominated; but they themſelves adopted the appellation of *Friends*.

reſpected elder, George Fox. They came to America as early as 1656. The firſt ſettlers of Pennſylvania were all of this denomination; and the number of Friends meetings in the United States at preſent, is between 300 and 400, 250 of which are ſouth of the ſtate of New York.

The Methodiſt denomination of Chriſtians aroſe in England in 1739; and made their firſt appearance in America, about the year 1772. Their general ſtyle is, "The United Societies of the Methodiſt Epiſcopal Church."

The late celebrated Mr John Weſley, is conſidered as the father of the claſs of Methodiſts, called *Arminian Methodiſts*. The famous Mr Whitefield, was the leader of the *Calviniſtic Methodiſts*, who are numerous in England, and a few are in different parts of the United States.

In 1797, the number of *Weſleian* Methodiſts in the United States, was 46,445 whites, 12,218 blacks; of theſe 2482 were in New England, 8 only of which were blacks.

The whole number of Roman Catholics in the United States was eſtimated, in 1796, at about 50,000; one half of which were in the ſtate of Maryland. They have a Biſhop, who reſides in Maryland, and many of their congregations are large and reſpectable.

The German inhabitants in theſe ſtates, who principally belong to Pennſylvania and New York, are divided into a variety of ſects; the principal of which are Lutherans, Calviniſts or Preſbyterians, Moravians, Tunkers, and Mennoniſts. Of theſe, the German Lutherans are the moſt numerous. Of this denomination, and the German Preſbyterians or Calviniſts, who are next to them in numbers, there are upwards of 60 miniſters, in Pennſylvania—and the former have 12, and the latter 6 churches in the ſtate of New York. Many of their churches are large and ſplendid, and in ſome inſtances furniſhed with organs. Theſe two denominations live together in the greateſt harmony, often preaching in each others churches, and ſometimes uniting in the erection of a church, in which they alternately worſhip.

The Moravians are a reſpectable body of Chriſtians in theſe ſtates. Of this denomination, there were, in 1788, about 1300 ſouls in Pennſylvania; viz. at Bethlehem, between 5 and 600, which number has ſince increaſed—at Nazareth, 450; at Litiz, upwards of 300. Their other ſettlements in the United States, are at Hope, in New Jerſey, about 100 ſouls; at Wachovia, on Yadkin river, North Carolina, containing 6 churches. Beſides theſe regular ſettlements, formed by ſuch only as are members of the Brethren's Church, and live together in good order and harmony, there are in different parts of Pennſylvania, Maryland and New Jerſey, and in the cities and towns of Newport, (Rhode Iſland), New York, Philadelphia, Lancaſter, Yorktown, &c. congregations of the brethren, who have their own church and miniſter, and hold the ſame principles, doctrinal tenets, and church rites and ceremonies as the former, though their local ſituation does not admit of ſuch particular regulations as are peculiar to the regular ſettlements.

They call themſelves, "The *United Brethren of the Proteſtant Epiſcopal Church*." They are called Moravians, becauſe the firſt ſettlers in the Engliſh dominions were chiefly migrants from Moravia. Theſe were the remnant and genuine deſcendants of the church of the ancient United Brethren, eſtabliſhed in Bohemia and Moravia, as early as the year 1456. About the middle of the 16th century, they left their native country to avoid perſecution, and to enjoy liberty of conſcience, and the true exerciſe of the religion of their forefathers. They were received in Saxony, and other Proteſtant dominions, and were encouraged to ſettle among them, and were joined by many ſerious people of other denominations. They adhere to the Auguſtan Confeſſion of Faith, which was drawn up by the Proteſtant divines at the time of the reformation in Germany, in the year 1530, and preſented at the diet of the empire at Augſburg; and which, at that time, contained the doctrinal ſyſtem of all the eſtabliſhed Proteſtant churches. They retain the diſcipline of their ancient church, and make uſe of Epiſcopal ordination, which has been handed down to them in a direct line of ſucceſſion for more than three hundred years (M).

They profeſs to live in ſtrict obedience to the ordinances of Chriſt, ſuch as the obſervation of the Sabbath, Infant Baptiſm, and the Lord's Supper; and in addition to theſe, they practiſe the foot waſhing, the kiſs of love, and the uſe of the lot.

They were introduced into America by Count Zinzendorf, and ſettled at Bethlehem, which is their principal ſettlement in America, as early as 1741. Regularity, induſtry, ingenuity and economy, are characteriſtics of theſe people.

The Tunkers, ſo called in deriſion from the word *tunken, to put a morſel in ſauce*, firſt appeared in America, in the fall of the year 1719, when about twenty families landed in Philadelphia, and diſperſed themſelves in various parts of Pennſylvania. They are what are called General Baptiſts, and hold to general redemption and general ſalvation.

Their principal ſettlement was at Ephrata, ſometimes called Tunkers-town, in Lancaſter county, ſixty miles weſtward of Philadelphia. Beſides this congregation there were, in 1770, fourteen others in various other parts of Pennſylvania, and ſome in Maryland. The whole, excluſive of thoſe in Maryland, amounted to upwards of 2000 ſouls.

The Mennoniſts derive their name from Menno Simon, a native of Witmars, in Germany, a man of learning, born in the year 1505, in the time of the reformation by Luther and Calvin. He was a famous Roman Catholic preacher, till about the year 1531, when he became

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(M) See David Crantz's Hiſtory of "The Ancient and Modern United Brethren's Church, tranſlated from the German, by the Rev Benjamin La Trobe." London, 1780. Thoſe who wiſh to obtain a thorough and impartial knowledge of their religious ſentiments and cuſtoms, may ſee them excellently ſummed up in a plain but nervous ſtyle, in "An Expoſition of Chriſtian Doctrine, as taught in the Proteſtant Church of the United Brethren," written in German, by A. G. Spangenberg; and tranſlated and publiſhed in Engliſh in 1794.

came a Baptiſt. Some of his followers came into Pennſylvania from New York and ſettled at Germantown, as early as 1692. This is at preſent their principal congregation, and the mother of the reſt. Their whole number, in 1770, in Pennſylvania, was upwards of 4000, divided into thirteen churches, and forty-two congregations, under the care of fifteen ordained miniſters, and fifty-three licenſed preachers.

The denomination ſtyled Univerſaliſts, has of late years conſiderably increaſed in the United States, they have a number of churches in different places; though the tenets of the different ſocieties vary conſiderably, they all agree in the belief of General Salvation.

There is a ſmall ſect of Chriſtians called Shakers, which have exiſted in America ſince 1774, when a few of them came from England to New York, and there being joined by a few others, they ſettled at Niſqueunia, above Albany, which is their principal ſettlement: A few others are ſcattered in different parts of the country but are now diminiſhing.

The Jews are not numerous in the United States. They have ſynagogues at Savanna, Charleſton, (S. C.) Philadelphia, New York, and Newport. Beſides thoſe who reſide at theſe places, there are a few others ſcattered in different towns in the United States.

The Jews in Charleſton, among other peculiarities in burying their dead, have theſe: After the funeral dirge is ſung, and juſt before the corpſe is depoſited in the grave, the coffin is opened, and a ſmall bag of earth, taken from the grave, is carefully put under the head of the deceaſed; then ſome powder, ſaid to be earth brought from Jeruſalem, and carefully kept for this purpoſe, is taken and put upon the eyes of the corpſe, in token of their remembrance of the Holy Land, and of their expectations of returning thither in God's appointed time. Whether this cuſtom is univerſal among the Jews, is not known.

They generally expect a glorious return to the Holy Land, when they ſhall be exalted above all the nations of the earth. And they flatter themſelves that the period of their return will ſpeedily arrive, though they do not venture to fix the preciſe time.

The whole number of perſons who profeſs the Jewiſh religion, in all parts of the world, is ſuppoſed to be about three millions; who as their phraſe is, are witneſſes of the unity of *God* in all the nations in the world.

After the revolution (of which an account has been given in Encyclopædia volume 1ſt) the United States began to experience the defects of their general government. While an enemy was in the country, fear, which had firſt impelled the colonies to aſſociate in mutual defence, continued to operate as a band of political union. It gave to the reſolutions and recommendations of Congreſs the force of laws, and generally commanded a ready acquieſcence on the part of the ſtate legiſlatures. Articles of confederation and perpetual union had been framed in Congreſs, and ſubmitted to the conſideration of the ſtates, in the year 1778. Some of the ſtates immediately acceded to them; but others, which had not unappropriated lands, heſitated to ſubſcribe a compact which would give an advantage to the ſtates which poſſeſſed large tracts of unlocated lands, and were thus capable of a great ſuperiority in wealth and population. All objections, however, had been overcome, and by the acceſſion of Maryland, in March, 1781, the articles of confederation were ratified, as the frame of government for the United States.

Theſe articles, however, were framed during the rage of war, when a principle of common ſafety ſupplied the place of a coercive power in government; by men who could have had no experience in the art of governing an extenſive country, and under circumſtances the moſt critical and embarraſſing. To have offered to the people, at that time, a ſyſtem of government armed with the powers neceſſary to regulate and control the contending intereſts of thirteen States, and the poſſeſſions of millions of people, might have raiſed a jealouſy between the ſtates or in the minds of the people at large, that would have weakened the operations of war, and perhaps have rendered a union impracticable. Hence the numerous defects of the confederation.

On the concluſion of peace, theſe defects began to be felt. Each ſtate aſſumed the right of diſputing the propriety of the reſolutions of Congreſs, and the intereſt of an individual ſtate was placed in oppoſition to the common intereſt of the union. In addition to this ſource of diviſion, a jealouſy of the powers of Congreſs began to be excited in the minds of the people.

The jealouſy of the privileges of freemen had been rouſed by the oppreſſive act of the Britiſh parliament; and no ſooner had the danger from this quarter ceaſed, than the fears of the people changed their object, and were turned againſt their own rulers.

In this ſituation, there were not wanting men of induſtry and talents, who have been enemies to the revolution, and who embraced the opportunity to multiply the apprehenſions of people and increaſe the popular diſcontents. A remarkable inſtance of this happened in Connecticut. As ſoon as the tumults of war had ſubſided, an attempt was made to convince the people, that the act of Congreſs paſſed in 1778, granting to the officers of the army half pay for life, was highly unjuſt and tyrannical; and that it was but the firſt ſtep towards the eſtabliſhment of penſions and an uncontrollable deſpotiſm. The act of Congreſs, paſſed in 1783, commuting half pay for life, for five years full pay, was deſigned to appeaſe the apprehenſions of the people, and to convince them that this gratuity was intended merely to indemnify the officers for their loſſes by the depreciation of the paper currency, and not to eſtabliſh a precedent for the granting of penſions. This act however did not ſatisfy the people, who ſuppoſed that the officers had been generally indemnified for the loſs of their pay, by the grants made them from time to time by the legiſlatures of the ſeveral ſtates. Beſides, the act, while it gave five years full pay to the officers, allowed but one year's pay to the privates; a diſtinction which had great influence in exciting and continuing the popular ferment, and one that turned a large ſhare of the public rage againſt themſelves.

The moment an alarm was raiſed reſpecting this act of Congreſs, the enemies of our independence became active in blowing up the flame, by ſpreading reports unfavourable to the general government, and tending to create public diſſentions. Newſpapers, in ſome parts of the country, were filled with inflammatory publications; while falſe reports and groundleſs inſinuations were induſtriouſly circulated to the prejudice of Congreſs and the officers of the late army. Among a people feelingly alive to every thing that could affect the rights for

which

which they had been contending, theſe reports could not fail of having a powerful effect; the clamour ſoon became general; the officers of the army, it was believed, had attempted to raiſe their fortunes on the diſtreſſes of their fellow-citizens, and Congreſs become the tyrants of their country.

Connecticut was the ſeat of this uneaſineſs; although other ſtates were much agitated on the occaſion. But the inhabitants of that ſtate, accuſtomed to order and a due ſubordination to the laws, did not proceed to outrages; they took their uſual mode of collecting the ſenſe of the ſtate—aſſembled in town meetings—appointed committees to meet in convention, and conſult what meaſures ſhould be adopted to procure a redreſs of their grievances. In this convention, which was held at Middletown, ſome nugatory reſolves were paſſed, expreſſing the diſapprobation of the half-pay act, and the ſubſequent commutation of the grant for five years whole pay. The ſame ſpirit alſo diſcovered itſelf in the aſſembly at their October ſeſſion, 1783. A remonſtrance againſt the acts in favour of the officers, was framed in the houſe of repreſentatives, and notwithſtanding the upper houſe refuſed to concur in the meaſure, it was ſent to Congreſs, as already mentioned.

During this ſituation of affairs, the public odium againſt the officers was augmented by another circumſtance. The officers, juſt before the diſbanding of the army, had formed a ſociety, called by the name of the *Cincinnati*, after the Roman Dictator, Cincinnatus.

Whatever were the real views of the framers of this inſtitution, its deſign was generally underſtood to be harmleſs and honourable. The oſtenſible views of the ſociety could not however ſcreen it from popular jealouſy. A ſpirited pamphlet appeared in South Carolina, the avowed production of Mr Burke, one of the Judges of the ſupreme court in that ſtate, in which the author attempted to prove that the principles on which the ſociety was formed, would, in proceſs of time, originate and eſtabliſh an order of nobility in this country, which would be repugnant to the genius of our republican governments, and dangerous to liberty. This pamphlet appeared in Connecticut, during the commotions raiſed by the half-pay and commutation acts and contributed not a little to ſpread the flame of oppoſition.

Notwithſtanding the diſcontents of the people were general, and ready to burſt forth into ſedition, yet men of information, viz. the officers of government, the clergy, and perſons of liberal education, were moſtly oppoſed to the unconſtitutional ſteps taken by the committees and convention at Middletown. They ſupported the propriety of the meaſures of Congreſs, both by converſation and writing, proved that ſuch grants to the army were neceſſary to keep the troops together, and that the expenſe would not be enormous nor oppreſſive. During the cloſe of the year 1783, every poſſible exertion was made to enlighten the people, and ſuch was the effect of the arguments uſed by the minority, that in the beginning of the following year the oppoſition ſubſided, the committees were diſmiſſed, and tranquillity reſtored to the ſtate. In May, the legiſlature were able to carry ſeveral meaſures which had before been extremely unpopular. An act was paſſed granting the impoſt of five per cent. to Congreſs; another giving great encouragement to commerce; and ſeveral towns were incorporated with extenſive privileges, for the purpoſe of regulating the exports of the ſtate, and facilitating the collection of debts.

The oppoſition to the congreſſional acts in favour of the officers, and to the order of the Cincinnati, did not riſe to the ſame pitch in the other ſtates as in Connecticut; yet it produced much diſturbance in Maſſachuſetts, and ſome others. Jealouſy of power had been univerſally ſpread among the people of the United States. The deſtruction of the old forms of governments, and the licentiouſneſs of war, had, in a great meaſure, broken their habits of obedience; their paſſions had been inflamed by the cry of deſpotiſm; and like centinels, who have been ſuddenly ſurpriſed by the approach of an enemy, the ruſtling of a leaf was ſufficient to give them an alarm. This ſpirit of jealouſy operated with other cauſes to relax the energy of federal operations.

During the war, vaſt ſums of paper currency had been emitted by Congreſs, and large quantities of ſpecie had been introduced, towards the cloſe of the war, by the French army, and the Spaniſh trade. This plenty of money enabled the ſtates to comply with the firſt requiſitions of Congreſs; ſo that during two or three years, the federal treaſury was, in ſome meaſure, ſupplied. But when the danger of war had ceaſed, and the vaſt importations of foreign goods had leſſened the quantity of circulating ſpecie, the ſtates began to be very remiſs in furniſhing their proportion of monies. The annihilation of the credit of the paper bills had totally ſtopped their circulation, and the ſpecie was leaving the country in cargoes, for remittances to Great Britain; ſtill the luxurious habits of the people, contracted during the war, called for new ſupplies of goods; and private gratifications ſeconded the narrow policy of ſtate intereſt in defeating the operations of the general government.

Thus the revenues of Congreſs were annually diminiſhing; ſome of the ſtates wholly neglecting to make proviſion for paying the intereſt of the national debt; others making but a partial proviſion, until the ſcanty ſupplies received from a few of the richeſt ſtates, would hardly ſatiſfy the demands of the civil liſt.

This weakneſs of the federal government, in conjunction with the flood of certificates or public ſecurities, which Congreſs could neither fund nor pay, occaſioned them to depreciate to a very inconſiderable value. The officers and ſoldiers of the late army, and thoſe who furniſhed ſupplies for public exigencies, were obliged to receive for wages theſe certificates, or promiſſory notes, which paſſed at a fifth, an eighth or tenth of their nominal value; being thus deprived at once of the greateſt part of the reward due for their ſervices. Some indeed profited by ſpeculations in theſe evidences of the public debt; but ſuch as were under a neceſſity of parting with them, were robbed of that ſupport which they had a right to expect and demand from their countrymen.

Pennſylvania indeed made proviſion for paying the intereſt of her debts, both ſtate and federal; aſſuming her ſuppoſed proportion of the continental debt, and giving the creditors her own ſtate notes in exchange for thoſe of the United States. The reſources of that ſtate are immenſe, but ſhe was not able to make punctual payments, even in a depreciated paper currency.

Maſſachuſetts, in her zeal to comply fully with the requiſitions of Congreſs, and ſatiſfy the demands of her own

own creditors, laid a heavy tax upon the people. This was the immediate cauſe of the rebellion in that ſtate, in 1786. But a heavy debt lying on the ſtate, added to burdens of the ſame nature, upon almoſt every corporation within it; a decline, or rather an extinction of public credit; a relaxation and corruption of manners, and a free uſe of foreign luxuries; a decay of trade and manufactures, with a prevailing ſcarcity of money; and, above all, individuals involved in debt to each other;—theſe were the real, though more remote cauſes of the inſurrection. It was the tax which the people were required to pay, that cauſed them to feel the evils which we have enumerated: This called forth all their other grievances; and the firſt act of violence committed, was the burning or deſtroying of the tax-bill. This ſedition threw the ſtate into a convulſion which laſted about a year; courts of juſtice were violently obſtructed; the collection of debts was ſuſpended; and a body of armed troops under the command of general Lincoln, was employed, during the winter of 1786, to diſperſe the inſurgents. Yet ſo numerous were the latter in the counties of Worceſter, Hampſhire and Berkſhire, and ſo obſtinately combined to oppoſe the execution of law by force, that the governor and council of the ſtate thought proper not to entruſt general Lincoln with military powers, except to act on the defenſive, and to repel force with force, in caſe the inſurgents ſhould attack him. The leaders of the rebels, however, were not men of talents; they were deſperate, but without fortitude; and while they were ſupported with a ſuperior force, they appeared to be impreſſed with that conſciouſneſs of guilt, which awes the moſt daring wretch, and makes him ſhrink from his purpoſe. This appears by the conduct of a large party of the rebels before the magazine at Springfield; where general Shepard, with a ſmall guard was ſtationed to protect the continental ſtores. The inſurgents appeared upon the plain, with a vaſt ſuperiority of numbers, but a few ſhot from the artillery made the multitude retreat in diſorder, with the loſs of four men. This ſpirited conduct of general Shepard, with the induſtry, perſeverance and prudent firmneſs of general Lincoln, diſperſed the rebels—drove the leaders from the ſtate, and reſtored tranquillity. An act of indemnity was paſſed in the legiſlature for all the inſurgents, except a few of the leaders, on condition they ſhould become peaceable ſubjects, and take the oath of allegiance. The leaders afterwards petitioned for pardon, which, from motives of policy, was granted by the legiſlature (N).

But the loſs of public credit, popular diſturbances and inſurrections, were not the only evils which were generated by the peculiar circumſtances of the times. The emiſſions of bills of credit and tender laws, were added to the black catalogue of political diſorders.

The expedient of ſupplying the deficiencies of ſpecie, by emiſſions of paper bills, was adopted very early in the colonies. The expedient was obvious, and produced good effects. In a new country, where population is rapid, and the value of lands increaſing, the farmer finds an advantage in paying legal intereſt for money; for if he can pay the intereſt by his profits, the increaſing value of his lands will in a few years diſcharge the principal.

In no colony was this advantage more ſenſibly experienced than in Pennſylvania. The emigrations to that province were numerous; the natural population rapid; and theſe circumſtances combined, advanced the value of real property to an aſtoniſhing degree. As the firſt ſettlers there, as well as in other provinces, were poor, the purchaſe of a few foreign articles drained them of ſpecie. Indeed for many years the balance of trade muſt have neceſſarily been greatly againſt the colonies.

But bills of credit, emitted by the ſtate and loaned to the induſtrious inhabitants, ſupplied the want of ſpecie, and enabled the farmer to purchaſe ſtock. Theſe bills were generally a legal tender in all colonial or private contracts, and the ſums iſſued did not generally exceed the quantity requiſite for a medium of trade; they retained their full nominal value in the purchaſe of commodities. But as they were not received by the Britiſh merchants, in payment of their goods, there was a great demand for ſpecie and bills, which occaſioned the latter at various times to appreciate. Thus was introduced a difference between the Engliſh ſterling money and the currencies of the colonies, which remains to this day (O).

The advantages the colonies had derived from bills of credit, under the Britiſh government, ſuggeſted to Congreſs, in 1775, the idea of iſſuing bills for the purpoſe of carrying on the war. And this was perhaps their only expedient. Money could not be raiſed by taxation; it could not be borrowed. The firſt emiſſions had no other effect upon the medium of commerce, than to drive the ſpecie from circulation. But when the paper ſubſtituted for ſpecie, had, by repeated emiſſions, augmented the ſum in circulation much beyond the uſual ſum of ſpecie, the bills began to loſe their value. The depreciation continued in proportion to the ſums emitted, until ſeventy, and even one hundred and fifty nominal paper dollars, were hardly an equivalent for one Spaniſh milled dollar. Still, from the year 1775 to 1781, this depreciating paper currency was almoſt the only medium of trade. It ſupplied the place of ſpecie, and enabled Congreſs to ſupport a numerous army; until the ſum in circulation amounted to two hundred millions of dollars. But about the year 1780, ſpecie began to be plentiful, being introduced by the French army, a private trade with the Spaniſh iſlands, and an illicit intercourſe with the Britiſh garriſon at New York. This circumſtance accelerated the depreciation of paper bills, until their value had ſunk almoſt to nothing. In 1781, the merchants and brokers in the ſouthern ſtates, apprehenſive of the approaching fate of the

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(N) See a well written impartial Hiſtory of this rebellion, by the late George Richards Minot, Eſq.

(O) A Dollar in ſterling money, is 4/6. But the price of a dollar roſe in New England currency to 6ſ. in New York to 8ſ. in New Jerſey, Pennſylvania and Maryland to 7/6. in Virginia to 6ſ. in North Carolina to 8ſ. in South Carolina and Georgia to 4/8. This difference, originating between paper and ſpecie, or bills, continued afterwards to exiſt in the nominal eſtimation of gold and ſilver.

the currency, puſhed immenſe quantities of it ſuddenly into New England, made vaſt purchaſes of goods in Boſton; and inſtantly the bills vaniſhed from circulation.

The whole hiſtory of this continental paper is a hiſtory of public and private frauds. Old ſpecie debts were often paid in a depreciated currency; and even new contracts for a few weeks or days were often diſcharged with a ſmall part of the value received. From this plenty and fluctuating ſtate of the medium, ſprung hoſts of ſpeculators and itinerant traders, who left their honeſt occupations for the proſpect of immenſe gains, in a fraudulent buſineſs, that depended on no fixed principles, and the profits of which could be reduced to no certain calculations.

To increaſe theſe evils, a project was formed to fix the price of articles, and reſtrain perſons from giving or receiving more for any commodity than the price ſtated by authority. Theſe regulating acts were reprobated by every man acquainted with commerce and finance; as they were intended to prevent an effect without removing the cauſe. To attempt to fix the value of money, while ſtreams of bills were inceſſantly flowing from the treaſury of the United States, was as ridiculous as an attempt to reſtrain the riſing of water in rivers amidſt ſhowers of rain.

Notwithſtanding all oppoſition, ſome ſtates framed and attempted to enforce theſe regulating acts. The effect was, a momentary apparent ſtand in the price of articles; innumerable acts of colluſion and evaſion among the diſhoneſt; numberleſs injuries done to the honeſt; and finally a total diſregard of all ſuch regulations, and the conſequent contempt of laws and the authority of the magiſtrate.

During theſe fluctuations of buſineſs, occaſioned by the variable value of money, people loſt ſight, in ſome meaſure, of the ſteady principles which had before governed their intercourſe with each other. Speculation followed and relaxed the rigour of commercial obligations.

Induſtry likewiſe had ſuffered by the flood of money which had deluged the ſtates. The prices of produce had riſen in proportion to the quantity of money in circulation, and the demand for the commodities of the country. This made the acquiſition of money eaſy, and indolence and luxury, with their train of deſolating conſequences, ſpread themſelves among all deſcriptions of people.

But as ſoon as hoſtilities between Great Britain and America were ſuſpended, the ſcene was changed. The bills emitted by Congreſs had for ſome time before ceaſed to circulate: and the ſpecie of the country was ſoon drained off to pay for foreign goods, the importations of which exceeded all calculation. Within two years from the cloſe of the war, *a ſcarcity of money* was the general cry. The merchants found it impoſſible to collect their debts, and make punctual remittances to their creditors in Great Britain; and the conſumers were driven to the neceſſity of retrenching their ſuperfluities in living, and of returning to their ancient habits of induſtry and economy.

This change was however progreſſive and ſlow. In many of the ſtates which ſuffered by the numerous debts they had contracted, and by the diſtreſſes of war, the people called aloud for emiſſions of paper bills to ſupply the deficiency of a medium. The depreciation of the continental bills was a recent example of the ill effects of ſuch an expedient, and the impoſſibility of ſupporting the credit of paper, was urged by the oppoſers of the meaſure as a ſubſtantial argument againſt adopting it. But nothing would ſilence the popular clamour; and many men, of the firſt talents and eminence, united their voices with that of the populace. Paper money had formerly maintained its credit, and been of ſingular utility; and paſt experience, notwithſtanding a change of circumſtances, was an argument in its favour that bore down all oppoſition.

Pennſylvania, although one of the richeſt ſtates in the union, was the firſt to emit bills of credit, as a ſubſtitute for ſpecie. But the revolution had removed the neceſſity of it, at the ſame time, that it had deſtroyed the means by which its former credit had been ſupported. Lands, at the cloſe of the war, were not riſing in value; bills on London could not ſo readily be purchaſed, as while the province was dependent on Great Britain; the ſtate was ſplit into parties, one of which attempted to defeat the meaſures moſt popular with the other; and the depreciation of continental bills, with the injuries which it had done to individuals, inſpired a general diſtruſt of all public promiſes.

Notwithſtanding a part of the money was loaned on good landed ſecurity, and the faith of that wealthy ſtate pledged for the redemption of the whole at its nominal value, yet the advantages of ſpecie as a medium of commerce, eſpecially as an article of remittance to London, ſoon made a difference of ten per cent. between the bills of credit and ſpecie. This difference may be conſidered rather as an appreciation of gold and ſilver, than a depreciation of paper; but its effects, in a commercial ſtate, muſt be highly prejudicial. It opens the door to frauds of all kinds, and frauds are uſually practiſed on the honeſt and unſuſpecting, eſpecially upon all claſſes of labourers.

North Carolina, South Carolina, and Georgia, had recourſe to the ſame wretched expedient to ſupply themſelves with money; not reflecting that induſtry, frugality, and good commercial laws are the only means of turning the balance of trade in favour of a country, and that this balance is the only permanent ſource of ſolid wealth and ready money. But the bills they emitted ſhared a worſe fate than thoſe of Pennſylvania; they expelled almoſt all the circulating caſh from the States; they loſt a great part of their nominal value, they impoveriſhed the merchants, and embarraſſed the planters.

The ſtate of Virginia tolerated a baſe practice among the inhabitants of cutting dollars and ſmaller pieces of ſilver, in order to prevent it from leaving the ſtate. This pernicious practice prevailed alſo in Georgia. (P)

Maryland eſcaped the calamity of a paper currency. The houſe of delegates brought forward a bill for the emiſſion of bills of credit to a large amount; but the ſenate

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(P) A dollar was uſually cut in five pieces, and each paſſed by toll for a quarter; ſo the man who cut it gained a quarter, or rather a fifth.

ſenate firmly and ſucceſsfully reſiſted the pernicious ſcheme. The oppoſition between the two houſes was violent and tumultuous; it threatened the ſtate with anarchy; but the queſtion was carried to the people, and the good ſenſe of the ſenate finally prevailed.

New Jerſey, ſituated between two of the largeſt commercial towns in America, was conſequently drained of ſpecie. This ſtate alſo emitted a large ſum in bills of credit, which ſerved to pay the intereſt of the public debt; but the currency depreciated, as in other ſtates.

Rhode Iſland exhibited a melancholy proof of that licentiouſneſs and anarchy which always follows a relaxation of the moral principles. In a rage for ſupplying the ſtate with money, and filling every man's pocket without obliging him to earn it by his diligence, the legiſlature paſſed an act for making one hundred thouſand pounds in bills; a ſum much more than ſufficient for a medium of trade in that ſtate, even without any ſpecie. The merchants in Newport and Providence, oppoſed the act with firmneſs; and their oppoſition added freſh vigour to the reſolution of the aſſembly, and induced them to enforce the ſcheme by a legal tender of a moſt extraordinary nature. They paſſed an act, ordaining that if any creditor ſhould refuſe to take their bills, for any debt whatever, the debtor might lodge the ſum due, with a juſtice of the peace, who ſhould give notice of it in the public papers; and if the creditor did not appear and receive the money within ſix months from the firſt notice, his debt ſhould be forfeited. This act aſtoniſhed all honeſt men; and even the promoters of paper money-making in other ſtates, and other principles, reprobated this act of Rhode Iſland, as wicked and oppreſſive. But the ſtate was governed by faction. During the cry for paper money, a number of boiſterous, ignorant men, were elected into the legiſlature, from the ſmaller towns in the ſtate. Finding themſelves united with a majority in opinion, they formed and executed any plan their inclination ſuggeſted; they oppoſed every meaſure that was agreeable to the mercantile intereſt; they not only made bad laws to ſuit their own wicked purpoſes, but appointed their own corrupt creatures to fill the judicial and executive departments. Their money depreciated ſufficiently to anſwer all their vile purpoſes in the diſcharge of debts; buſineſs almoſt totally ceaſed; all confidence was loſt; the ſtate was thrown into confuſion at home, and was execrated abroad.

Maſſachuſetts Bay had the good fortune, amidſt her political calamities, to prevent an emiſſion of bills of credit. New Hampſhire made no paper; but in the diſtreſſes which followed her loſs of buſineſs after the war, the legiſlature made horſes, lumber and moſt articles of produce, a legal tender in the fulfilment of contracts. It is doubtleſs unjuſt to oblige a creditor to receive any thing for his debt, which he had not in contemplation at the time of the contract. But as the commodities which were to be a tender by law, in New Hampſhire, were of an intrinſic value, bearing ſome proportion to the amount of the debt, the injuſtice of the law was leſs flagrant, than that which enforced the tender of paper in Rhode Iſland. Indeed a ſimilar law prevailed for ſome time in Maſſachuſetts; and in Connecticut it is optional with the creditor either to impriſon the debtor, or take land on execution, at a price to be fixed by three indifferent freeholders; provided no other means of payment ſhall appear to ſatiſfy the demand. It muſt not however be omitted, that while the moſt flouriſhing commercial ſtates introduced a paper medium, to the great injury of honeſt men, a bill for an emiſſion of paper in Connecticut, where there is very little ſpecie, could never command more than one-eighth of the votes of the legiſlature. The movers of the bill have hardly eſcaped ridicule: ſo generally is the meaſure reprobated, as a ſource of frauds and public miſchief.

The legiſlature of New York, a ſtate that had the leaſt neceſſity and apology for making paper money, as her commercial advantages always furniſh her with ſpecie ſufficient for a medium, iſſued a large ſum in bills of credit, which ſupported their value better than the currency of any other ſtate. Still the paper raiſed the value of ſpecie, which is always in demand for exportation, and this difference of exchange between paper and ſpecie, ever expoſes commerce to moſt of the inconveniencies reſulting from a depreciated medium.

Such is the hiſtory of paper money thus far; a miſerable ſubſtitute for real coin, in a country where the reins of government are too weak to compel the fulfilment of public engagements, and where all confidence in public faith is totally deſtroyed.

While the ſtates were thus endeavouring to repair the loſs of ſpecie, by empty promiſes, and to ſupport their buſineſs by ſhadows, rather than by reality, the Britiſh miniſtry formed ſome commercial regulations that deprived them of the profits of their trade to the Weſt Indies and Great Britain. Heavy duties were laid upon ſuch articles as were remitted to the London merchants for their goods, and ſuch were the duties upon American bottoms, that the ſtates were almoſt wholly deprived of the carrying trade. A prohibition was laid upon the produce of the United States, ſhipped to the Engliſh Weſt India Iſlands in American built veſſels, and in thoſe manned by American ſeamen. Theſe reſtrictions fell heavy upon the eaſtern ſtates, which depended much upon ſhip-building for the ſupport of their trade; and they materially injured the buſineſs of the other ſtates.

Without a union that was able to form and execute a general ſyſtem of commercial regulations, ſome of the ſtates attempted to impoſe reſtraints upon the Britiſh trade that ſhould indemnify the merchant for the loſſes he had ſuffered, or induce the Britiſh miniſtry to enter into a commercial treaty and relax the rigor of their navigation laws.

Theſe meaſures, however, produced nothing but miſchief. The ſtates did not act in concert, and the reſtraints laid on the trade of one ſtate, operated to throw the buſineſs into the hands of its neighbour. Maſſachuſetts, in her zeal to counteract the effect of the Engliſh navigation laws, laid enormous duties upon Britiſh goods imported into that ſtate; but the other ſtates did not adopt a ſimilar meaſure; and the loſs of buſineſs ſoon obliged that ſtate to repeal or ſuſpend the law. Thus when Pennſylvania laid heavy duties on Britiſh goods, Delaware and New Jerſey made a number of free ports to encourage the landing of goods within the limits of thoſe ſtates; and the duties in Pennſylvania ſerved no purpoſe, but to create ſmuggling.

Thus divided, the ſtates began to feel their weakneſs. Moſt of the legiſlatures had neglected to comply with the requiſitions of Congreſs for furniſhing the federal treaſury; the reſolves of Congreſs were diſregarded; the propoſition for a general impoſt to be laid and collected by Congreſs was negatived firſt by Rhode Iſland, and afterwards by New York. The Britiſh troops continued, under pretence of a breach of treaty on the part of America, to hold poſſeſſion of the forts on the frontiers of the ſtates. Many of the ſtates individually were infeſted with popular commotions or iniquitous tender laws, while they were oppreſſed with public debts; the certificates or public notes had loſt moſt of their value, and circulated merely as the objects of ſpeculation; Congreſs loſt their reſpectability, and the United States their credit and importance.

In the midſt of theſe calamities, a propoſition was made in 1785, in the houſe of delegates in Virginia, to appoint commiſſioners, to meet ſuch as might be appointed in the other ſtates, who ſhould form a ſyſtem of commercial regulations for the United States, and recommend it to the ſeveral legiſlatures for adoption. Commiſſioners were accordingly appointed, and a requeſt was made to the legiſlature of the other ſtates to accede to the propoſition. Accordingly ſeveral of the ſtates appointed commiſſioners, who met at Annapolis in the ſummer of 1786, to conſult what meaſures ſhould be taken to unite the ſtates in ſome general and efficient commercial ſyſtem. But as the ſtates were not all repreſented, and the powers of the commiſſioners were, in their opinion, too limited to propoſe a ſyſtem of regulations adequate to the purpoſes of government, they agreed to recommend a general convention to be held at Philadelphia the next year, with powers to frame a general plan of government for the United States. This meaſure appeared to the commiſſioners abſolutely neceſſary. The old confederation was eſſentially defective. It was deſtitute of almoſt every principle neceſſary to give effect to legiſlation.

It was defective in the article of legiſlating over ſtates, inſtead of individuals. All hiſtory teſtifies that recommendations will not operate as laws, and compulſion cannot be exerciſed over ſtates, without violence, war and anarchy. The confederation was alſo deſtitute of a ſanction to its laws. When reſolutions were paſſed in Congreſs, there was no power to compel obedience by fine, by ſuſpenſion of privileges, or other means. It was alſo deſtitute of a guarantee for the ſtate governments. Had one ſtate been invaded by its neighbour, the union was not conſtitutionally bound to aſſiſt in repelling the invaſion, and ſupporting the conſtitution of the invaded ſtate. The confederation was further deficient in the principle of apportioning the quotas of money to be furniſhed by each ſtate; in a want of power to form commercial laws, and to raiſe troops for the defence and ſecurity of the union; in the equal ſuffrage of the ſtates, which placed Rhode Iſland on a footing in Congreſs with Virginia; and to crown all the defects, we may add the want of a judiciary power, to define the laws of the union, and to reconcile the contradictory deciſions of a number of independent judicatories.

Theſe and many inferior defects were obvious to the commiſſioners, and therefore they urged a general convention, with powers to form and offer to the conſideration of the ſtates, a ſyſtem of general government that ſhould be leſs exceptionable. Accordingly in May, 1787, delegates from all the ſtates, except Rhode Iſland, aſſembled at Philadelphia, and choſe General Waſhington for their preſident. After four months deliberation, in which the claſhing intereſts of the ſeveral ſtates appeared in all their force, the convention agreed to recommend the plan of federal government which we have already recited.

As ſoon as the plan of the federal conſtitution was ſubmitted to the legiſlatures of the ſeveral ſtates, they proceeded to take meaſures for collecting the ſenſe of the people upon the propriety of adopting it. In the ſmall ſtate of Delaware, a convention was called in November, which, after a few days deliberation, ratified the conſtitution without a diſſenting voice.

In the convention of Pennſylvania, held the ſame month, there was a ſpirited oppoſition to the new form of government. The debates were long and intereſting. Great abilities and firmneſs were diſplayed on both ſides; but on the 13th of December, the conſtitution was received by two-thirds of the members. The minority were diſſatisfied, and with an obſtinacy that ill became the repreſentatives of a free people, publiſhed their reaſons of diſſent, which were calculated to inflame a party already violent, and which, in fact, produced ſome diſturbances in the weſtern part of the ſtate.

In New Jerſey, the convention which met in December, were unanimous in adopting the conſtitution; as was likewiſe that of Georgia.

In Connecticut there was ſome oppoſition; but the conſtitution was, on the 9th of January, 1788, ratified by three-fourths of the votes in convention, and the minority peaceably acquieſced in the deciſion.

In Maſſachuſetts, the oppoſition was large and reſpectable. The convention, conſiſting of more than three hundred delegates, were aſſembled in January, and continued their debates with great candor and liberality, about five weeks. At length the queſtion was carried for the conſtitution by a ſmall majority; and the minority, with that manly condeſcenſion which becomes great minds, ſubmitted to the meaſure, and united to ſupport the government.

In New Hampſhire, the federal cauſe was for ſome time doubtful. The greateſt number of the delegates in convention, were at firſt on the ſide of the oppoſition; and ſome, who might have had their objections removed by the diſcuſſion of the ſubject, were inſtructed to reject the conſtitution. Although the inſtructions of conſtituents cannot, on the true principles of repreſentation, be binding upon a deputy, in any legiſlative aſſembly, becauſe his conſtituents are but a *part* of the ſtate, and have not heard the arguments and objections of the *whole*, whereas his act is to affect the *whole* ſtate, and therefore is to be directed by the ſenſe or wiſdom of the whole, collected in the legiſlative aſſembly; yet the delegates in the New Hampſhire convention conceived very erroneouſly, that the ſenſe of the freemen in the towns, thoſe little diſtricts, where no act of legiſlation can be performed, impoſed a reſtraint upon their own wills. An adjournment was therefore moved and carried. This gave the people opportunity to gain a further knowledge of the merits of the conſtitution, and at the ſecond meeting of the convention, it was ratified by a reſpectable majority.

In Maryland, ſeveral men of abilities appeared in the oppoſition, and were unremitted in their endeavours to perſuade the people that the propoſed plan of government

ment was artfully calculated to deprive them of their deareſt rights; yet in convention it appeared that five-ſixths of the voices were in favour of it.

In South Carolina, the oppoſition was reſpectable; but two-thirds of the convention appeared to advocate and vote for the conſtitution.

In Virginia, many of the principal characters oppoſed the ratification of the conſtitution with great abilities and induſtry. But after a full diſcuſſion of the ſubject, a ſmall majority, of a numerous convention, appeared for its adoption.

In New York, two-thirds of the delegates in convention were, at their firſt meeting, determined to reject the conſtitution. Here therefore the debates were the moſt intereſting, and the event extremely doubtful. The argument was managed with uncommon addreſs and abilities on both ſides of the queſtion. But during the ſeſſion, the ninth and tenth ſtates had acceded to the propoſed plan, ſo that by the conſtitution, Congreſs were empowered to iſſue an ordinance for organizing the new government. This event placed the oppoſition on new ground; and the expediency of uniting with the other ſtates, the generous motives of conciliating all differences, and the danger of a rejection, influenced a reſpectable number, who were originally oppoſed to the conſtitution, to join the federal intereſt. The conſtitution was accordingly ratified by a ſmall majority; but the ratification was accompanied here, as in Virginia, with a bill of rights, declaratory of the ſenſe of the convention, as to certain great principles, and with a catalogue of amendments, which were to be recommended to the conſideration of the new Congreſs, and the ſeveral ſtate legiſlatures.

North Carolina met in convention in July, to deliberate on the new conſtitution. After a ſhort ſeſſion, they rejected it by a majority of one hundred and ſeventy-ſix againſt ſeventy-ſix. In November 1789, however, this ſtate again met in convention, and ratified the conſtitution by a large majority.

Rhode Iſland was doomed to be the ſport of a blind and ſingular policy. The legiſlature, in conſiſtency with the meaſures which had been before purſued, did not call a convention, to collect the ſenſe of the ſtate upon the propoſed conſtitution; but in an unconſtitutional and abſurd manner, ſubmitted the plan of government to the conſideration of the people. Accordingly it was brought before town-meetings, and in moſt of them rejected. In ſome of the large towns, particularly in Newport and Providence, the people collected and reſolved, with great propriety, that they could not take up the ſubject; and that the propoſition for embracing or rejecting the federal conſtitution, could come before no tribunal but that of the *ſtate* in convention or legiſlature. On the 24th of May, 1790, a convention of this ſtate met at Newport, and on the 29th, adopted the conſtitution by a majority of *two* only.

Vermont, in convention at Bennington, January 10th, 1791, ratified the conſtitution of the United States, by a great majority (R).

From the moment the proceedings of the general convention at Philadelphia tranſpired, the public mind was exceedingly agitated, and ſuſpended between hope and fear, until nine ſtates had ratified their plan of a federal government. Indeed the anxiety continued until Virginia and New York had acceded to the ſyſtem. But this did not prevent the demonſtrations of their joy, on the acceſſion of each ſtate.

On the ratification in Maſſachuſetts, the citizens of Boſton, in the elevation of their joy, formed a proceſſion in honour of the happy event, which was novel, ſplendid and magnificent. This example was afterwards followed, and in ſome inſtances improved upon, in Baltimore, Charleſton, Philadelphia, New Haven, Portſmouth and New York, ſucceſſively. Nothing could equal the beauty and grandeur of theſe exhibitions. A ſhip was mounted upon wheels, and drawn through the ſtreets; mechanics erected ſtages, and exhibited ſpecimens of labour in their ſeveral occupations, as they moved along the road; flags with emblems, deſcriptive of all the arts and of the federal union, were invented and diſplayed in honour of the government; multitudes of all ranks in life aſſembled to view the ſplendid ſcenes; while ſobriety, joy and harmony marked the brilliant exhibitions, by which the Americans celebrated the eſtabliſhment of their empire.

On the 3d of March, 1789, the delegates from the eleven ſtates which at that time had ratified the conſtitution, aſſembled at New York, where a convenient and elegant building had been prepared for their accommodation. On opening and counting the votes for Preſident,

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(R) The following exhibits at one view, the order, time, &c. in which the ſeveral ſtates ratified the federal conſtitution.

					Majority.
Delaware,	December	3,	1787,	unanimouſly,	
Pennſylvania,	December	13,		46 to 23	23
New Jerſey,	December	19,		unanimouſly,	
Georgia,	January	2,	1788,	unanimouſly,	
Connecticut,	January	9,		128 to 40	88
Maſſachuſetts,	February	6,		187 to 168	19
Maryland,	April	28,		63 to 12	51
South Carolina,	May	23,		149 to 73	76
New Hampſhire,	June	21,		57 to 46	11
Virginia,	June	25,		89 to 79	10
New York,	July	26,		30 to 25	5
North Carolina,	November	27,	1789,	193 to 75	118
Rhode Iſland,	May	29,	1790,		2
Vermont,	January	10,	1791,	by a great majority	
Kentucky,					

United States,
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dent, it was found that GEORGE WASHINGTON was *unanimouſly* elected to that dignified office, and that JOHN ADAMS was choſen Vice Preſident. The annunciation of the choice of the firſt and ſecond magiſtrates of the United States, occaſioned a general diffuſion of joy among the friends to the union, and fully evinced that theſe eminent characters were the choice of the people.

On the 30th of April, 1789, George Waſhington was inaugurated Preſident of the United States of America, in the city of New York. The ceremony was performed in the open gallery of Federal Hall, in the view of many thouſand ſpectators. The oath was adminiſtered by Chancellor Livingſton. Several circumſtances concurred to render the ſcene unuſually ſolemn—The preſence of the beloved Father and Deliverer of his country—the impreſſions of gratitude for his paſt ſervices—the vaſt concourſe of ſpectators—the devout fervency with which he repeated the oath, and the reverential manner in which he bowed to kiſs the ſacred volume—theſe circumſtances, together with that of his being choſen to the moſt dignified office in America, and perhaps in the world, by the unanimous voice of more than three millions of enlightened *freemen*, all conſpired to place this among the moſt auguſt and intereſting ſcenes which have ever been exhibited on this globe. For ſeveral years after the eſtabliſhment of the new conſtitution, the United States were happily diſtinguiſhed by affording a few materials for hiſtory.

The deliberations of the legiſlature of the union were marked with wiſdom, and the meaſures they adopted productive of great national proſperity. The wiſe appointments to office, which in general were made—the eſtabliſhment of a revenue and judiciary ſyſtem, and of a national bank—the aſſumption of the debts of the individual ſtates, and the encouragement given to manufactures, commerce, literature, and to uſeful inventions, opened the faireſt proſpects of the peace, union and increaſing reſpectability of the American States. Theſe proſpects have been realized.

The account of the United States which is here preſented to our readers, is extracted from that valuable work, the American Univerſal Geography, by the Rev. Dr Morſe.—To give a regular hiſtory, or even a ſketch, of the progreſs of things under the adminiſtration of the Federal government—of the wiſdom and firmneſs exhibited by the Preſident and Congreſs, in their meaſures in times the moſt critical and trying—of the intrigues and colliſions of contending parties—of the dangers, domeſtic and foreign which we have ſo happily eſcaped—and of the exiſting ſtate of our political affairs, does not fall in with the plan of this work.

UNITY, a ſettlement in Lincoln county, Diſtrict of Maine, between the Weſt Ponds, 7 or 8 miles weſt of Sidney, oppoſite to Vaſſalborough, and 15 miles north-weſt of Halowell. It lies on Sandy river, about 16 miles from its mouth.—*Morſe.*

UNITY, a townſhip of New-Hampſhire, ſituated in Cheſhire county, a few miles north-eaſt of Charleſton. It was incorporated in 1764, and contains 538 inhabitants.—*ib.*

UNITY *Town*, in Montgomery county, Maryland, lies 2 or 3 miles from Patuxent river, 11 from Montgomery court-houſe, and 24 N. of the city of Waſhington.—*ib.*

VOLCANIC *Iſland*, between Swallow Iſland and *Santa Cruz*, about 8 leagues north of the latter, in the Pacific Ocean, in which Mendana, in 1595, ſaw a volcano, which flamed continually. S. lat. 10 30.—*ib.*

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VOLUNTOWN, a townſhip on the E. line of Connecticut, Windham county, E. of Plainfield, 19 miles N. E. of Norwich, and 26 S. W. of Providence. It was ſettled in 1696, having been granted to volunteers in the Narraganſet war; hence its name. It was incorporated in 1719. It is 20 miles long, and between 3 and 4 broad, and has a large ſwamp abounding with white pine, ſufficient to ſupply the neighbouring towns with materials for building.—*ib.*

VORTICES of Des Cartes are now juſtly exploded; but being the fiction of a very ſuperior mind, they are ſtill an object of curioſity, as being the foundation of a great philoſophical romance. According to the author of that romance, the whole of infinite ſpace was full of matter; for with him matter and extenſion were the ſame, and conſequently there could be no void. This immenſity of matter he ſuppoſed to be divided into an infinite number of very ſmall cubes; all of which, being whirled about upon their own centres, neceſſarily gave occaſion to the production of two different elements. The firſt conſiſted of thoſe angular parts which, having been neceſſarily rubbed off, and grinded yet ſmaller by their mutual friction, conſtituted the moſt ſubtle and moveable part of matter. The ſecond conſiſted of thoſe little globules that were formed by the rubbing off of the firſt. The interſtices betwixt theſe globules of the ſecond element were filled up by the particles of the firſt. But in the infinite colliſions, which muſt occur in an infinite ſpace filled with matter, and all in motion, it muſt neceſſarily happen that many of the globules of the ſecond element ſhould be broken and grinded down into the firſt. The quantity of the firſt element having thus been increaſed beyond what was ſufficient to fill up the interſtices of the ſecond, it muſt, in many places, have been heaped up together, without any mixture of the ſecond along with it. Such, according to Des Cartes, was the original diviſion of matter. Upon this infinitude of matter thus divided, a certain quantity of motion was originally impreſſed by the Creator of all things, and the laws of motion were ſo adjuſted as always to preſerve the ſame quantity in it, without increaſe, and without diminution. Whatever motion was loſt by one part of matter, was communicated to ſome other; and whatever was acquired by one part of matter, was derived from ſome other: and thus, through an eternal revolution from reſt to motion, and from motion to reſt, in every part of the univerſe, the quantity of motion in the whole was always the ſame.

But as there was no void, no one part of matter could be moved without thruſting ſome other out of its place, nor that without thruſting ſome other, and ſo on. To avoid, therefore, an infinite progreſs, he ſuppoſed that the matter which any body puſhed before it rolled immediately backwards to ſupply the place of that matter which flowed in behind it; as we may obſerve in the ſwimming of a fiſh, that the water which it puſhes before it immediately rolls backwards to ſupply the place of what flows in behind it, and thus forms a ſmall circle or vortex round the body of the fiſh. It was in the ſame manner that the motion originally impreſſed by the Creator upon the infinitude of matter neceſſarily produced in it an infinity of greater and ſmaller vortices,

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tices, or circular ſtreams: and the law of motion being ſo adjuſted as always to preſerve the ſame quantity of motion in the univerſe, thoſe vortices either continued for ever, or by their diſſolution gave birth to others of the ſame kind. There was thus at all times an infinite number of greater and ſmaller vortices, or circular ſtreams, revolving in the univerſe.

But whatever moves in a circle is conſtantly endeavouring to fly off from the centre of its revolution. For the natural motion of all bodies is in a ſtraight line. All the particles of matter therefore, in each of thoſe greater vortices, were continually preſſing from the centre to the circumference, with more or leſs force, according to the different degrees of their bulk and ſolidity. The larger and more ſolid globules of the ſecond element forced themſelves upwards to the circumference, while the ſmaller, more yielding, and more active particles of the firſt, which could flow even through the interſtices of the ſecond, were forced downwards to the centre. They were forced downwards to the centre notwithſtanding their natural tendency was upwards to the circumference; for the ſame reaſon that a piece of wood, when plunged in water, is forced upwards to the ſurface, notwithſtanding its natural tendency is downwards to the bottom; becauſe its tendency downwards is leſs ſtrong than that of the particles of water, which, therefore, if one may ſay ſo, preſs in before it, and thus force it upwards. But there being a greater quantity of the firſt element than what was neceſſary to fill up the interſtices of the ſecond, it was neceſſarily accumulated in the centre of each of theſe great circular ſtreams, and formed there the fiery and active ſubſtance of the ſun. For, according to that philoſopher, the ſolar ſyſtems were infinite in number, each fixed ſtar being the centre of one; and he is among the firſt of the moderns who thus took away the boundaries of the univerſe: even Copernicus and Kepler, themſelves, have confined it within what they ſuppoſed the vault of the firmament.

The centre of each vortex being thus occupied by the moſt active and moveable parts of matter, there was neceſſarily among them a more violent agitation than in any other part of the vortex, and this violent agitation of the centre cheriſhed and ſupported the movement of the whole. But among the particles of the firſt element, which fill up the interſtices of the ſecond, there are many, which, from the preſſure of the globules on all ſides of them, neceſſarily receive an angular form, and thus conſtitute a third element of particles leſs fit for motion than thoſe of the other two. As the particles, however, of this third element were formed in the interſtices of the ſecond, they are neceſſarily ſmaller than thoſe of the ſecond, and are therefore, along with thoſe of the firſt, urged down towards the centre, where, when a number of them happen to take hold of one another, they form ſuch ſpots upon the ſurface of the accumulated particles of the firſt element, as are often diſcovered by teleſcopes upon the face of that ſun which enlightens and animates our particular ſyſtem. Thoſe ſpots are often broken and diſpelled by the violent agitation of the particles of the firſt element, as has hitherto happily been the caſe with thoſe which have ſucceſſively been formed upon the face of our ſun. Sometimes, however, they encruſt the whole ſurface of that fire which is accumulated in the centre; and the communication betwixt the moſt active and the moſt inert parts of the vortex being thus interrupted, the rapidity of its motion immediately begins to languiſh, and can no longer defend it from being ſwallowed up and carried away by the ſuperior violence of ſome other like circular ſtream; and, in this manner, what was once a ſun becomes a planet. Thus the time was, according to the ſyſtem, when the Moon was a body of the ſame kind with the ſun, the fiery centre of a circular ſtream of ether, which flowed continually round her; but her face having been cruſted over by a congeries of angular particles, the motion of this circular ſtream began to languiſh, and could no longer defend itſelf from being abſorbed by the more violent vortex of the earth, which was then, too, a ſun, and which chanced to be placed in its neighbourhood. The moon therefore became a planet, and revolved round the earth. In proceſs of time, the ſame fortune, which had thus befallen the moon, befel alſo the earth; its face was encruſted by a groſs and inactive ſubſtance; the motion of its vortex began to languiſh, and it was abſorbed by the greater vortex of the ſun: but though the vortex of the earth had thus become languid, it ſtill had force enough to occaſion both the diurnal revolution of the earth, and the monthly motion of the moon. For a ſmall circular ſtream may eaſily be conceived as flowing round the body of the earth, at the ſame time that it is carried along by that great ocean of ether which is continually revolving round the ſun; in the ſame manner, as in a great whirlpool of water, one may often ſee ſeveral ſmall whirlpools, which revolve round centres of their own, and at the ſame time are carried round the centre of the great one. Such was the cauſe of the original formation and conſequent motions of the planetary ſyſtem. When a ſolid body is turned round its centre, thoſe parts of it which are neareſt, and thoſe which are remoteſt from the centre, complete their revolutions in one and the ſame time. But it is otherwiſe with the revolutions of a fluid: the parts of it which are neareſt the centre complete their revolutions in a ſhorter time than thoſe which are remoter. The planets, therefore, all floating in that immenſe tide of ether which is continually ſetting in from weſt to eaſt round the body of the ſun, complete their revolutions in a longer or a ſhorter time, according to their nearneſs or diſtance from him.

This bold ſyſtem was eminently fitted to captivate the imagination; and though fraught with contradictions and impoſſibilities, attempts have been made to revive it, even in this country, under different names. All thoſe ſyſtems which repreſent the motions of the heavenly bodies as being the effect of the phyſical agency of ethers, of air, of fire, and of light, of which the univerſe is conceived to be full, labour under the ſame difficulties with the Carteſian hypotheſis; and very few of them, if any, are ſo neatly put together. It is ſurely ſufficient, however, to demoliſh this goodly fabric, barely to aſk how an abſolute infinity of matter can be divided into cubes, or any thing elſe? how there can poſſibly be interſtices in a perfect plenum? or how in ſuch a plenum any portion of matter can be thruſt from its place?

UPATCHAWANAN, or *Temiſcamain*, a Canadian ſettlement in N. America, in lat. 47 17 30 north.—*Morſe.*

UPPER ALLOWAYS *Creek*, in Salem county, New-Jerſey.—*ib.*

UPPER BALD EAGLE, a townſhip of Pennſylvania, in Mifflin county.—*ib.*

UPPER DISTRICT, a diviſion of Georgia, which contains the counties of Montgomery, Waſhington, Hancock, Greene, Franklin, Oglethorpe, Elbert, Wilkes, Warren, Columbia, and Richmond.—*ib.*

UPPER DUBLIN, a townſhip of Pennſylvania, in Montgomery county.—*ib.*

UPPER FREEHOLD, a townſhip of New-Jerſey, Monmouth county, adjoining to Burlington and Middleſex counties on the north and ſouth-weſt, and Freehold on the eaſt. It contains 3,442 inhabitants.—*ib.*

UPPER GREAT MONADNOCK, in the townſhip of Lemington, in the north eaſt corner of Vermont, on Connecticut river.—*ib.*

UPPER HANOVER, a townſhip of Pennſylvania, Montgomery county.—*ib.*

UPPER MARLBOROUGH, a poſt-town of Maryland, 16 miles ſouth-eaſt of Bladenſburg, 15 north-eaſt of Piſcataway, and 162 ſouth-weſt of Philadelphia.—*ib.*

UPPER MILFORD, a townſhip of Pennſylvania, Northampton county.—*ib.*

UPPER PENN'S NECK, a townſhip of New-Jerſey, Salem county.—*ib.*

UPPER SAURA, a place in North-Carolina, on Dan river, about 200 miles from Halifax.—*ib.*

UPPER SAVAGE *Iſlands*, in Hudſon's Bay. N. lat. 62 32 30, W. long. 70 48.—*ib.*

UPTON, a townſhip of Maſſachuſetts, Worceſter county, containing 900 inhabitants, diſperſed on 13,000 acres of land, favourable for orcharding, paſturage and graſs. It is weſt of Sherburne in Middleſex county, 15 miles ſouth-eaſt of Worceſter, and 38 ſouth-weſt of Boſton.—*ib.*

UPRIGHT *Bay*, near the weſt end of the Straits of Magellan. S. lat. 53 8, W. long. 75 35.—*ib.*

URACHO, a river on the eaſt coaſt of South-America, is 18 leagues W. N. W. of Caurora river.—*ib.*

URAGUA, a province in the eaſt diviſion of Paraguay, in South-America, whoſe chief town is Los Reyes.—*ib.*

URALIAN Cossacs, a people that inhabit the Ruſſian province of Orenburg in Aſia, on the ſouth ſide of the river Ural. Theſe Coſſacs are deſcended from thoſe of the Don: they are a very valiant race. They profeſs the Greek religion; but there is a kind of diſſenters from the eſtabliſhed religion, whom the Ruſſians called *Roſkolniki*, or Separatiſts, and who ſtyle themſelves *Staroverſki*, or Old Believers. They conſider the ſervice of the eſtabliſhed church as profane and ſacrilegious, and have their own prieſts and ceremonies. The Uralian Coſſacs are all enthuſiaſts for the ancient ritual, and prize their beards almoſt equal to their lives. A Ruſſian officer having ordered a number of Coſſac recruits to be publicly ſhaved in the town of Yaitſk, in 1771, this wanton inſult excited an inſurrection, which was ſuppreſſed for a time; but, in 1773, that daring impoſtor, Pugatchef, having aſſumed the name and perſon of Peter III. appeared among them, and taking advantage of this circumſtance, and of their religious prejudices, rouſed them once more into open rebellion. This being at laſt effectually ſuppreſſed by the defeat and execution of the impoſtor (See Suworow, *Suppl.*), in order to extinguiſh all remembrance of this rebellion, the river Yaik was called *Ural*; the Yaic Coſſacs were denominated *Uralian Coſſacs*; and the town of Yaitſk, *Uralſk*. The Uralian Coſſacs enjoy the right of fiſhing on the coaſt of the Caſpian Sea, for 47 miles on each ſide of the river Ural. Their principal fiſhery is for ſturgeons and beluga, whoſe roe ſupplies large quantities of caviare; and the fiſh, which are chiefly ſalted and dried, afford a conſiderable article of conſumption in the Ruſſian empire. In conſequence of theſe fiſheries, theſe Coſſacs are very rich.

URANO, a river on the north coaſt of S. America, which enters the ocean abreaſt of the weſternmoſt of the Peritas Iſlands, about 3 leagues weſtward of Comana Bay. It only admits ſmall boats and canoes. Otchier Bay is to the weſt of it.—*Morse.*

URBANNA, a ſmall poſt-town of Virginia, Middleſex county, on the ſouth-weſt ſide of Rappahannock river, 22 miles from Stingray Point, at the mouth of the river, 73 ſouth-eaſt of Fredericksburg, 73 eaſt by ſouth of Richmond, 28 from Tappahannock, and 291 from Philadelphia. Wheat is ſhipped from this to Europe, and Indian corn, &c. to New-England, Nova-Scotia, and the Weſt-Indies.—*ib.*

URBINO, a town of Italy, in the territory of the Pope, and capital of the duchy of Urbino, with an old citadel, an archbiſhop's ſee, and a handſome palace, where the dukes formerly reſided. The houſes are well built, and great quantities of fine earthen ware are made here. It is ſeated on a mountain, between the rivers Metro and Foglia, 18 miles ſouth of Rimini, 58 eaſt of Florence, and 120 north-eaſt of Rome. E. Lon. 12. 40. N. lat. 43. 46.

Urbino, a duchy of Italy, in the territory of the church, bounded on the north by the gulph of Venice; on the ſouth, by Perugino and Umbria; on the eaſt, by the marquiſate of Ancona; and on the weſt, by Tuſcany and Romagna. It is about 55 miles in length, and 45 in breadth. Here is great plenty of game and fiſh; but the air is not very wholeſome, nor is the ſoil fertile. Urbino is the capital.

URCEOLA, a lately diſcovered genus of the *pentandria* claſs, and *monogynia* order of plants, ranking immediately after Tabernæ montana (ſee *Encycl.*), and conſequently belonging to the 30th natural order or claſs called *Contortæ* by Linnæus in his natural method of arrangement. One of the qualities of the plants of this order is their yielding, on being cut, a juice which is generally milky, and for the moſt part deemed of a poiſonous nature. The genus is thus characteriſed by Dr Roxburgh; *Calyx* beneath five-toothed; corol one petaled, pitcher-ſhaped, with its contracted mouth five-toothed: nectary entire, ſurrounding the germs; follicles two, round, drupacious; ſeeds numerous, immerſed in pulp. There is but one known ſpecies, which is thus deſcribed by the ſame eminent botaniſt;

Urceola elastica: Shrubby, twining, leaves oppoſite, oblong, panicles terminal, is a native of Sumatra, Prince of Wales's Iſland, &c. Malay countries. *Stem* woody, climbing over trees, &c. to a very great extent, young ſhoots twining, and a little hairy, bark of the old woody parts thick, dark coloured, conſiderably uneven, a little ſcabrous, on which are found ſeveral ſpecies of moſs, particularly large patches of lichen; the wood is white, light and porous. *Leaves* oppoſite, ſhort-petioled, horizontal, ovate, oblong, pointed, entire, a little ſcabrous, with a few ſcattered white hairs on the under

under ſide. *Stipulus* none. *Panicles* terminal, brachiate, very ramous. *Flowers* numerous, minute, of a dull greeniſh colour, and hairy on the outſide. *Bracts* lanceolate, one at each diviſion and ſubdiviſion of the panicle. *Calyx* perianth, one-leafed, five-toothed, permanent. *Corol* one petaled, pitcher-ſhaped, hairy, mouth much contracted, five-toothed, diviſions erect, acute, nectary entire, cylindric, embracing the lower two-thirds of the germs. *Stamens*, filaments five, very ſhort from the baſe of the corol. Anthers arrow-ſhaped, converging, bearing their pollen in two grooves on the inſide, near the apex; between theſe grooves and the inſertions of the filaments they are covered with white ſoft hairs. *Piſtil*, germs two; above the nectary they are very hairy round the margins of their truncated tops. Style ſingle, ſhorter than the ſtamens. Stigma ovate, with a circular band, dividing it into two portions of different colours. *Per.* Follicles two, round, laterally compreſſed into the ſhape of a turnip, wrinkled, leathery, about three inches in their greateſt diameters—one celled, two valved. *Seeds* very numerous, reniform, immerſed in firm fleſhy pulp.

See Plate XLVII. where fig. 1. is a branchlet in flower of the natural ſize. 2. A flower magnified. 3. The ſame laid open, which expoſes to view the ſituation of the ſtamens inſerted into the bottom of the corol, the nectarium ſurrounding the lower half of the two germs, their upper half with hairy margins, the ſtyle and ovate party coloured; ſtigma appearing above the nectary. 4. Outſide of one of the ſtamens; and, 5. Inſide of the ſame, both much magnified. 6. The nectarium laid open, expoſing to view the whole of the piſtil. 7. The two ſeed veſſels (called by Linnæus *follicles*), natural ſize; half of one of them is removed, to ſhew the ſeed immerſed in pulp. A portion thereof is alſo cut away, which more clearly ſhews the ſituation and ſhape of the ſeed.

From wounds made in the bark of this plant there oozes a milky fluid, which on expoſure to the open air ſeparates into an elaſtic coagulum, and watery liquid, apparently of no uſe, after the ſeparation takes place. This coagulum is not only like the American caoutchouc or Indian rubber, but poſſeſſes the ſame properties; for which, ſee CAOUTCHOUC, both in the *Encycl.* and *Suppl.*

The chemical properties of this vegetable milk, while freſh, were found by Mr Howiſon, late ſurgeon on Prince of Wales's Iſland, ſurpriſingly to reſemble thoſe of animal milk. From its decompoſition, in conſequence of ſpontaneous fermentation, or by the addition of acids, a ſeparation takes place between its caſeous and ſerous parts, both of which are very ſimilar to thoſe produced by the ſame proceſſes from animal milk. An oily or butyrous matter is alſo one of its component parts, which appears upon the ſurface of the gum ſo ſoon as the latter has attained its ſolid form. He endeavoured to form an extract of this milk ſo as to approach to the conſiſtence of new butter, by which he hoped to retard its fermentative ſtage, without depriving it of its uſeful qualities; but as he had no apparatus for diſtilling, the ſurface of the milk, that was expoſed to the air, inſtantly formed into a ſolid coat, by which the evaporation was in a great degree prevented. He, however, learned, by collecting the thickened milk from the inſide of the coats, and depoſiting it in a jelly pot, that, if excluded from the air, it might be preſerved in this ſtate for a conſiderable length of time; and even without any preparation he kept it in bottles, tolerably good, upwards of twelve months.

URINARY CONCRETIONS. See *Animal* SUBSTANCES, Suppl.

URTICA. See *Encycl.* where it is obſerved that the common nettle, though it has a place in the *materia medica*, is now very little uſed. It has lately been recommended, however, by *Zannetini*, a phyſician who attended the French army in Italy, as a good ſubſtitute in fevers for cinchona. The ſucceſs of ſome experiments, which he made with it in tertian and quartan malignant fevers, ſurpaſſed, he ſays, his moſt ſanguine expectation. The nettle often produces a ſpeedier effect than bark; for it heats in a great degree, and when the doſe is pretty ſtrong, occaſions a lethargic ſleep. The doſe muſt never exceed a dram, and is given in wine two or three times in the courſe of 24 hours. Zannetini found this medicine of great ſervice to guard againſt that total exhauſtion which forms the principal character of malignant fevers; and he recommends a ſlight infuſion of it in wine as an excellent preſervative for thoſe who reſide in marſhy and inſalubrious diſtricts. In employing the nettle in fever, Zannetini gives the ſame caution as ought to be obſerved in regard to cinchona, that is, that it muſt not be employed where there is an inclination to inflammation, or where a continued fever, ariſing from obſtructions, exiſts. This diſcovery is not unworthy the attention of phyſicians, and deſerves at leaſt to be farther inveſtigated, as a great deal would be ſaved if cinchona could be entirely diſpenſed with.

URVAIG, or *Urvaiga*, a province of South-America; bounded by Guayra on the north, the mouth of Rio de la Plata on the ſouth, the captainry of del Rey on the eaſt, and Parana on the weſt, from which it is divided by the river of that name. Its extent is from lat. 25 to 33 20 ſouth; the length from north-eaſt to ſouth-eaſt being ſomewhat above 210 leagues, and the breadth from eaſt to weſt, where broadeſt, 130, but much narrower in other parts. It is divided by the river Urvaiga, or Uruguay, into the eaſt and weſt parts. This river runs above 400 leagues, the upper part with a prodigious noiſe among rocks and ſtones, and falls into the La Plata almoſt oppoſite to Buenos Ayres.—*Morſe.*

UTAWAS, a river which divides Upper and Lower Canada, and falls into Jeſus Lake, 118 miles ſouth-weſt of Quebec. It receives the waters of Timmiſkamain 360 miles from its mouth: 85 miles above it is called Montreal river.—*ib.*

UTRECHT, *New*, a townſhip of New-York, King's county, Long-Iſland. It has a Dutch church, and contains 562 inhabitants; of whom 76 are electors, and 206 are ſlaves. It is 7 or 8 miles ſouthward of New-York city.—*ib.*

UXBRIDGE, a townſhip of Maſſachuſetts, Worceſter county, 41 miles ſouth-weſt of Boſton. It was taken from Mendon, and incorporated in 1727, and Northbridge was afterwards taken from it. It contains 180 dwelling houſes, and 1,308 inhabitants. It is bounded ſouth by the State of Rhode-Iſland. Not far from Shoe-log Pond, in the ſouth-weſt part of the town, there is an iron mine which is improved to conſiderable advantage.—*ib.*

W.

WABASH is a beautiful navigable river, of the N. W. Territory, which runs a S. W. and ſouthern courſe, and empties into the Ohio, by a mouth 270 yards wide, in lat. 37 41 N. 168 miles from the mouth of the Ohio, and 1022 miles below Pittſburg. In the ſpring, ſummer, and autumn, it is paſſable in batteaux and barges, drawing about 3 feet water, 412 miles, to Ouiatanon; and for large canoes 197 miles further, to the Miami carrying place, 9 miles from Miami village. This village ſtands on Miami river, which empties into the S. W. part of Lake Erie. The communication between Detroit and the Illinois and Ohio countries, is up Miami river, to Miami village, thence by land 9 miles, when the rivers are high, and from 18 to 30 when they are low, through a level country to the Wabaſh, and through the various branches of the Wabaſh to the places of deſtination. The land on this river is remarkably fertile. A ſilver mine has been diſcovered about 28 miles above Ouiatanon, on the northern ſide of the Wabaſh. Salt ſprings, lime, free-ſtone, blue, yellow, and white clay, are found in plenty on this river. The copper mine on this river, is perhaps the richeſt vein of native copper in the bowels of the whole earth.—*Morſe.*

WABASH, *Little*, runs a courſe S. S. E. and falls into the Wabaſh 10 miles from the Ohio.—*ib.*

WACHOVIA, or *Dobb's Pariſh*, a tract of land in N. Carolina, ſituated between the E. ſide of Yadkin river, and the head waters of Haw and Deep rivers, conſiſting of about 100,000 acres, partly in Stokes and Surry counties. The United Brethren, or Moravians, purchaſed this tract of Lord Granville, in 1751, and called it Wachovia, after the name of an eſtate of Count Zinzendorf, in Germany. In 1755, it was made a ſeparate pariſh, and named Dobb's, by the legiſlature. The ſettlement of Bethabara, was begun in 1753, by a number of the Brethren from Pennſylvania. Salem, which is the principal ſettlement, commenced in 1766, and is inhabited by a number of ingenious tradeſmen. This thriving pariſh lies about 10 miles S. of Pilot Mountain, and contains 6 churches. —*ib.*

WACHQUATNACH, an ancient Moravian ſettlement in Connecticut, on Stratford river; 23 miles from its mouth.—*ib.*

WACHUSET *Mountain*, in the town of Princetown, Maſſachuſetts, may be ſeen in a clear horizon, at the diſtance of 67 miles, being 2,989 feet above the level of the ſea.—*ib.*

WADESBOROUGH, the chief town of Anſon county, in Fayetteville diſtrict, N. Carolina. It contains a court-houſe, gaol, and about 30 houſes, and being ſeated on a lofty hill, is both pleaſant and healthy. It is 76 miles weſt by ſouth of Fayetteville, and 50 ſouth-eaſt by S. of Saliſbury.—*ib.*

WADMELAW, an iſland in Charleſton harbour, S. Carolina.—*ib.*

WADSWORTH, a town of New-York, Ontario county, ſituated on the eaſt bank of Geneſſee river; 4 miles weſt of Coneſus Lake, and 13 ſouth-weſt by ſouth of Hartford.—*ib.*

WADHAM *Iſlands*, near the N. E. coaſt of Newfoundland Iſland. N. lat. 49 57, weſt long. 53 37. —*ib.*

WAGER'S *Strait*, or *River*, in New North Wales, in N. America, lies in lat. 65 23 N. and is about 2 or 3 miles wide. At 5 or 6 miles within its entrance, it is 6 or 8 leagues wide, having ſeveral iſlands and rocks in the middle. It has ſoundings from 16 to 30 and 44 fathoms; and the land on both ſides is as high (according to Captain Middleton's account) as any in England. Savage Sound, a ſmall cove or harbour, fit for ſhips to anchor in, lies on the northern ſhore, 13 or 14 leagues up the ſtrait, in long. 87 18 W. All the country from Wager's Strait to Seal river, is in ſome maps called New Denmark. Capt. Monk was ſent thither, in 1610. by the king of Denmark, and wintered at a place called Monk's Winter Harbour, in lat. 63 20 N. which muſt be a little north of Rankin's Inlet.—*ib.*

WAGER'S *Strait*, in N. America, is in about lat. 65 37 N. When Capt. Ellis was in this latitude, the tide ran at the rate of from 8 to 10 leagues an hour. He compares it to the ſluice of a mill.—*ib.*

WAITSFIELD, the ſouth-eaſternmoſt townſhip of Chittenden county, Vermont, containing 61 inhabitants.—*ib.*

WAIT'S *River* riſes in Orange county, Vermont, and empties into Connecticut river, at Bradford.—*ib.*

WAJOMICK, an Indian town on Suſquehannah river, about 400 miles from the ſea. In the ſpring of 1756, the Indians ſhot 2 ſeals here, and they could not ſufficiently expreſs their aſtoniſhment at the ſight of theſe animals unknown to them.—*ib.*

WAKE, an inland county of Hillſborough diſtrict, North-Carolina; bounded N. W. by Orange, and E. and S. E. by Johnſon. It contains 10,192 inhabitants, including 2.463 ſlaves. Chief town, Raleigh.—*ib.*

WAKEFIELD, formerly *Eaſt town* and *Watertown*, a townſhip of Strafford county, New-Hampſhire, eaſt of Wolfborough, incorporated in 1774. It contains 640 inhabitants. In the north-eaſt part is a pond which is the ſource of Piſcataqua river.—*ib.*

WAKKAMAW, a beautiful lake, 26 miles in circuit, ſituated in Bladen county, North-Carolina. The lands on its eaſtern ſhores are fertile, and the ſituation delightful, gradually aſcending from the ſhores; bounded on the north-weſt coaſt by vaſt rich ſwamps, fit for rice. This lake is the ſource of a fine river, of the ſame name, and runs a ſoutherly courſe, for 70 or 80 miles, and empties into Winyaw Bay, at Georgetown, in South-Carolina.—*ib.*

WALDEN, a townſhip of Vermont, Caledonia county, having Danville on the ſouth-eaſt. It contains only 11 inhabitants.—*ib.*

WALDOBOROUGH, a poſt-town and port of entry of the Diſtrict of Maine, in Lincoln county, 12 miles S. by W. of Warren, 10 E. by S. of Newcaſtle, 20 eaſt of Wiſcaſſet, and 545 north-eaſt of Philadelphia. This is the port of entry for the diſtrict, lying between the towns of Camden and Northport; and all the ſhores and waters from the middle of Damariſcotta river to the ſouth-weſtern ſide of the town of Northport. The townſhip of Waldoborough was incorporated in 1773, and contains 1210 inhabitants.—*ib.*

WALDO *Patent*, a tract of land forming the ſouth-eaſt part of Hancock county in the Diſtrict of Maine, and on the weſt ſide of Penobſcot river and bay.—*ib.*

Wales.

WALES, New South, is a country which muſt be intereſting on account of the ſingular colony which was ſettled there in the year 1788. Under the title *New Holland* (*Encycl.*) ſome account has been given of that ſettlement, as well as of the climate and the ſoil about Port Jackſon; but it will probably gratify the curioſity of our readers, if we give a ſhort hiſtory of thoſe European ſettlers, of whom it is to be hoped that they carried not with them, to that diſtant ſhore,

> "Minds not to be changed by time or place."

This hiſtory we ſhall take from the accurate *Account of the Engliſh Colony in New South Wales*, by David Collins, Eſq; who went out with Governor Phillip, and continued to execute the offices of Judge-advocate and Secretary till the cloſe of the year 1796; and we ſhall begin our narrative from the diſembarkation of the firſt coloniſts, when his Majeſty's commiſſion to the governor, and the letters patent eſtabliſhing courts of criminal and civil judicature in the territory were read.

The criminal court was conſtituted a court of record, and was to conſiſt of the judge-advocate and ſuch ſix officers of the ſea and land ſervice as the governor ſhall, by precept iſſued under his hand and ſeal, require to aſſemble for that purpoſe. This court has power to inquire of, hear, determine, and puniſh all treaſons, miſpriſions of treaſons, murders, felonies, forgeries, perjuries, treſpaſſes, and other crimes whatſoever that may be committed in the colony; the puniſhment for ſuch offences to be inflicted according to the laws of England as nearly as may be, conſidering and allowing for the circumſtances and ſituation of the ſettlement and its inhabitants. The charge againſt any offender is to be reduced into writing, and exhibited by the judge-advocate: witneſſes are to be examined upon oath, as well for as againſt the priſoner; and the court is to adjudge whether he is guilty or not guilty by the opinion of the major part of the court. If guilty, and the offence is capital, they are to pronounce judgment of death, in like manner as if the priſoner had been convicted by the verdict of a jury in England, or of ſuch corporal puniſhment as the court, or the major part of it, ſhall deem meet. And in caſes not capital, they are to adjudge ſuch corporal puniſhment as the majority of the court ſhall determine. But no offender is to ſuffer death unleſs five members of the court ſhall concur in adjudging him to be guilty, until the proceedings ſhall have been tranſmitted to England, and the king's pleaſure ſignified thereupon. The provoſt-marſhal is to cauſe the judgment of the court to be executed according to the governor's warrant under his hand and ſeal.

Beſide this court for the trial of criminal offenders, there is a civil court, conſiſting of the judge-advocate and two inhabitants of the ſettlement, who are to be appointed by the governor; which court has full power to hear and determine in a ſummary way all pleas of lands, houſes, debts, contracts, and all perſonal pleas whatſoever.

From this court on either party, plaintiff or defendant, finding himſelf or themſelves aggrieved by the judgment or decree, an appeal lies to the governor, and from him, where the debt or thing in demand ſhall exceed the value of L. 300, to the king in council.

A vice-admiralty court was alſo appointed, for the trial of offences on the high ſeas; and the governor, lieutenant-governor, and judge-advocate, were by patent made juſtices of the peace, with a power in the governor to appoint other juſtices.

The ſituation which Governor Phillip had ſelected for his reſidence, and for the principal ſettlement, was the eaſt ſide of a cove in Port Jackſon, which he called *Sydney Cove*. Its latitude was found to be 33° 52′ 30′ ſouth, and its longitude 152° 19′ 30″ eaſt. This ſituation was choſen without due examination; for it ſoon appeared that the head or upper part of the cove wore a much more favourable appearance than the ground immediately about the ſettlement. From the natives, the new ſettlers met no oppoſition; during the firſt ſix weeks they received only one viſit from them, two men ſtrolling one evening into the camp, and remaining in it for about half an hour. They appeared to admire whatever they ſaw; and after receiving a hatchet (of the uſe of which the eldeſt inſtantly and curiouſly ſhewed his knowledge, by turning up his foot and ſharpening a piece of wood on the ſole with the hatchet) took their leave, apparently well pleaſed with their reception. The fiſhing boats alſo frequently reported their having been viſited by many of theſe people when hauling the ſeine; at which labour they often aſſiſted with cheerfulneſs, and in return were generally rewarded with a part of the fiſh taken.

The firſt labour in which the convicts were employed was that of building huts; and for this purpoſe it was found neceſſary to divide them into gangs, and to appoint an overſeer to each, who ſhould ſee that the proper quantity of work was performed. The proviſions were diſtributed by a weekly ration, and to each man were allowed 7lb. of biſcuit, 1lb. of flour, 7lb. of beef or 4lb. of pork, 3 pints of peaſe, and 6 ounces of butter. To the female convicts two-thirds of this ration were allowed. This was the full ration, which, in many inſtances, it became neceſſary to reduce; and once, in conſequence of the delay of tranſports with a ſupply, the convicts were put on an allowance of which fleſh meat conſtituted no part.

The temporary huts in which the coloniſts lived, for ſome time after their arrival, were formed principally of the cabbage-tree. With this the ſides and ends were filled; the poſts and plates being made of the pine; and the whole was plaſtered with clay. The roofs were generally thatched with the graſs of the gumruſh; though ſome were covered with clay, but ſeveral of theſe failed; the weight of the clay and rain ſoon deſtroying them. In a ſhort time they applied themſelves to the burning of bricks; by which their habitations ſoon became much more laſting and comfortable. The progreſs of the colony, however, towards that degree of convenience which was within its reach, was greatly impeded by the incorrigible vices of thoſe who principally compoſed it. Drunkenneſs, theſt, robbery, and unconquerable lazineſs, continued to mark the character of the great body of the convicts. Though to fly from the colony, and venture into the interior of the country, was inevitable death in the form of famine or of murder, yet ſuch was the invincible antipathy to labour manifeſted by ſome of thoſe people, that they often fled to the woods, from which they ſeldom returned; ſome dying of hunger, and ſome being ſacrificed by the natives. Diſinclination to labour produced here, as elſewhere, its natural effect—robbery.

In the month of May 1788, a lad of 17 years of age was tried, convicted, and executed, for breaking open a tent belonging to one of the tranſport ſhips; ſeveral others were taken into cuſtody in that month for various thefts and burglaries, and two were afterward tried and executed. One of theſe had abſconded, and lived in the woods for 19 days, ſubſiſting by what he was able to procure by nocturnal depredations among the huts and ſtock of individuals. His viſits for this purpoſe were ſo frequent and daring, that it became abſolutely neceſſary to proclaim him an outlaw. By the negligence of one of thoſe fellows who had been intruſted with the care of the cattle, the bull and four cows were loſt: he left them in the fields, and returned to his hut to dine; and in the mean time they either ſtrayed away or were driven off by the natives. Five years elapſed before theſe cattle were diſcovered wild, at a conſiderable diſtance up the country, and greatly multiplied.

The perpetration of crimes, chiefly theft and robbery, had become ſo prevalent before twenty months had paſſed ſince the colony was eſtabliſhed, that it was neceſſary to think of a ſyſtem of police. A plan was preſented to the governor by a *convict*, which with ſome improvements was adopted on the 8th of Auguſt 1789. The following are the heads of the arrangement.

The ſettlement was divided into four diſtricts, over each of which was placed a watch conſiſting of three perſons, one principal and two ſubordinate watchmen. Theſe being ſelected from among thoſe convicts whoſe conduct and character had been unexceptionable ſince their landing, were veſted with authority to patrole at all hours in the night, to viſit ſuch places as might be deemed requiſite for the diſcovery of any felony, treſpaſs, or miſdemeanor, and to ſecure for examination all perſons that might appear to be concerned therein; for which purpoſe they were directed to enter any ſuſpected hut or dwelling, or to uſe any other means that might appear expedient. They were required to detain and give information to the neareſt guardhouſe of any ſoldier or ſeaman who ſhould be found ſtraggling after the tattoo had been beat. They were to uſe their utmoſt endeavours to trace out offenders on receiving accounts of any depredation; and in addition to their night-duty, they were directed to take cognizance of ſuch convicts as gamed, or ſold or bartered their ſlops or proviſions, and report them for puniſhment. A return of all occurrences during the night was to be made to the judge-advocate; and the military were required to furniſh the watch with any aſſiſtance they might be in need of, beyond what the civil power could give them. They were provided each with a ſhort ſtaff, to diſtinguiſh them during the night, and to denote their office in the colony; and were inſtructed not to receive any ſtipulated encouragement or reward from any individual for the conviction of offenders, but to expect that negligence or miſconduct in the execution of their truſt would be puniſhed with the utmoſt rigour. It was to have been wiſhed, ſays Mr Collins, that a watch eſtabliſhed for the preſervation of public and private property had been formed of free people, and that neceſſity had not compelled us, in ſelecting the firſt members of our little police, to appoint them from a body of men, in whoſe eyes, it could not be denied, the property of individuals had never before been ſacred. But there was not any choice: The military had their line of duty marked out for them, and between them and the convict there was no deſcription of people from whom overſeers or watchmen could be provided. It might, however, be ſuppoſed, that among the convicts there muſt be many who would feel a pride in being diſtinguiſhed from their fellows, and a pride that might give birth to a returning principle of honeſty. It was hoped that the convicts whom we had choſen were of this deſcription; ſome effort had become neceſſary to detect the various offenders who were prowling about with ſecurity under cover of the night; and the convicts who had any property were themſelves intereſted in defeating ſuch practices. They promiſed fidelity and diligence, from which the ſcorn of their fellow-priſoners ſhould not induce them to ſwerve, and began with a confidence of ſucceſs the duty which they had themſelves offered to undertake.

A ſpecies of diſturber now infeſted the colony, againſt which the vigilance of a police could not guard. Rats, in immenſe numbers, had attacked the proviſion ſtores, and could be counteracted only by removing the proviſions from one ſtore to another. When their ravages were firſt diſcovered, it was found that eight caſks of flour were already deſtroyed by theſe vermin. Such of theſe animals as eſcaped the dogs, which were ſet upon them, flew to the gardens of individuals, where they rioted on the Indian corn that was growing, and did conſiderable miſchief.

Our author gives the moſt melancholy account of the extreme ſufferings of the early coloniſts from want of proviſions, and of the diſeaſes imported into the country by newcomers, who had either caught them on the voyage or brought them from England. The ſettlers on *Norfolk-Iſland* (ſee *Encycl.*), to which New South Wales was a mother country, muſt have been much more liable than that colony to ſuffer from famine, had they not ſometimes obtained a temporary ſupply from a ſource which was unknown at Sydney Cove. On a mountain in the iſland, to which had been given the name of *Mount Pitt*, they were fortunate enough to obtain in an abundance almoſt incredible, a ſpecies of aquatic birds, anſwering the deſcription of that known by the name of the *puffin*. Theſe birds came in from the ſea every evening, in clouds literally darkening the air, and deſcending on Mount Pitt, depoſited their eggs in deep holes made by themſelves in the ground, generally quitting them in the morning, and returning to ſeek their ſubſiſtence in the ſea. From two to three thouſand of theſe birds were often taken in a night. Their ſeeking their food in the ocean left no doubt of their own fleſh partaking of the quality of that upon which they fed; but to people circumſtanced as were the inhabitants of Norfolk-iſland, this leſſened not their importance; and while any Mount Pitt birds (ſuch being

ing the name given them) were to be had, they were eagerly ſought.

The firſt ſettler in New South Wales, who declared himſelf able to live on the produce of his farm, without any aſſiſtance from the ſtores, was James Ruſe; who in April 1790 relinquiſhed his claim to any farther ſhare of the public proviſion. As a reward, the governor immediately put him in poſſeſſion of an allotment of 30 acres.

In the July of the ſame year, the convicts whoſe terms of tranſportation had expired were now collected, and by the authority of the governor informed, that ſuch of them as wiſhed to become ſettlers in this country ſhould receive every encouragement; that thoſe who did not, were to labour for their proviſions, ſtipulating to work for 12 or 18 months certain; and that in the way of ſuch as preferred returning to England no obſtacles would be thrown, provided they could procure paſſages from the maſters of ſuch ſhips as might arrive; but that they were not to expect any aſſiſtance on the part of government to that end. The wiſh to return to their friends appeared to be the prevailing idea, a few only giving in their names as ſettlers, and none engaging to work for a certain time.

That the wiſh to return home was ſtrong indeed, and paramount to all other feelings, was evinced in a very melancholy inſtance ſome time before. A convict, an elderly man, was found dead in the woods, near the ſettlement; who, on being opened, it appeared had died from want of nouriſhment; and it was found that he was accuſtomed to deny himſelf even what was abſolutely neceſſary to his exiſtence, abſtaining from his proviſions, and ſelling them for money, which he was reſerving, and had ſomewhere concealed, in order to purchaſe his paſſage to England when his time ſhould terminate!

Of ſome convicts whoſe terms of tranſportation had expired, the governor eſtabliſhed a new ſettlement in Auguſt 1791, at a place which he called *Proſpect Hill*, about twenty miles diſtant from Sydney Cove; and another reſidence was formed at the Ponds within three or four miles of the former. This made the fourth ſettlement in the colony, excluſively of that at Norfolk Iſland.

About this time the governor received from England a public ſeal for the colony: on the obverſe of which were the king's arms and royal titles; and on the reverſe, emblematic figures ſuited to the ſituation of the people for whoſe uſe it was deſigned. The motto was "*Sic fortis Etruria crevit*;" and in the margin were the words "*Sigillum Nov. Camb. Auſt.*" A commiſſion alſo arrived, empowering him to remit abſolutely, or conditionally, the whole or any part of the term for which the felons ſent to the colony might be tranſported. By this power he was enabled to beſtow on ſuperior honeſty and induſtry the moſt valuable reward which, in ſuch circumſtances, they could receive.

In addition to the calamities under which the ſettlement had ſo often laboured from being reduced to very ſhort allowance of proviſions, and the frequency of the ordinary diſeaſes which were to be expected among a people ſo ſituated, a new malady of a very alarming nature was perceived about April 1792. Several convicts were ſeized with inſanity; and as the major part of thoſe who were viſited by this calamity were females, who, on account of their ſex, were not harraſſed with hard labour, and who in general ſhared largely of ſuch little comforts as were to be procured in the ſettlement, it was difficult to aſſign a cauſe for this diſorder. It ſeems, however, to have been of ſhort duration; for we hear not of it again during the period that Mr Collins's narrative comprehends.

About this time (1792) the colony had aſſumed ſomething of an eſtabliſhed form. Brick huts were in hand for the convicts in room of the miſerable hovels occupied by many, which had been put up at their firſt landing, and in room of others which, from having been erected on ſuch ground as was then cleared, were now found to interfere with the direction of the ſtreets which the governor was laying out. People were alſo employed in cutting paling for fencing in their gardens. At a place called Paramatta, about 16 miles from Sydney Cove, ſituated on a ſmall river which runs into Port Jackſon, the people were employed, during the greateſt part of the month of May, in getting in the maize and ſowing wheat. A foundation for an hoſpital was laid, a houſe built for the maſter carpenter, and roofs prepared for the different huts either building or to be built in future.

In December 1792, when Captain Phillip reſigned the government, nearly five years from the foundation of the colony, there were in cultivation at the different ſettlements 1429 acres, of which 417 belonged to ſettlers; that is, 67 ſettlers, for there were no more, cultivated nearly half as much ground as was cultivated by the public labour of all the convicts; a ſtriking proof of the ſuperior zeal and diligence with which men exert themſelves when they have an intereſt in their labour. Of free ſettlers, whoſe exertions promiſed ſo fairly to promote the intereſts of the colony, ſeveral arrived from England in January 1793, and fixed themſelves in a ſituation which they called *Liberty Plains*. To one of theſe, Thomas Roſe, a farmer from Dorſetſhire, and his family of a wife and four children, 120 acres were allotted. The conditions under which theſe people agreed to ſettle were, "to have their paſſage provided by government (A); an aſſortment of tools and implements to be given to them out of the ſtores; that they ſhould be ſupplied with two years proviſions; that their lands ſhould be granted free of expenſe; the ſervice of convicts alſo to be aſſigned to them free of expenſe; and that thoſe convicts ſhould be ſupplied with two years rations and one year's clothing."

Among the great difficulties with which this infant eſtabliſhment had to ſtruggle, not the leaſt was that of procuring cattle. Of thoſe which were embarked in England and other places for the colony, a very ſmall proportion only arrived; for of 15 bulls and 119 cows, which had been embarked for Botany Bay, only 3 bulls and 28 cows were landed at the ſettlement. It was not until the arrival of the Endeavour, Captain Bampton, in 1795, that the mode of conveying cattle to the colony,

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(A) Government paid for the paſſage of each perſon above ten years of age L. 8, 8s. and one ſhilling per day for victualling them.

lony without material loſs was diſcovered. In that veſſel, out of 130 head which he embarked at Bombay, one cow only died on the paſſage, and that too on the day before his arrival.

The ſcarcity of cattle naturally raiſed their price. Even after this laſt importation, an Engliſh cow in calf ſold for L. 80.

Notwithſtanding the various obſtacles which induſtry had met in the cultivation of this ſettlement, it yet made conſiderable advances; for in October 1793, the value of land had ſo riſen that one ſettler ſold his allotment of 30 acres for as many pounds; and one farm, with the houſe, &c. ſold for L.100. The value of ground, indeed, was conſiderably enhanced by government agreeing to purchaſe the redundance of the produce of the ſettlers at fixed prices. Wheat properly dried and cleanſed was received from the ſettlers at Sydney, by the commiſſary, at 10s. per buſhel. Some cultivators, however, had deviſed another mode of diſpoſing of their corn. One of them, whoſe ſituation was near Parramatta, having obtained a ſmall ſtill from England, found it more advantageous to draw an ardent diabolical ſpirit from his wheat, than to ſend it to the ſtores. From one buſhel of wheat he obtained nearly five quarts of ſpirit, which he ſold or paid in exchange for labour, at the rate of five or ſix ſhillings per quart. A better uſe was made of grain by another ſettler; who having a mill, ground it, and procured 44lb. of good flour, from a buſhel of wheat taken at 59lb. This flour he ſold at 4d. per lb.

By a return of the number of perſons in New South Wales and Norfolk Iſland in April 1794, it appeared that there were in all 4414, including women and children; the annual expenſe of whom, to the mother-country, Mr Collins eſtimates at L.161,101. Rapid ſtrides, however, were at that time making towards independence, if not towards an ability of repaying to England a part of what the ſettlement had coſt her. Already the colony lived on grain of its own growth, and an increaſe of live ſtock was become almoſt certain. There were now 4665 acres of ground cleared for cultivation; more than half of which had been effected by thoſe who had become ſettlers in the courſe of fifteen months.

To this ſpirit of improvement ſuch a check was given in September 1794, that not more than a third of government ground, and a fifth of ground belonging to individuals, was in cultivation 1795. As this event has been miſrepreſented, we ſuſpect purpoſely, by ſome of our journaliſts, we ſhall give the true account of it in the words of Mr Collins himſelf.

"The Francis ſchooner (ſays he) returned from Norfolk, having been abſent about eight weeks and three days. From Mr King, who commanded in that iſland, we learned that his harveſt had been prodigiouſly productive. He had purchaſed from the firſt crops, which the ſettlers had brought to market, upwards of 11,000 buſhels of maize; and bills for the amount were drawn by him in favour of the reſpective ſettlers; but requiring the ſanction of the Lieutenant governor, they were now ſent to Port Jackſon. Mr King had been partly induced to make this proviſional kind of purchaſe under an idea, that the corn would be acceptable at Port Jackſon, and alſo in compliance with the conditions on which the ſettlers had received their reſpective allotments under the regulations of Governor Phillip; that is to ſay, that their overplus grain ſhould be purchaſed at a fair market-price. Being, however, well ſtocked with that article already, the Lieutenant governor did not think himſelf juſtifiable in putting the crown to ſo great an expenſe (nearly L. 3000 Sterling), and declined accepting the bills." This naturally excited ſome diſcontents in Norfolk Iſland, and one or two ſettlers gave up their farms; but immediately on the arrival of Governor Hunter, he paid for the corn, and tranquillity was reſtored to the iſland.

Though ſeveral quarrels had occurred between the natives and individuals among the coloniſts, yet it was ſuppoſed that our people were in general the aggreſſors. The governor had taken much pains to inſpire the natives with confidence, and had in a great meaſure ſucceeded. To theft they were naturally and irreſiſtibly inclined: but, like other ſavages, they ſeemed unconſcious of the crime, and were ſeldom deterred by detection from mixing with the coloniſts. At a ſettlement which had early been formed at a river called the *Hawkeſbury* (and at which, cultivation having gone on well, there was, in courſe, much grain to ſtimulate to depredation), the natives aſſumed a more formidable appearance.

"At that ſettlement (ſays Mr Collins) an open war ſeemed about this time to have commenced between the natives and the ſettlers; and word was received overland, that two people were killed by them; one a ſettler of the name of Wilſon, and the other a freeman, one William Thorp, who had hired himſelf to this Wilſon as a labourer. The natives appeared in large bodies, men, women, and children, provided with blankets and nets to carry off the corn, of which they appeared as fond as the natives who lived among us, and ſeemed determined to take it whenever and wherever they could meet with opportunities. In their attacks they conducted themſelves with much art; but where that failed they had recourſe to force; and on the leaſt appearance of reſiſtance made uſe of their ſpears or clubs. To check at once, if poſſible, theſe dangerous depredators, Captain Paterſon directed a party of the corps to be ſent from Paramatta, with inſtructions to deſtroy as many as they could meet with of the wood tribe (Bè-diagal); and, in the hope of ſtriking terror, to erect gibbets in different places, whereon the bodies of all they might kill were to be hung. It was reported that ſeveral of theſe people were killed in conſequence of this order; but none of their bodies being found (perhaps if any were killed they were carried off by their companions), the number could not be aſcertained. Some priſoners, however, were taken, and ſent to Sydney; one man (apparently a cripple), five women, and ſome children. One of the women, with a child at her breaſt, had been ſhot through the ſhoulder, and the ſame ſhot had wounded the babe. They were immediately placed in a hut near our hoſpital, and every care taken of them that humanity ſuggeſted. The man was ſaid, inſtead of being a cripple, to have been very active about the farms, and inſtrumental in ſome of the murders which had been committed. In a ſhort time he found means to eſcape, and by ſwimming reached the north ſhore in ſafety; whence, no doubt, he got back to his friends. Captain Paterſon hoped, by detaining the priſoners and treating them well, that ſome good effect might reſult; but les.

but finding, after ſome time, that coercion, not attention, was more likely to anſwer his ends, he ſent the women back. While they were with us, the wounded child died, and one of the women was delivered of a boy, which died immediately. On our withdrawing the party, the natives attacked a farm nearly oppoſite Richmond Hill, belonging to one William Rowe, and put him and a very fine child to death; the wife, after receiving ſeveral wounds, crawled down the bank, and concealed herſelf among ſome reeds half immerſed in the river, where ſhe remained a conſiderable time without aſſiſtance: being at length found, this poor creature, after having ſeen her huſband and her child ſlaughtered before her eyes, was brought into the hoſpital at Paramatta, where ſhe recovered, though ſlowly, of her wounds."

By the vigorous meaſures which were adopted, the colony, towards the cloſe of 1796, had acquired a degree of ſtrength which ſeemed to enſure its future proſperity. Not only the neceſſary edifices were raiſed for the habitations of its people, but ſome for the purpoſes of religion, amuſement, &c. A playhouſe had been erected at the expenſe of ſome perſons who performed in it for their own emolument, and who admitted auditors at one ſhilling each. A convenient church had been built, a printing-preſs had been ſet up, the civil court was open for the recovery of debts by action and for proving wills, licenſes had been iſſued to regulate the ſale of ſpirits, and paſſage-boats were eſtabliſhed for the convenience of communication between the different ſettlements. In the houſes of individuals were to be found moſt of the comforts, and not a few of the luxuries, of life; and, in a word, the former years of famine, toil, and difficulty, were now exchanged for thoſe of plenty, eaſe, and pleaſure.

The quantity of ground at this time in cultivation was 5419 acres; of which 2547 were occupied by ſettlers. The number of perſons in New South Wales and its dependencies amounted to 4848. The price of labour, however, compared with the prices of proviſions (as given in Mr Collins's Tables), does not appear ſo high as to enable the workman to live very comfortably. He who receives but three ſhillings for his day's work, and gives two ſhillings for a pound of mutton, fifteen pence for a pound of pork, and half of that ſum for a pound of flour, will ſcarcely derive from his mere labour the ſupport neceſſary for a family.

That many things are yet wanted to give full effect to the advantages which the colony now enjoys, Mr Collins declares in the following paragraph, with which he concludes his account:

"The want at this time of ſeveral public buildings in the ſettlement has already been mentioned. To this want muſt be added, as abſolutely neceſſary to the well-being and comfort of the ſettlers, and the proſperity of the colony in general, that of a public ſtore, to be opened on a plan, though not exactly the ſame, yet as liberal as that of the Iſland of St Helena, where the Eaſt India Company iſſue to their own ſervants European and Indian goods at 10 *per cent.* advance on the prime coſt. Conſidering our immenſe diſtance from England, a greater advance would be neceſſary; and the ſettlers and others would be well ſatisfied, and think it equally liberal, to pay 50 *per cent.* on the prime coſt of all goods brought from England; for at preſent they pay never leſs than 100, and frequently 1000, *per cent.* on what they have occaſion to purchaſe. It may be ſuppoſed that government would not chooſe to open an account, and be concerned in the retail of goods, but any individual would find it to his intereſt to do this, particularly if aſſiſted by government in the freight; and the inhabitants would gladly prefer the manufactures of their own country to the ſweepings of the Indian bazars.

Wales.

"The great want of men in the colony muſt be ſupplied as ſoon as a peace ſhall take place; but the want of reſpectable ſettlers may, perhaps, be longer felt; by theſe are meant men of property, with whom the gentlemen of the colony could aſſociate, and who ſhould be thoroughly experienced in the buſineſs of agriculture. Should ſuch men ever arrive, the adminiſtration of juſtice might aſſume a leſs military appearance, and the trial by jury, ever dear and moſt congenial to Engliſhmen, be ſeen in New South Wales."

There is, however, one ſerious difficulty which the colony has not yet overcome, and which, until it be overcome, will certainly prevent ſuch men from ſettling in New South Wales. Till ſome ſtaple commodity can be raiſed for exportation, induſtrious free ſettlers will never be tempted to emigrate from Europe to a country where their induſtry cannot procure the comforts as well as the neceſſaries of life. The American colonies, in their infancy did not labour under this diſadvantage. Tobacco ſoon became, and ſtill continues to be, an article of ſuch importance, that its cultivation afforded the trans-atlantic farmer a ready exchange for European commodities; whilſt in New South Wales there ſeems to be no vegetable production of much value, except New Zealand hemp, which is produced indeed in great abundance in Norfolk Iſland: and which Captain Cook long ago pointed out as an article of great importance to the Britiſh navy. This is indeed a valuable plant, and grows in all the cliffs of the iſland, where nothing elſe will grow, in ſufficient abundance to give conſtant employment to 500 people; yet when Mr Collins left the ſettlement, there was no more than one loom on the iſland, and the ſlay or reed was deſigned for coarſe canvas; nor did they poſſeſs a ſingle tool required by flax-dreſſers or weavers beyond the poor ſubſtitutes which they were obliged to fabricate for themſelves. In this defect of neceſſaries for the manufacture, only 18 people could be employed in it; and of theſe the united labour in a week produced 16 yards of canvas, of the ſize called N° 7.

Beſides a uſeful manufactory of this plant, which certainly might be eſtabliſhed, the colony appears to poſſeſs ſeveral important advantages. From Mr Collins's narrative, it appears probable that a ſeal and perhaps a whale fiſhery might be eſtabliſhed with a fair proſpect of ſucceſs; good rich earth is found near Sidney Cove; there are immenſe ſtrata of coal in the ſouthern part of New Holland; Norfolk Iſland abounds with lime; and vaſt quantities of ſhells, which anſwer the ſame purpoſe, have been found on the main land. Though the wood in general be not of a durable kind, it appears that there is ſome good timber near the Hawkeſbury river; and at Norfolk Iſland and New Zealand it is remarkably fine.

Wales, *New South*, a country of vaſt extent, but little known, lying round the ſouthern part of Hudſon's Bay.—*Morse.*

Wales, *New North*, an extenſive territory of North-America; having Prince William's Land on the north, part of Baffin's Bay on the eaſt, and ſeparated from New South Wales, on the ſouth by Seal river.—*ib.*

Wales, a plantation in Lincoln county, Diſtrict of Maine, 55 miles north-eaſt of Portland, and 180 from Boſton. It contains 439 inhabitants.—*ib.*

WALHALDING, the Indian name of an eaſtern branch of Muſkingum river, at the mouth of which ſtood Goſchachguenk, a Delaware town, and ſettlement of Chriſtian Indians.—*ib.*

WALLINGFORD, a townſhip of Vermont, Rutland county, eaſt of Tinmouth. It contains 536 inhabitants.—*ib.*

Wallingford, a pleaſant poſt-town of Connecticut, New-Haven county, 13 miles S. W. of Middleton, 13 N. E. of New-Haven, and 195 north-eaſt of Philadelphia. This townſhip, called by the Indians *Coginchauge*, was ſettled in 1671; is divided into two pariſhes, and contains about 2000 inhabitants. It is 12 miles long, and 7 broad.—*ib.*

WALLKILL, a townſhip of New York, Ulſter county, on the creek of its name, about 15 miles N. by E. of Goſhen, 11 weſt of Newburgh, and 58 N. W. of New York city. It contains 2571 inhabitants, of whom 340 are qualified electors, and 103 ſlaves.—*ib.*

WALNUT *Hills*, in the weſtern territory of Georgia, are ſituated on a tract of land formed by Miſſiſſippi river and the Looſa Chitto, and on the north ſide of the latter.—*ib.*

WALLOOMSCHACK, a ſmall branch of Hooſack river, Vermont.—*ib.*

WALLPACK, a townſhip in Suſſex county, New-Jerſey, on Delaware river, about 11 miles weſt of Newtown, and 50 north-weſt of Brunſwick. It contains 496 inhabitants, including 30 ſlaves.—*ib.*

WALPOLE (Horace, Earl of Orford), was the youngeſt ſon of the celebrated Sir Robert Walpole, afterwards Earl of Orford, by his firſt wife, Catharine, daughter of Robert Shorter, Eſq; of Bybrook in Kent. He was born 1716; and was educated, firſt at Eton ſchool, and afterwards at Cambridge. At Eton he formed an intimate aquaintance with the celebrated poet Gray; and they went together on the tour of Europe, in the years 1739, 1740, and 1741. Unhappily they had a diſpute in the courſe of their travels, which produced a ſeparation.

Mr Walpole was able to make a ſplendid figure during the remainder of his deſtined courſe; but poor Gray, after the ſeparation, was obliged to obſerve a very ſevere economy. "This difference aroſe from the difference of their tempers: the latter being, from his earlieſt years, curious, penſive, and philoſophical; the former, gay, lively, and inconſiderate. This, therefore, occaſioned their ſeparation at Reggio. Mr Gray went before him to Venice; and ſtaying there till he could find means of returning to England, he made the beſt of his way home, repaſſing the Alps, and following almoſt the ſame rout, through France, which he had before gone to Italy. In juſtice to the memory of ſo reſpectable a friend, Mr Walpole (ſays Mr Maſon, life of Gray, 4to, p. 4 .) enjoins me to charge him with the chief blame in their quarrel, confeſſing that more attention, complaiſance, and deference, to a warm friendſhip, and ſuperior judgment and prudence, might have prevented a rupture that gave much uneaſineſs to them both, and a laſting concern to the ſurvivor; though in the year 1744 a reconciliation was effected between them, by a lady who wiſhed well to both parties."—This event took place after their return to England; but the *wound* in their friendſhip left a *ſcar* that never was totally effaced.

We do not, indeed, think that Horace Walpole and Mr Gray were formed, either by nature or by habits, to continue long in a ſtate of intimate friendſhip. Gray appears to have been a man of the pureſt moral principles, a friend to religion, penſive, and at leaſt ſufficiently conſcious of his intellectual powers and intellectual attainments. Walpole's morality was certainly of a looſer kind; he ſeems to have had no religion; he was often unſeaſonably gay; and to an equal ſhare of intellectual pride, though without equal reaſon, he added the pride of birth. It can therefore excite no ſurpriſe that a man of Gray's independent ſpirit could not bear the ſupercilious freaks of ſuch a character.

Mr Walpole was nominated to repreſent the city of Norwich, when his father viſited it July 3d, 1733, having acquired conſequence, not only as the ſon of the miniſter, but as having attended the Prince of Orange to England in that year. He was choſen member for Collington, in Cornwall, in the parliament which met June 25th, 1741; was a ſecond time in parliament as repreſentative for Caſtle Riſing, in Norfolk, in 1747; and for King's Lynn in 1754 and 1761; and, at the expiration of that parliament, he finally retired from the ſtage of politics, and confined himſelf wholly to literary purſuits. He held to his death the office of uſher of his Majeſty's exchequer, controller of the pipe, and clerk of the eſtreats. Upon the death of his nephew George, third Earl of Orford, 1791, he ſucceeded to the title and eſtates; but that event made ſo little alteration in his mode of living, that we know not whether he ever took his ſeat in the houſe of peers. During almoſt the whole courſe of his life he was the victim of the gout, which at laſt reduced him to a cripple: but it never impaired his faculties; and, to the very moment of death, his underſtanding ſeemed to bid defiance to the ſhock of Nature. He died at his houſe in Berkeſley Square, in 1796, having juſt entered his 80th year; and was interred in the family vault at Houghton, in a private manner, agreeably to his particular directions.

Horace, Lord Orford, was never married, and, by one of his biographers, his chief miſtreſs through life is ſaid to have been the muſe. It is certain that he devoted the greater part of his life to belles lettres and virtú, though he ridiculouſly affected, in his letters to his friends, to deſpiſe learning and learned men, for which he was very properly reprimanded both by Gray and Hume. It was an affectation peculiarly abſurd in him who was conſtantly publiſhing ſomething, and who wrote with uncommon acrimony againſt all who preſumed to call in queſtion the fidelity of the picture which he had drawn of Richard III. or indeed to controvert any of his opinions. Hence his antipathy to Johnſon, becauſe he was a tory, a Chriſtian, and a rigid moraliſt; whilſt he himſelf was a whig, an infidel, and ſuch a moraliſt as could

could retail, without bluſhing, all the ſcandalous anecdotes, whether true or falſe, of that auguſt family, from whom he acknowledged his whole fortune to be derived. He had, indeed, another reaſon for diſliking Johnſon. Lord Orford ſhone in converſation, and ſurpaſſed all his contemporaries in that kind of talk, which, without dazzling by its wit, always delighted; while Johnſon, when rouſed, knocked down, as by a flaſh of lightning, his Lordſhip and every one elſe who had the confidence before him to talk profanely. Johnſon's wit was original: Lord Orford's conſiſted of ludicrous ſtories and of literary and political anecdotes. His works, of which by far the moſt valuable part has long been in the hands of the public, were collected in 1798, and publiſhed in five volumes, 4to. They reſemble his converſation, being rather amuſing than profound or inſtructive.

Walpole, a poſt-town of New-Hampſhire, Cheſhire county, on the eaſtern ſide of Connecticut river, eleven miles ſouth of Charleſtown, 14 N. W. by N. of Keene, 108 weſt of Portſmouth, and 330 from Philadelphia. The townſhip contains 1245 inhabitants.—*Morſe.*

Walpole, a townſhip of Maſſachuſetts, Norfolk county, on the great road to Providence, and 20 miles ſouth-weſt of Boſton. It was incorporated in 1724, and contains 1005 inhabitants.—*ib.*

WALSINGHAM, *Cape*, is on the eaſt ſide of Cumberland's Iſland, in Hudſon's Straits. N. lat. 62 39, W. long. 77 53. High water, at full and change, at 12 o'clock.—*ib.*

WALTHAM, a townſhip of Maſſachuſetts, Middleſex county, 11 miles north-weſt by north of Boſton. It was incorporated in 1737, and contains 882 inhabitants. —*ib.*

Waltham, or *Weſtham*, a village in Henrico county, Virginia, ſituated on the north ſide of James's river, 4 miles north-weſt of Richmond.—*ib.*

WAMPANOS, an Indian tribe, allies of the Hurons.—*ib.*

WANASPATUCKET *River*, riſes in Glouceſter, Rhode Iſland, and falls into Providence river a mile and an half north-weſt of Weyboſſet bridge. Upon this river formerly ſtood the only powder-mill in this ſtate, and within one mile of its mouth there are a ſlitting-mill, two paper-mills, two griſt-mills with four run of ſtones, an oil-mill, and a ſaw-mill.—*ib.*

WANDO, a ſhort, broad river of S. Carolina, which riſes in Charleſton diſtrict, and empties into Cooper's river, a few miles below Charleſton.—*ib.*

WANOOAETTE, an iſland in the S. Pacific Ocean, about two miles in extent from ſouth-eaſt to north-weſt. It is about 10 miles at north-weſt by weſt from the north end of Wateehoo Iſland.—*ib.*

WANTAGE, a townſhip near the N. W. corner of New-Jerſey, Suſſex county, 15 miles northerly of Newtown. It contains 1700 inhabitants, including 26 ſlaves.—*ib.*

WANTASTIC, the original name of Weſt river, Vermont.—*ib.*

WAPPACAMO *River*, a large ſouth branch of Patowmack river, which it joins in lat. 39 39 N. where the latter was formerly known by the name of Cohongoronto.—*ib.*

WAPUWAGAN *Iſlands*, on the Labrador coaſt, lie between lat. 50 and 50 5 N. and between long. 59 55 and 60 30 W.—*ib.*

WARD, a townſhip of Maſſachuſetts, Worceſter county, 5 miles ſouth of Worceſter, and 55 ſouth-weſt of Boſton, and contains 473 inhabitants.—*ib.*

WARDSBOROUGH, a townſhip of Vermont, Windham county, 12 or 15 miles weſt of Putney, and 27 north-eaſt of Bennington, and contains 753 inhabitants.—*ib.*

WARDSBRIDGE, a poſt-town of New York, Ulſter county, on the Wallkill, 10 miles north of Goſhen, 36 ſouth by weſt of Kingſton, and 156 north-eaſt by north of Philadelphia. It contains about 40 compact houſes and an academy.—*ib.*

WARE, a ſmall river of Maſſachuſetts which originates in a pond in Gerry, in Worceſter county, and in Peterſham it receives Swift river, and receiving Quaboag river, which comes from Brookfield, it thence aſſumes the name of Chicabee, and falls into Connecticut river at Springfield. Its courſe is ſouth and ſouth-weſt. —*ib.*

Ware, a townſhip of Maſſachuſetts, in Hampſhire county, incorporated in 1701, and contains 773 inhabitants. It is 15 miles N. E. of Springfield, and 70 miles weſt-north-weſt of Boſton.—*ib.*

WAREHAM, a townſhip of Maſſachuſetts, ſituated in Plymouth county, at the head of Buzzard's Bay, and on the weſt ſide, 60 miles S. by E. of Boſton. It was incorporated in 1739, and contains 854 inhabitants. N. lat. 41 45, W. long. 70 40.—*ib.*

WARING (Edward, M. D.), Lucaſian Profeſſor of Mathematics in the univerſity of Cambrige, was the ſon of a wealthy farmer, of the Old Heath, near Shrewſbury. The early part of his education he received at the free ſchool in Shrewſbury; whence he removed to Cambridge, and was admitted on the 24th of March 1753 a member of Magdalen College. Here his talents for abſtruſe calculation ſoon developed themſelves, and, at the time of taking his degree, he was conſidered as a prodigy in thoſe ſciences which make the ſubject of the bachelor's examination. The name of Senior Wrangler, on the firſt of the year, was thought ſcarcely a ſufficient honour to diſtinguiſh one who ſo far outſhone his contemporaries; and the merits of John Jebb were ſufficiently acknowledged, by being the ſecond in the liſt. Waring took his firſt, or bachelor's degree, in 1757, and the Lucaſian Profeſſorſhip became vacant before he was of ſufficient ſtanding for the next, or maſter's degree, which is a neceſſary qualification for that office. This defect was ſupplied by a royal mandate, through which he became maſter of arts in 1760; and ſhortly after his admiſſion to this degree, the Lucaſian Profeſſor.

The royal mandate is too frequently a ſcreen for indolence; and it is now become almoſt a cuſtom, that heads of colleges, who ought to ſet the example in diſcipline to others, are the chief violators of it, by making their office a pretext for taking their doctor's degree in divinity, without performing thoſe exerciſes which were deſigned as proofs of their qualifications. Such indolence cannot be imputed to Waring: yet ſeveral circumſtances, previous to his election into the profeſſorial chair, diſcovered that there was, at leaſt, one perſon in the univerſity who diſapproved of the anticipation

pation of degrees by external influence.—Waring, before his election, gave a ſmall ſpecimen of his abilities, as proof of his qualification for the office which he was then ſoliciting; and a controverſy on his merits enſued: Dr Powell, the maſter of St John's college, attacking, in two pamphlets, the Profeſſor; and his friend, afterwards Judge Wilſon, defending. The attack was ſcarcely warranted by the errors in the ſpecimen; and the abundant proofs of talents in the exerciſe of the profeſſorial office are the beſt anſwers to the ſarcaſms which the learned divine amuſed himſelf in caſting on riſing merit. An office held by a Barrow, a Newton, a Whiſton, a Cotes, and a Sanderſon, muſt excite an ingenuous mind to the greateſt exertions; and the new Profeſſor, whatever may have been his ſucceſs, did not fall behind any of his predeceſſors, in either zeal for the ſcience, or application of the powers of his mind, to extend its boundaries. In 1762, he publiſhed his Miſcellanea Analytica; one of the moſt abſtruſe books written on the abſtruſeſt parts of algebra. This work extended his fame over all Europe. He was elected, without ſolicitation on his part, member of the ſocieties of Bononia and Gottingen; and received flattering marks of eſteem from the moſt eminent mathematicians at home and abroad. The difficulty of this work may be preſumed from the writer's own words, "I cannot ſay that I know any one who thought it worth while to read through the whole, and perhaps not the half of it."

Mathematics did not, however, engroſs the whole of his attention. He could dedicate ſome time to the ſtudy of his future profeſſion; and in 1767, he was admitted to the degree of doctor of phyſic; but, whether from the incapacity of uniting together the employments of active life with abſtruſe ſpeculation, or from the natural diffidence of his temper, for which he was moſt peculiarly remarkable; the degree which gave him the right of exerciſing his talents in medicine was to him merely a barren title. Indeed he was ſo embarraſſed in his manners before ſtrangers, that he could not have made his way in a profeſſion in which ſo much is done by addreſs; and it was fortunate that the caſe of his circumſtances permitted him to devote the whole of his time to his favourite purſuit. His life paſſed on, marked out by diſcoveries, chiefly in abſtract ſcience; and by the publication of them in the Philoſophical Tranſactions, or in ſeparate volumes, under his own inſpection. He lived ſome years after taking his doctor's degree, at St Ives, in Huntingdonſhire. While at Cambridge he married—quitted Cambridge with a view of living at Shrewſbury; but the air or ſmoke of the town being injurious to Mrs Waring's health, he removed to his own eſtate at Plaiſley, about 8 miles from Shrewſbury, where he died in 1797, univerſally eſteemed for inflexible integrity, modeſty, plainneſs, and ſimplicity of manners. They who knew the greatneſs of his mind from his writings looked up to him with reverence everywhere: but he enjoyed himſelf in domeſtic circles with thoſe chiefly among whom his purſuits could not be the object either of admiration or envy. The outward pomp which is affected frequently in the higher departments in academic life, was no gratification to one whoſe habits were of a very oppoſite nature; and he was too much occupied in ſcience to attend to the intrigues of the univerſity. There, in all queſtions of ſcience, his word was the law; and at the annual examination of the candidates for the prize inſtituted by Dr Smith, he appeared to the greateſt advantage. The candidates were generally three or four of the beſt proficients in the mathematics at the previous annual examination for the bachelor's degree, who were employed from nine o'clock in the morning to ten at night, with the exception of two hours for dinner, and twenty minutes for tea, in anſwering, *viva voce*, or writing down anſwers to the profeſſor's queſtions, from the firſt rudiments of philoſophy to the deepeſt parts of his own and Sir Iſaac Newton's works. Perhaps no part of Europe affords an inſtance of ſo ſevere a proceſs; and there was never any ground for ſuſpecting the Profeſſor of partiality. The zeal and judgment with which he performed this part of his office cannot be obliterated from the memory of thoſe who paſſed through his fiery ordeal.

Wiſhing to do ample juſtice to the talents and virtue of the Profeſſor, we feel ourſelves ſomewhat at a loſs in ſpeaking of the writings by which alone he will be known to poſterity. He is the diſcoverer, according to his own account, of nearly 400 propoſitions in the analytics. This may appear a vain-glorious boaſt, eſpecially as the greater part of thoſe diſcoveries are likely to ſink into oblivion; but he was, in a manner, compelled to make it by the inſolence of Lalande, who, in his life of Condorcet, aſſerts that, in 1764, there was no firſt-rate analyſt in England. In reply to this aſſertion, the Profeſſor, in a letter to Dr Maſkelyne, firſt mentions, with proper reſpect, the inventions and writings of Harriot, Briggs, Napier, Wallis, Halley, Bruncker, Wren, Pell, Barrow, Mercator, Newton, De Moivre, Maclaurin, Cotes, Stirling, Taylor, Simpſon, Emerſon, Landen, and others; of whom Emerſon and Landen were living in 1764. He then gives a fair and full detail of his own inventions, of which many were publiſhed anterior to 1764; and concludes his letter in theſe words.

"I know that Mr Lalande is a firſt-rate aſtronomer, and writer of aſtronomy; but I never heard that he was much converſant in the deeper parts of mathematics; for which reaſon I take the liberty to aſk him the following queſtions:

"Has he ever read or underſtood the writings of the Engliſh mathematicians: and, as the queſtion comes from me, I ſubjoin, particularly of mine? If the anſwer be in the negative, as it is my opinion, if his anſwer be the truth, that it will, then there is an end of all further controverſy;—but if he aſſerts that he has, which is more than Condorcet did by his own acknowledgment, then he may know, from the enumeration of inventions made in the prefaces, with ſome ſubſequent ones added, that they are ſaid to amount to more than 400 of one kind or other. Let him try to reduce thoſe to as low a number as he can, with the leaſt appearance of candour and truth; and then let him compare the number with the number of inventions of any French mathematician or mathematicians, either in the preſent or paſt times, and there will reſult a compariſon (if I miſtake not) not much to his liking; and, further, let him compare ſome of the firſt inventions of the French mathematicians with ſome of the firſt contained in my works, both as to utility, generality, novelty, difficulty, and elegance, but wiſely as to utility, there is little contained in the deep parts of any ſcience; he will find their

difficulty

difficulty and novelty from his difficulty of underſtanding them, and his never having read any thing ſimilar before; their generality, by the application of them; principles of elegance will differ in different perſons.— I muſt ſay, that he will probably not find the difference expected. After or before this inquiry is inſtituted for mine, let him perform the ſame for the other Engliſh mathematicians; and when he has completed ſuch inquiries, and not before, he will become a judge of the juſtice of his aſſertion; but I am afraid that he is not a ſufficient adept in theſe ſtudies to inſtitute ſuch inquiries; and if he was, ſuch inquiries are invidious, troubleſome, and of ſmall utility."

By mathematical readers this account, which was not publiſhed by the Profeſſor himſelf, is allowed to be very little, if at all, exaggerated. Yet if, according to his own confeſſion, " few thought it worth their while to read even half of his works," there muſt be ſome grounds for this neglect, either from the difficulty of the ſubject, the unimportance of the diſcoveries, or a defect in the communication of them to the public. The ſubjects are certainly of a difficult nature, the calculations are abſtruſe; yet Europe contained many perſons not to be deterred by the moſt intricate theorems. Shall we ſay then, that the diſcoveries were unimportant? If this were really the caſe, the want of utility would be a very ſmall diſparagement among thoſe who cultivate ſcience with a view chiefly to entertainment and the exerciſe of their rational powers. We are compelled, then, to attribute much of this neglect to a perplexity in ſtyle, manner, and language; the reader is ſtopped at every inſtant, firſt to make out the writer's meaning, then to fill up the chaſm in the demonſtration. He muſt invent anew every invention; for, after the enunciation of the theorem or problem, and the mention of a few ſteps, little aſſiſtance is derived from the Profeſſor's powers of explanation. Indeed, an anonymous writer, certainly of very conſiderable abilities, has aptly compared the works of Waring to the heavy appendages of a Gothic building, which add little of either beauty or ſtability to the ſtructure.

A great part of the diſcoveries relate to an aſſumption in algebra, that equations may be generated by multiplying together others of inferior dimenſions. The roots of theſe latter equations are frequently terms called *negative* or *impoſſible*; and the relation of theſe terms to the coefficients of the principal equation is a great object of inquiry. In this art the profeſſor was very ſucceſsful, though little aſſiſtance is to be derived from his writings in looking for the real roots. We ſhall not, perhaps, be deemed to depreciate his merits, if we place the ſeries for the ſum of the powers of the roots of any equation among the moſt ingenious of his diſcoveries; yet we cannot add, that it has very uſefully enlarged the bounds of ſcience, or that the algebraiſt will ever find occaſion to introduce it into practice. We may ſay the ſame on many ingenious transformations of equations, on the diſcovery of impoſſible roots, and ſimilar exertions of undoubtedly great talents. They have carried the aſſumption to its utmoſt limits; and the difficulty attending the ſpeculation has rendered perſons more anxious to aſcertain its real utility; yet they who reject it may occaſionally receive uſeful hints from the Miſcellanea Analytica.

The firſt time of Waring's appearing in public as an author was, we believe, in the latter end of the year 1759, when he publiſhed the firſt chapter of the Miſcellanea Analytica, as a ſpecimen of his qualifications for the profeſſorſhip; and this chapter he defended, in a reply to a pamphlet, intitled, " Obſervations on the Firſt Chapter of a book called Miſcellanea Analytica." Here the Profeſſor was ſtrangely puzzled with the common paradox, that nothing divided by nothing may be equal to various finite quantities, and has recourſe to unqueſtionable authorities in proof of this poſition. The names of Maclaurin, Sanderſon, De Moivre, Bernoulli, Monmort, are ranged in favour of his opinion: But Dr Powell was not ſo eaſily convinced, and returns to the charge in defence of the Obſervations; to which the Profeſſor replied in a letter to the Rev. Dr Powell, Fellow of St John's college, Cambridge, in anſwer to his Obſervations, &c. In this controverſy, it is certain that the Profeſſor gave evident proofs of his abilities; though it is equally certain that he followed too implicitly the deciſions of his predeceſſors. No apparent advantage, no authority whatever, ſhould induce mathematicians to ſwerve from the principles of right reaſoning, on which their ſcience is ſuppoſed to be peculiarly founded. According to Maclaurin, Dr Waring, and others, If $P = \frac{a - x}{a^2 - x^2}$, then, when $x = a$, P is equal to $\frac{1}{2a}$; for, ſay they, $\frac{a - x}{a^2 - x^2}$ is equal to $\frac{a - x}{a - x} \times \frac{1}{a + x}$; that is, when x is equal to a, $P = \frac{1}{a + x}$, or $\frac{1}{2a}$. But when x is equal to a, the numerator and denominator of the fraction $\frac{a - x}{a^2 - x^2}$ are both, in their language, equal to nothing. Therefore, nothing divided by nothing is equal to $\frac{1}{2a}$. In the ſame manner, $\frac{a - x}{a^3 - x^3} = \frac{1}{a^2 + ax + x^2} \times \frac{a - x}{a - x}$, which, when x is equal to a, becomes $\frac{1}{3a^2}$. Therefore, nothing divided by nothing is equal to $\frac{1}{3a^2}$, or $\frac{1}{3a^2} = \frac{1}{2a}$; that is, $\frac{1}{3a} = \frac{1}{2}$; which is abſurd. But we need only trace back our ſteps to ſee the fallacy in this mode of reaſoning. For P is equal to ſome number multiplied into $\frac{a - x}{a - x}$; that is, when x is equal to a. P is equal to ſome number multiplied into nothing, and divided by nothing; that is, P is, in that caſe, no number at all. For $a - a$ cannot be divided by $a - x$ when x is equal to a, ſince, in that caſe, $a - x$ is no number at all.

If, in the beginning of his career, the Profeſſor could admit ſuch paralogiſms into his ſpeculations, and the writings of the mathematicians, for nearly a century before him, may plead in his excuſe, we are not to be ſurpriſed that his diſcoveries ſhould be built rather on the aſſumptions of others than on any new principles of his own. Acquieſcing in the ſtrange notion, that nothing could be divided by nothing, and produce a variety of numbers, he as eaſily adopted the poſition, that an equation has as many roots as it has dimenſions.— Thus

Waring.

Thus 2 and — 4 are ſaid to be roots of the equation $x^2 - 2x = 8$, though 4 can be the root only of the equation; $x^2 - 2x = 8$, which differs ſo materially from the preceding, that in one caſe $2x$ is added, in the other caſe it is ſubtracted from x^2.

Allowances being made for this error in the principles, the deductions are, in general, legitimately made; and any one, who can give himſelf the trouble of demonſtrating the propoſitions, may find ſufficient employment in the Profeſſor's analytics. Perhaps it will be ſufficient for a ſtudent to devote his time to the ſimpleſt caſe $x^n \underline{+} 1 = 0$; and when he has found a few thouſand roots of + 1 and — 1, the publication of them may afford to poſterity a ſtrong proof of the ingenuity of their predeceſſors, and the application of the powers of their mind to uſeful and important truths. In this exerciſe may be conſulted the method given by the Profeſſor, of finding a quantity, which, multiplied into a given irrational quantity, will produce a rational product, or conſequently exterminate irrational quantities out of a given equation; but if an irrational quantity cannot come into an equation, the utility of this invention will not be admitted without heſitation.

The "Proprietates Algebraicarum Curvarum," publiſhed in 1772, neceſſarily labour under the ſame defects with the Miſcellanea Analytica, the Meditationes Algebraicæ, publiſhed in 1770, and the Meditationes Analyticæ, which were in the preſs during the years 1773, 1774, 1775, 1776. Theſe were the chief and the moſt laborious works edited by the Profeſſor; and in the Philoſophical Tranſactions is to be found a variety of papers, which alone would be ſufficient to place him in the firſt rank in the mathematical world. The nature of them may be ſeen from the following catalogue.

Vol. LIII. p. 294, Mathematical Problems.—LIV. 193. New Properties in Conics.—LV. 143. Two Theorems in Mathematics.—LXIX. Problems concerning Interpolations.—86. A General Reſolution of Algebraical Equations—LXXVI. 81. On Infinite Series. LXXVII. 71. On Finding the Values of Algebraical Quantities by Converging Serieſes, and Demonſtrating and Extending Propoſitions given by Pappus and others.—LXXVIII. 67. On Centripetal Forces.—*Ib.* 588. On ſome Properties of the Sum of the Diviſion of Numbers.—LXXIX. 166. On the Method of Correſpondent Values, &c.—*Ib.* 185. On the Reſolution of Attractive Powers.—LXXXI. 146. On Infinite Serieſes.—LXXXIV. 385—415. On the Summation of thoſe Serieſes whoſe general term is a determinate function of z, the diſtance of the term of the Series.

For theſe papers, the Profeſſor was, in 1784, deſervedly honoured by the Royal Society with Sir Godfrey Copley's medal; and moſt of them afford very ſtrong proofs of the powers of his mind, both in abſtract ſcience, and the application of it to philoſophy; though they labour, in common with his other works, under the diſadvantage of being clothed in a very unattractive form. The mathematician, who has reſolution to go through them, will not only add much to his own knowledge, but be uſefully employed in dilating on thoſe articles for the benefit of the more general reader. We might add in this place, a work written on morals and metaphyſics in the Engliſh language; but as a few copies only were preſented to his friends, and it was the Profeſſor's wiſh that they ſhould not have a more extenſive circulation, we ſhall not here enlarge upon its contents.

In the mathematical world, the life of Waring may be conſidered as a diſtinguiſhed æra. The ſtrictneſs of demonſtration required by the ancients had gradually fallen into diſuſe, and a more commodious, though almoſt mechanical mode by algebra and fluxions took its place, and was carried to the utmoſt limit by the Profeſſor. Hence many new demonſtrations may be attributed to him, but 400 diſcoveries can ſcarcely fall to the lot of a human being. If we examine thoroughly thoſe which our Profeſſor would diſtinguiſh by ſuch names, we ſhall find many to be mere deductions, others, as in the ſolution of biquadratics, anticipated by former writers. But if we cannot allow to him the merit of ſo inventive a genius, we muſt applaud his aſſiduity; and diſtinguiſhed as he was in the ſcientific world, the purity of his life, the ſimplicity of his manners, and the zeal which he always manifeſted for the truths of the Goſpel, will intitle him to the reſpect of all who do not eſteem the good qualities of the heart inferior to thoſe of the head.

WARMINSTER, a ſmall poſt-town of Virginia, ſituated on the north ſide of James' river, in Amherſt county, about 90 miles above Richmond. It contains about 40 houſes, and a tobacco warehouſe. It is 332 miles from Philadelphia, 21 miles from Charlotteſville, and 9 from Newmarket. There is alſo a townſhip of this name in Buck's county, Pennſylvania.—*Morſe.*

WARM *Spring*, a ridge of mountains bears this name, a part of the Alleghany Mountains, ſituated N. W. of the Calf Paſture, and famous for warm ſprings. The moſt efficacious of theſe, are two ſprings in Auguſta, near the ſources of James' river, where it is called Jackſon's river. They riſe near the foot of the ridge of mountains, generally called the Warm Spring Mountains, but in the maps Jackſon's Mountains. The one is diſtinguiſhed by the name of the Warm Spring, and the other of the Hot Spring. The Warm Spring iſſues with a very bold ſtream, ſufficient to work a griſt-mill, and to keep the waters of its baſon, which is 30 feet in diameter, at the vital warmth, viz. 96° of Farenheit's thermometer. The matter with which theſe waters is allied is very volatile; its ſmell indicates it to be ſulphureous, as alſo does the circumſtance of turning ſilver black. They relieve rheumatiſms. Other complaints alſo of very different natures have been removed or leſſened by them. It rains here 4 or 5 days in every week. The Hot Spring is about ſix miles from the Warm, is much ſmaller, and has been ſo hot as to have boiled an egg. Some believe its degree of heat to be leſſened. It raiſes the mercury in Farenheit's thermometer to 112 degrees, which is fever heat. It ſometimes relieves where the Warm Spring fails. A fountain of common water, iſſuing within a few inches of its margin, gives it a ſingular appearance. Comparing the temperature of theſe with that of the hot ſprings of Kamſchatka, of which Krachininnikow gives an account, the difference is very great, the latter raiſing the mercury to 200 degrees, which is within 12 degrees of boiling water. Theſe ſprings are very much reſorted to, in ſpite of a total want of accommodation for the ſick. Their waters are ſtrongeſt in the hotteſt months, which occaſions their being viſited in July and Auguſt principally.

principally. The Sweet Springs, in the county of Botetourt, at the eaſtern foot of the Alleghany, are about 42 miles from the Warm Springs.—*ib.*

WARNER, a townſhip of New Hampſhire, Hillſborough county. It was incorporated in 1774, and contains 863 inhabitants.—*ib.*

WARREN, a new county of the Upper Diſtrict of Georgia.—*ib.*

Warren, a county of Halifax diſtrict, N. Carolina. It contains 9,397 inhabitants, including 4,720 ſlaves. —*ib.*

WARRENTON, a poſt-town, and the capital of the above-mentioned county, ſituated 16 miles E. by N. of Hillſborough, 35 weſt of Halifax, 54 north of Raleigh, 83 ſouth of Peterſburg in Virginia, and 390 from Philadelphia. The town contains about 30 houſes, and ſtands in a lofty, dry, and healthy ſituation. Europeans, of various nations, reſide in and about the town. Here is a reſpectable academy, having generally from 60 to 70 ſtudents.—*ib.*

WARREN, a townſhip of Vermont, Addiſon county, about 30 miles N. E. by E. of Crown Point.—*ib.*

Warren, a poſt-town of the Diſtrict of Maine, Lincoln county, adjoining Camden and Thomaſton; 33 miles ſouth by weſt of Belfaſt, 203 N. E. by N. of Boſton, and 557 from Philadelphia. This townſhip is ſeparated from that of Thomaſton, by St George's river; was incorporated in 1776, and contains 642 inhabitants.—*ib.*

Warren, a townſhip of Grafton county, New-Hampſhire, north-eaſt of Orford, adjoining, incorporated in 1763, and contains 206 inhabitants.—*ib.*

Warren, a poſt-town of Rhode-Iſland, in Briſtol county, pleaſantly ſituated on Warren river and the north-eaſt part of Narraganſet Bay, 4 miles north of Briſtol, 10 S. S. E. of Providence, and 302 from Philadelphia. This is a flouriſhing town; carries on a briſk coaſting and Weſt-India trade, and is remarkable for ſhip building. The whole townſhip contains 1122 inhabitants, of whom 22 are ſlaves. Rhode-Iſland College was firſt inſtituted in this town, and afterwards removed to Providence.—*ib.*

Warren, a new townſhip of Herkemer county, New-York. It was taken from German Flats, and incorporated in 1796.—*ib.*

Warren, a part of the townſhip of Chenengo, in the State of New-York, on Suſquehannah river, bears this name in De Witt's map.—*ib.*

Warren, a townſhip in Connecticut, in Litchfield county, between the townſhips of Kent and Litchfield. —*ib.*

Warren, a poſt town of Virginia, 10 miles from Warminſter, 21 from Charlotteſville, and 326 from Philadelphia.—*ib.*

Warren's *Point*, on the coaſt of Nova-Scotia, is on the eaſt ſide of Chebucto Harbour, about 2 miles eaſt of the town of Halifax. It is at the entrance of a creek, which receives Saw-Mill river and other ſtreams. —*ib.*

WARRINGTON, the name of two townſhips of Pennſylvania; the one in York county, the other in Buck's county.—*ib.*

WARSAW, or *Waſſaw*, an iſland and ſound on the coaſt of Georgia, between the mouth of Savannah river and that of Ogeechee. The iſland forms the north ſide of Oſſabaw Sound; being in a N. E. direction from Oſſabaw Iſland. Warſaw Sound is formed by the northern end of the iſland of its name, and the ſouthern end of Tybee Iſland.—*ib.*

WARTON (Joſeph, D. D.) was born either towards the end of the year 1721, or in the beginning of the year 1722. He was the eldeſt ſon of Thomas Warton, B. D. who had been fellow of Magdalen College, Oxford; poetry profeſſor from the year 1718 to 1728, and vicar of Baſingſtoke in Hampſhire, and of Cobham in Surrey. Where the ſubject of this memoir was born we have not learned, though, were we to hazard a conjecture, we would ſay that it was in Oxford, as his father probably reſided in that city during his profeſſorſhip.

Our knowledge of the private hiſtory of Dr Warton is indeed extremely limited. We do not even know at what ſchool, or in what college, he was educated; though it was probably at Wincheſter ſchool, and certainly in ſome of the colleges in the univerſity of Oxford. For many years he was ſucceſſively under and upper maſter of Wincheſter college; but reſigned the laſt of theſe offices when he found the infirmities of age coming upon him; and was ſucceeded by Dr Goddard the preſent excellent maſter. He was likewiſe prebendary of the cathedral church of Wincheſter, and rector of Wickham in Hampſhire, where he died, aged 78.

His publications are few, but valuable. A ſmall collection of poems, without a name, was the firſt of them, and contained the Ode to Fancy, which has been ſo much and ſo deſervedly admired. They were all of them afterwards printed in Dodſley's collection. He was alſo a conſiderable contributer to the Adventurer, publiſhed by Dr Hawkeſworth; and all the papers which contain criticiſms on Shakeſpeare were written by him and his brother Thomas Warton, the ſubject of the next article.

The firſt volume of his Eſſay on the Life and Writings of Pope was publiſhed, had paſſed through ſeveral editions, and an interval of between 20 and 30 years had elapſed, before he gave a ſecond volume of that elegant and inſtructive work to the world. He had not only meditated, but had collected materials for a literary hiſtory of the age of Leo X: and propoſals were actually in circulation for a work of that kind; but it is probable that the duties of his ſtation did not leave him the neceſſary leiſure for an undertaking which required years of ſecluſion and independence. His laſt and late work which he undertook for the bookſellers at a very advanced age, was an edition of Pope's Works, that has not altogether ſatisfied the public expectation. He retained, with great propriety indeed, many of the notes of Warburton: but is ſeverely reprehended by the author of the Purſuits of Literature for ſuppreſſing the name of that prelate on his title-page, or including it only, as ſubordinate to his own, in the general expreſſion *others*.

Dr Warton was cheerful in his temper, convivial in his diſpoſition, of an elegant taſte and lively imagination, with a large portion of ſcholarſhip, and a very general knowledge of the Belles Lettres of Europe; it may be preſumed that Dr Warton poſſeſſed, beyond moſt men, the power of enlivening Claſſical Society. He was the intimate friend of Dr Johnſon; was ſeen at the parties of Mrs Montague, as well as at the table of Sir Joſhua Reynolds, and was an original member of the Literary Club. He poſſeſſed a liberal mind, a generous diſpoſition, and a benevolent heart. He was not only admired for his talents and his knowledge, but was beloved for thoſe qualities which are the beſt gifts of this imperfect ſtate.

Biog. Dict.

WARTON (Thomas), the brother of the preceding, was born in the year 1728. He received, as we have reaſon to believe, the firſt part of his education at Wincheſter; and at the age of 16 was entered a commoner of Trinity College, Oxford, under the tuition of Mr Geering.

He began his poetical career at an early age. In 1745, he publiſhed five paſtoral eclogues, in which are beautifully deſcribed the miſeries of war to which the ſhepherds of Germany were expoſed. Not long after, in the year 1748, he had full ſcope afforded for the exertion of his genius. It is well known that Jacobite principles were ſuſpected to prevail in the univerſity of Oxford about the time of the rebellion in the year 1745. Soon after its ſuppreſſion, the drunkenneſs and folly of ſome young men gave offence to the court, in conſequence of which a proſecution was inſtituted in the court of King's Bench, and a ſtigma was fixed on the vice-chancellor and ſome other heads of colleges in Oxford. Whilſt this affair was the general ſubject of converſation, Mr Maſon publiſhed his "Iſis," an elegy, in which he adverts to the above mentioned circumſtances. In anſwer to this poem, Mr Warton, encouraged by Dr Huddesford, the preſident of the college, publiſhed, in 1749, "The Triumph of Iſis," which excelled more in manly expoſtulation and dignity than the poem that produced it did in neatneſs and elegance. With great poetical warmth, and a judicious ſelection of circumſtances, he characteriſes the eminent men who had been educated in Oxford, and draws a ſtriking and animated portrait of Dr King, the celebrated public orator of that time. The whole poem ſhews the early maturity of his genius, and is finiſhed with happy diligence.

In the year 1751, he ſucceeded to a fellowſhip of his college, and was thus placed in a ſituation eaſy and independent, and particularly congenial with his habits of retirement and ſtudy. In 1753, appeared his obſervations on "The Faery Queen of Spencer," in 8vo, a work which he corrected, enlarged, and republiſhed, in two volumes crown octavo, in the year 1762. He ſent a copy of the firſt edition to Dr Johnſon, who, in a letter to him upon the ſubject, expreſſed this handſome compliment: "I now pay you a very honeſt acknowledgement for the advancement of the literature of our native country: you have ſhewn to all, who ſhall hereafter attempt the ſtudy of ancient authors, the way to ſucceſs, by directing them to the peruſal of the books which theſe authors had read."

In 1754, Dr Johnſon viſited Oxford for the firſt time after he had quitted reſidence there. Much of his time was ſpent with Mr Warton; and there appeared to have been a conſiderable degree of confidential intercourſe between them upon literary ſubjects, and particularly on their own works. A pleaſing account of this viſit was communicated by Mr Warton to Mr Boſwell, who has inſerted it in his life of Johnſon.

In 1755, Mr Warton exerted himſelf to procure for his friend the degree of maſter of arts by diploma from the univerſity of Oxford; an honour which Johnſon eſteemed of great importance to grace the title page of his dictionary which he was about to publiſh. In 1756, Mr Warton was elected profeſſor of poetry, which office he held for the uſual term of ten years. His lectures were remarkable for elegance of diction and juſtneſs of obſervation. One of them on the ſubject of paſtoral poetry, was afterwards prefixed to his edition of Theocritus. In 1758, he contributed to aſſiſt Dr Johnſon in the ſubſcription to his edition of Shakeſpeare, and furniſhed him with ſome valuable notes. The Doctor remarks in a letter to him, when ſoliciting his farther aid, "It will be reputable to my work, and ſuitable to your profeſſorſhip, to have ſomething of yours in my notes."

From the Clarendon preſs, in the year 1766, he publiſhed "Anthologiæ Græcæ, a Conſtantino Cephalà conditæ, Libri tres," in 2 vols, 12mo. He concludes the learned and claſſical preface to this work, which is replete with accurate remarks on the Greek epigram, in the following words, which mark this publication for his own: Vereor ut hactenus in plexendis florum corollis otium nimis longum pertraxerim. Proximè ſequetur, cui nunc omnes operas et vires intendo, Theocritus. Interea quaſi promulſidem convivii Lectoribus meis elegantias haſce vetuſtatis eruditæ propino."

In the year 1770, he conferred a ſimilar honour upon the academical preſs by his edition of Theocritus, in 2 vols, 8vo. He undertook this work by the advice of Judge Blackſtone, then fellow of All-Souls College, and an ardent promoter of every publication that was likely to do credit to the Clarendon preſs. This elaborate publication reflects no ſmall credit on the learning, diligence, and taſte of the editor.

In 1771, he was elected a fellow of the Antiquarian Society, and was preſented by the Earl of Lichfield to the ſmall living of Kiddington in Oxfordſhire, which he held till his death. He likewiſe in this year publiſhed an improved account of "The Life of Sir Thomas Pope, founder of Trinity College, Oxford. In compoſing theſe memoirs, he beſtowed much labour and reſearch, and ſhewed great judgment in the arrangement of his materials. But poſſibly, in his ardour to pay a debt of gratitude, he has not ſufficiently conſidered what was due to his own fame. The ſame ſtrength of deſcription and vigour of remark would have better ſuited the life of ſome eminently diſtinguiſhed character, and extended the reputation of the author as a biographer beyond the circle of thoſe academical readers who are influenced by the ſame feelings of veneration, reſpect, and gratitude which prompted Mr Warton to compoſe this work. The preface contains ſome excellent remarks on biographical writing.

The plan for a hiſtory of Engliſh poetry was laid by Pope, enlarged by Gray: but to bring an original plan nearly to a completion was reſerved for the perſeverance of Warton. In 1774 appeared his firſt volume; in 1778, the ſecond and third; which brings the narrative down to the commencement of the reign of Elizabeth in 1581. This work diſplays the moſt ſingular combination of extraordinary talents and attainments. It unites the deep and minute reſearches of the antiquary with the elegance of the claſſical ſcholar and the ſkill

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of the practiſed writer. The ſtyle is vigorous and manly; the obſervations acute and juſt; and the views of the ſubject are extenſive and accurate.

In 1777, he collected his poems into an octavo volume, containing miſcellaneous pieces, odes, and ſonnets. This publication may be conſidered in ſome meaſure original; there being only ſeven pieces that had before appeared, and near three times that number which were then printed for the firſt time.

In vindication of the opinion he had given in his ſecond volume of "The Hiſtory of Poetry," relative to the ingenious attempt of Chatterton to impoſe upon the public, he produced, in 1782, "An Inquiry into the Authenticity of the Poems attributed to Rowley." In this excellent pamphlet the principles of true criticiſm are laid down, an appeal is properly made to the internal evidence of the poems; and upon theſe grounds it is proved, in the moſt ſatisfactory manner, that they could not have been written by a monk of the fourteenth century.

The year 1785 brought him thoſe diſtinctions which were no leſs honourable to thoſe who conferred than to him who received them. He was appointed poet-laureat on the death of Whitehead, and elected Camden profeſſor of ancient hiſtory on the reſignation of Dr Scott. His inauguration lecture was delivered in a clear and impreſſive manner from the profeſſorial chair. It contained excellent obſervations of the Latin hiſtorians, and was written in a ſtrong, perſpicuous, and claſſical ſtyle. In his odes, the vigour and brilliancy of his fancy were not proſtituted to an inſipid train of courtly compliments: each preſents an elegant ſpecimen of deſcriptive poetry, and as all of them have only a ſlight relation to the particular occaſion on which they were written, and have always a view to ſome particular and intereſting ſubject, they will be peruſed with pleaſure as long as this ſpecies of compoſition is admired.

He made occaſional journeys to London to attend the literary club, of which he was ſome years a member; and to viſit his friends, particularly Sir Joſhua Reynolds. At his houſe he was ſure to meet perſons remarkable for faſhion, elegance, and taſte.

His laſt publication, except his official odes, conſiſted of Milton's ſmaller poems. A quarto edition appeared in 1790, with corrections and additions. The great object of theſe notes is to explain the alluſions of Milton, to trace his imitations, and to illuſtrate his beauties.

Until he reached his ſixty-ſecond year, he continued to enjoy vigorous and uninterrupted health. On being ſeized with the gout, he went to Bath, and flattered himſelf, on his return to college, that he was in a fair way of recovery. But the change that had taken place in his conſtitution was viſible to his friends. On Thurſday, May 20, 1790, he paſſed the evening in the common room, and was for ſome time more cheerful than uſual. Between ten and eleven o'clock he was ſtruck with the palſy, and continued inſenſible till his death, which happened the next day at two o'clock. On the 27th, his remains were interred in the college chapel with the moſt diſtinguiſhed academical honours. The inſcription upon the flat ſtone which is placed over his grave contains only an enumeration of his preferments.

Such was the general conduct and behaviour of Mr Warton as to render him truly amiable and reſpectable. By his friends he was beloved for his open and eaſy manners; and by the members of the univerſity at large he was reſpected for his conſtant reſidence, ſtrong attachment to Alma Mater, his ſtudious purſuits, and high literary character. In all parties where the company accorded with his inclination, his converſation was eaſy and gay, enlivened with humour, enriched with anecdote, and pointed with wit. Among his peculiarities it may be mentioned that he was fond of all military ſights. He was averſe to ſtrangers, particularly to thoſe of a literary turn; and yet he took a great pleaſure in encouraging the efforts of riſing genius, and aſſiſting the ſtudious with his advice; as many of the young men of his college, who ſhared his affability and honoured his talents, could teſtify. He was bred in the ſchool of punſters; and made as many good ones as Barton and Leigh, the celebrated word-hunters of his day. Under the maſk of indolence, no man was more buſy; his mind was ever on the wing in ſearch of ſome literary prey. Although, at the accuſtomed hours of Oxford ſtudy, he was often ſeen ſauntering about, and converſing with any friend he chanced to meet; yet, when others were waſting their mornings in ſleep, he was indulging his meditations in his favourite walks, and courting the Muſes. His ſituation in Oxford was perfectly congenial with his diſpoſition, whether he indulged his ſallies of pleaſantry in the common room, retired to his own ſtudy, or to the Bodleian library; ſauntered on the banks of his favourite Cherwell, or ſurveyed, with the enthuſiaſtic eye of taſte, the ancient gateway of Magdalen College, and other ſpecimens of Gothic architecture.

The following is a liſt of Mr Warton's works; 1. "Five Paſtoral Eclogues," 4to, 1745. Reprinted in Peach's Collection of Poems. 2. "The Pleaſures of Melancholy," written in 1745; firſt printed in Dodſley's Collection, and afterwards in the Collection of Mr Warton's Poems. 3. "Progreſs of Diſcontent," written in 1746. Firſt printed in the "Student," a periodical paper. 4. "The Triumph of Iſis, a Poem," 4to, 1750. 5. "Newmarket, a Satire," folio, 1751. 6. "Ode for Muſic," performed at the theatre in Oxford 1751. 7. "Obſervations on the Faerie Queen of Spencer," 8vo, 1754. 8. "Inſcriptionum Metricarum Delectus," 4to, 1758. 9. "A Deſcription of the City, College and Cathedral, of Wincheſter," 8vo, no date. 10. "The Life of Sir Thomas Pope," in the 5th volume of the Biographia Britannica," republiſhed in 1772. 11. "The Life and Literary Remains of Ralph Bathurſt, M D Dean of Wells, and Preſident of Trinity College in Oxford," 1761. 12. "A Companion to the Guide, and a Guide to the Companion," 12mo, 1762. 13. "The Oxford Sauſage," in which are ſeveral Poems by Warton. 14. "Anthologiæ Græcæ a Conſtantino Cephalâ conditæ Libri tres," 2 tom. 1766. 15. "Theocritis Syracuſii quæ ſuperſunt, cum Scholiis Græcis," &c. 2 tom. 4to, 1770 16. "Hiſtory of Engliſh Poetry, from the Cloſe of the 11th to the Commencement of the 18th Century," 4to, Vol. I 1774. Vol. II. 1778. Vol. III 1781. 17. "Poems," 8vo, 1777. 18. "Specimen of a Hiſtory of Oxfordſhire," 1783. 19 "An Enquiry into the Authenticity of the Poems attributed to Thomas Rowley," 8vo, 1782. 20. "Verſes on Sir J.

Reynolds's painted Window in New College Chapel, 4to," 1782. 21. "Poems on ſeveral Occaſions, by John Milton, with Notes critical and explanatory," 8vo, 1785.

WARWICK, a county of Virginia, bounded north by York county, and ſouth by James' river, which ſeparates it from Iſle of Wight, and Nanſemond counties. It is the oldeſt county of the State, having been eſtabliſhed in 1628. It contains 1690 inhabitants, of whom 990 are ſlaves.—*Morſe.*

Warwick, a townſhip of Maſſachuſetts, in Hampſhire county, incorporated in 1763, and contains 1246 inhabitants. It is bounded north by the ſtate of New-Hampſhire, not far eaſt of Connecticut river, and is 90 miles north weſt of Boſton.—*ib.*

Warwick, the chief town of Kent county, Rhode-Iſland, ſituated at the head of Narraganſet Bay, and on the weſt ſide; about 8 miles ſouth of Providence. The townſhip contains 2,493 inhabitants, including 35 ſlaves. A cotton manufactory has been eſtabliſhed in this town upon an extenſive ſcale. One of Arkwright's machines was erected here in Auguſt, 1795; and the yarn produced anſwers the moſt ſanguine expectation. This town was the birth-place of the celebrated Gen. Green.—*ib.*

Warwick, a townſhip of New-York, Orange county, bounded eaſterly by New-Cornwall, and ſoutherly by the State of New-Jerſey. It contains 3,603 inhabitants; of whom 383 are electors, and 95 ſlaves.—*ib.*

Warwick, the name of two townſhips of Pennſylvania; the one in Buck's county, the other in that of Lancaſter. In the latter is the fine Moravian ſettlement called Litiz.—*ib.*

Warwick, a poſt-town of Maryland, Cecil county, on the eaſtern ſhore of Cheſapeak Bay; about 14 miles ſoutherly of Elkton, 8 N. E. of Georgetown Croſs Roads, and 57 ſouth-weſt of Philadelphia.—*ib.*

Warwick, a ſmall town of Cheſterfield county, Virginia; agreeably ſituated on the ſouth-weſt ſide of James' river, about 7 miles ſouth-ſouth eaſt of Richmond, and 17 north of Peterſburg. Veſſels of 250 tons burden can come to this town. In 1781, Benedict Arnold deſtroyed many veſſels in the river and on the ſtocks at this place.—*ib.*

WASHINGTON (George), one of thoſe few men who have been great without being criminal, was born on the 11th of *February*, 1732 *in the Pariſh of Waſhington, Virginia.* He was deſcended from an ancient family in Cheſhire, of which a branch had been eſtabliſhed in Virginia about the middle of the laſt century. We are not acquainted with any remarkable circumſtances of his education or his early youth; and we ſhould not indeed expect any marks of that diſorderly prematureneſs of talent, which is ſo often fallacious, in a character whoſe diſtinguiſhing praiſe was to be perfectly regular and natural. His claſſical inſtruction was probably ſmall, ſuch as the private tutor of a Virginian country gentleman could at that period have imparted; and if his opportunities of information had been more favourable, the time was too ſhort to profit by them. Before he was twenty he was appointed a major in the colonial militia, and he had very early occaſion to diſplay thoſe political and military talents, of which the exertions on a greater theatre have ſince made his name ſo famous throughout the world.

The plenipotentiaries who framed the treaty of *Aix la Chapelle*, by leaving the boundaries of the Britiſh and French territories in North America unfixed, had ſown the ſeeds of a new war, at the moment when they concluded a peace.—The limits of Canada and Louiſiana, negligently deſcribed in vague language by the treaties of Utrecht and Aix la Chapelle, becauſe the greater part of theſe vaſt countries was then an impenetrable wilderneſs, furniſhed a motive or a pretext, for one of the moſt ſucceſsful but one of the moſt bloody and waſteful wars in which Great Britain had ever been engaged.

In the diſputes which aroſe between the French and Engliſh officers on this ſubject, Major Waſhington was employed by the governor of Virginia, in a negotiation with the French governor of *Fort du Queſne* (now Pitſburgh); who threatened the Engliſh frontiers with a body of French and their Indian allies. He ſucceeded in averting the invaſion; but hoſtilities becoming inevitable, he was in the next year appointed lieutenant colonel of a regiment raiſed by the colony for its own defence; to the command of which he ſoon after ſucceeded. The expedition of Braddock followed in the year 1755; of which the fatal iſſue is too well known to require being deſcribed by us. Colonel Waſhington ſerved in that expedition only as a volunteer; but ſuch was the general confidence in his talents, that he may be ſaid to have conducted the retreat. Several Britiſh officers are ſtill alive who remember the calmneſs and intrepidity which he ſhewed in that difficult ſituation, and the voluntary obedience which was ſo cheerfully paid by the whole army to his ſuperior mind. After having acted a diſtinguiſhed part in a ſubſequent and more ſucceſsful expedition to the Ohio, he was obliged by ill health, in the year 1758, to reſign his military ſituation. The ſixteen years which followed of the life of Waſhington, ſupply few materials for the biographer. Having married Mrs Cuſtis, a Virginian lady of amiable character and reſpectable connections, he ſettled at his beautiful ſeat of Mount Vernon, of which we have had ſo many deſcriptions; where, with the exception of ſuch attendance as was required by his duties as a magiſtrate and a member of the aſſembly, his time was occupied by his domeſtic enjoyments, and the cultivation of his eſtate, in a manner well ſuited to the tranquillity of his pure and unambitious mind. At the end of this period he was called by the voice of his country from this ſtate of calm and ſecure though unoſtentatious happineſs.

The events of that deplorable conteſt which rent aſunder the Britiſh empire, are yet perhaps too recent for free and impartial diſcuſſion. The connection between Great Britain and America had long been ſuffered to remain in that uncertain ſtate which is not inconſiſtent with mutual harmony as long as each party repoſes confidence in each other. The ſupreme authority of the mother country was reſpected without being definitely acknowledged in its utmoſt extent. It was not ſyſtematically declared, nor rigorouſly enforced by England—It was not zealouſly watched nor legally limited by the colonies. England derived increaſed wealth and proſperity from the growing greatneſs of America. America was protected by the ſtrength of England, and felt pride in the participation of her liberty. In this happy ſtate of mutual affection, neither hingn.

party harboured ſuch diſtruſt as to prompt them to take ſecurity for the authority of one or the privileges of the other. All thoſe doubtful and dangerous queſtions which relate to the boundaries of power and freedom were forgotten, during this fortunate connection between obedient liberty and protecting authority. The parliament of Great Britain, content with that ſtream of wealth which *indirectly* flowed into the Exchequer through the channels of American commerce, had hitherto either doubted their right to tax America, or wiſely forborn to exerciſe that unprofitable and perilous right. The ſcheme of an American revenue had been ſuggeſted to Sir Robert Walpole, but that cautious and pacific miniſter declared, "that he would leave it to bolder men."—Men bolder, but not wiſer, than Sir Robert were at length found to adopt it. The counſels which predominated at the beginning of the preſent reign were favourable to ſuch plans. A ſyſtem of taxing America by the Britiſh parliament was avowed and acted upon.—A ſtamp duty was impoſed on all the colonies. Whatever may have been the cauſes of this unfortunate deviation from the ſound principles of the ancient American policy, the effects ſoon became manifeſt. The old affectionate confidence of the coloniſts was changed into hoſtile diſtruſt; inſtead of relying in the benevolence of a paternal government, they began to think of guarding themſelves againſt an enemy. The intercourſe of jealous chicane ſucceeded to that of generous friendſhip; metaphyſical diſcuſſions with reſpect to the limits and foundation of ſupreme power, which ſeldom diſturb the quiet of a happy and well governed people, were for the firſt time forced on the attention of the Americans by the indiſcretion of their governors. Nothing, however, is more certain, than that the firſt views of the American leaders were merely *defenſive*; and that they were far advanced in the reſiſtance before the idea of independence preſented itſelf to their minds. They did not ſeek ſeparation; it was obtruded on them by the irreſiſtible force of circumſtances. After they had appealed to arms, it was extremely obvious, that their power muſt be tottering as long as they acknowledged the lawfulneſs of the power againſt whom they were armed; that the zeal of their partizans never could be vigorous till they had cut off all poſſibility of retreat; and that no foreign ſtate would be connected with them, as long as they themſelves confeſſed, that they had neither the right nor the power to enter into a legitimate and permanent alliance. All the paſſions, which in violent times are almoſt ſure to baniſh moderate counſels, were at work in America. Theſe conſequences always follow in the neceſſary courſe of things, from the firſt impulſe that throw a people into confuſion: moſt certainly theſe conſequences did not enter into the original plan of the American leaders. There are thoſe who remember the horror expreſſed by Dr Franklin, before he left England, at the bare mention of ſeparation: yet Franklin was, perhaps, of all the Americans, the man moſt likely to entertain ſuch a project. Their leaders were in general men of great ſobriety, caution, and practical good ſenſe; zealous indeed for the maintenance of their ancient legal rights and privileges; but utterly untainted by that daring and ſpeculative character which leads men to ſeek untried, and perilous paths in politics, for their own greatneſs or for ſuppoſed public benefit.

Waſhington.

The diſorders in America had reached their height, and it became perfectly obvious, that the diſpute between the two countries could only be decided by arms, when the repreſentatives of the thirteen provinces aſſembled at Philadelphia, on the 26th of October, 1774. Of this famous aſſembly Mr Waſhington was one; no American united in ſo high a degree as he did military experience, with reſpectable character and great natural influence. He was therefore appointed to the command of the army which aſſembled in the New England Provinces, to hold in check the Britiſh army under General Gage, then encamped at Boſton. If theſe circumſtances had not called Waſhington forth, he would have lived happy, and died obſcure, as a reſpectable country gentleman in Virginia: now the ſcene opened which made his name immortal: ſo dependent upon accident is human fame, and ſo great is the power of circumſtances in calling forth, and perhaps even in forming, the genius of men.

In the month of July, 1775, General Waſhington took the command of the continental army before Boſton. To detail his conduct in the years which followed, would be to relate the hiſtory of the American war: a moſt memorable and inſtructive part of Britiſh annals, which has not yet been treated in a manner ſuited to its importance and dignity. Within a very ſhort period after the declaration of independence, the affairs of America were in a condition ſo deſperate, that perhaps nothing but the *peculiar* character of Waſhington's genius could have retrieved them. Activity was the policy of invaders. In the field of battle the ſuperiority of a diſciplined army is diſplayed. But delay was the wiſdom of a country defended by undiſciplined ſoldiers againſt an enemy who muſt be more exhauſted by time than he could be weakened by defeat. It required the conſummate prudence, the calm wiſdom, the inflexible firmneſs, the moderate and well balanced temper of Waſhington to embrace ſuch a plan of policy, and to perſevere in it; to reſiſt the temptations of enterprize; to fix the confidence of his ſoldiers without the attraction of victory; to ſupport the ſpirit of the army and the people amidſt thoſe ſlow and cautious plans of defenſive warfare which are more diſpiriting than defeat itſelf; to contain his own ambition and the impetuoſity of his troops; to endure temporary obſcurity for the ſalvation of his country, and for the attainment of ſolid and immortal glory, and to ſuffer even temporary reproach and obloquy, ſupported by the approbation of his own conſcience and the applauſe of that ſmall number of wiſe men whoſe praiſe is an earneſt of the admiration and gratitude of poſterity. Victorious generals eaſily acquire the confidence of their army. Theirs, however, is a confidence in the *fortune* of their general. That of Waſhington's army was a confidence in his *wiſdom*. Victory gives ſpirit to cowards, and even the agitations of defeat ſometimes impart a courage of deſpair. Courage is inſpired by ſucceſs, and it may be ſtimulated to deſperate exertion even by calamity, but it is generally palſied by inactivity—A ſyſtem of cautious defence is the ſevereſt trial of human fortitude. By this teſt the firmneſs of Waſhington was tried. His intrepidity never could have maintained itſelf under ſuch circumſtances, if it had ariſen from ambition or vain glory, from robuſt nerves or diſorderly enthuſiaſm. It ſtood the teſt, becauſe it grew out of the deep root of principle and duty. His mind was ſo perfectly framed, that he did not need the vulgar incentives of fame and glory to rouſe his genius. In him public virtue was a principle of ſufficient force to excite the ſame great exertions to which the rabble of heroes muſt be ſtimulated by the love of power or of praiſe.

It is hardly neceſſary to ſay, that the courage which flowed from honeſty, was tempered in its exerciſe by humanity. The character of Waſhington was not deformed by any of thoſe furious paſſions which drive men to ferocity. His military life was unſtained by military cruelty; and if we lamented the ſeverity of ſome of his acts, we never were at liberty to queſtion their juſtice. It would be unjuſt to aſcribe the mildneſs of the American war excluſively to the perſonal character of Waſhington.—It muſt be imputed in a great meaſure to the ſobriety and moderation of the national temper. Never was a civil war ſo ſpotleſs as that which unhappily broke out between the two nations of the Engliſh race. Not a ſingle maſſacre, not a ſingle aſſaſſination, no ſlaughter in cold blood tarniſhed the glory of conqueſt or aggravated the ſhame of defeat. Gallantry and humanity characterized this conteſt between two nations who amidſt all the fierceneſs of hoſtility ſhewed themſelves worthy of each other's friendſhip.

We are well aware that the military critics of Europe, accuſtomed to the vaſt and ſcientific plans, to the complicated yet exact movements, to the daring and ſplendid exploits of great European generals, may conſider the moſt deciſive ſucceſs in a war like the American as a very inadequate title to the name and glory of an illuſtrious commander. We feel all the deference which upon every ſubject is due from the ignorant to the maſters of the art. But we doubt the ſoundneſs of the judgment of military critics on this ſubject. To us it ſeems probable that more genius and judgment are generally exerted by uneducated generals and among irregular armies, than in the conteſts of thoſe commanders who are more perfectly inſtructed in military ſcience. It is with the arts of war as with every other art. Wherever any art is moſt perfected, there is leaſt room for the exertions of individual genius. Where moſt can be done by rule, leaſt is left for talents. We accordingly find that thoſe ſurprizes and ſtratagems which are ſo brilliant and intereſting a part of the hiſtory of war in paſt times, are now infinitely more rare, becauſe vigilance is now more uniform and the means of defence more perfect. It is now much more eaſy than it was formerly to calculate the event of a campaign from the numbers of the contending armies, the fortreſſes which they poſſeſs and the nature of the country which they occupy. It is impoſſible that the art of war ſhould ever be ſo improved, as to obliterate all differences between the talents of generals: but it is certain that its improvement has a tendency to make the inequality of their talents leſs felt. It cannot be denied that they who beſt know the power of the *art* are the moſt ſober *admirers* of the talents of generals. But whatever be the juſtneſs of theſe obſervations, it muſt be univerſally allowed, that as much judgment and intrepidity may be ſhewn among irregular and imperfectly diſciplined armies as under the moſt highly improved ſyſtem of mechanical tactics. This is ſufficient for our purpoſe; for we are now contemplating the character of him whoſe leaſt praiſe is that of being a great commander, whoſe valour was the miniſter of virtue, and whoſe military genius is chiefly ennobled by being employed in the defence of juſtice.

It is extremely remarkable, that though there never was a civil conteſt diſgraced by ſo few violent or even ambiguous acts as the American war, yet ſo pure were the moral ſentiments of Waſhington, that he could not look back on the period of hoſtilities with unmixed pleaſure. An Italian nobleman, who viſited him after the peace, had often attempted, in vain, to turn the converſation to the events of the war. At length he thought he had found a favourable opportunity of effecting his purpoſe; they were riding together over the ſcene of an action where Waſhington's conduct had been the ſubject of no ſmall animadverſion. Count ——— ſaid to him, "Your conduct, Sir, in this action has been criticized." Waſhington made no anſwer, but clapped ſpurs to his horſe; after they had paſſed the field, he turned to the Italian and ſaid, "Count ———, I obſerve that you wiſh me to ſpeak of the war. It is a converſation which I always avoid. I rejoice at the eſtabliſhment of the liberties of America. But the time of the ſtruggle was a horrible period, in which the beſt men were compelled to do many things repugnant to their nature."

So fatal are even the mildeſt civil commotions to men's morals, and ſo admirable was the temperament of the man who had too much magnanimity not to take up arms at the call of his country, and yet too delicate a purity to dwell with complacency on the recollection of ſcenes which, though they were the ſource of his glory, allowed more ſcope for the diſplay of his talents than for the exerciſe of his humanity!

The concluſion of the American war permitted Waſhington to return to thoſe domeſtic ſcenes, from which nothing but a ſenſe of duty ſeems to have had the power to draw him. But he was not allowed long to enjoy this privacy. The ſupreme government of the United States, haſtily thrown up, in a moment of turbulence and danger, as a temporary fortification againſt anarchy, proved utterly unadequate to the preſervation of general tranquillity and permanent ſecurity. The confuſions of civil war had given a taint to the morality of the people which rendered the reſtraints of a juſt and vigorous government more indiſpenſably neceſſary. Confiſcation and paper money, the two greateſt ſchools of rapacity and diſhoneſty in the world, had widely ſpread their poiſon among the Americans. In this ſtate of things, which threatened the diſſolution of morality and government, good men ſaw the neceſſity of concentrating and invigorating the ſupreme authority. Under the influence of this conviction, a convention of delegates was aſſembled at Philadelphia, which ſtrengthened the bands of the Federal Union, and beſtowed on Congreſs thoſe powers which were neceſſary for the purpoſes of good government. Waſhington was the preſident of this convention, and afterwards was unanimouſly elected preſident of the United States of America, under what was called "The New Conſtitution," though it might have been called a *reform* of the republican government, as that republican government itſelf was only a *reform* of the ancient colonial conſtitution under the Britiſh crown. None of theſe changes extended ſo far as an attempt to new-model the whole ſocial and political ſyſtem.

There is nothing more ſtriking in the whole character of General Waſhington, and which diſtinguiſhes him more from other extraordinary men, than the circumſtances which attended his promotion and retreat from office. Unſought elevation and cheerful retreat are almoſt peculiar to him. He eagerly courted privacy, and only *ſubmitted* to exerciſe authority as a public duty. The promotions of many men are the triumph of ambition over virtue. The promotions, even of good men, have generally been eagerly ſought by them from motives which were very much mixed. The promotions of Waſhington alone, ſeem to have been victories gained by his conſcience over his taſte. His public virtue did not need the ambiguous aid of ambition to urge its activity. We do not affirm that all ambition is to be condemned; it is perhaps neceſſary to ſtimulate the ſluggiſhneſs of human virtue. Thoſe who avoid the public ſervice from an epicurean love of pleaſure and of eaſe, from the fear of danger, from inſenſibility to honeſt fame, are not ſo much to be praiſed for their exemption from ambition as to be deſpiſed for baſer vices. But though it be mean to be *below* ambition, it is a proof of unſpeakable greatneſs of mind to be *above* it. This elevation the mind of Waſhington had reached; and unleſs we are greatly deceived, he will be found to be a ſolitary example of ſuch exalted magnanimity. To deſpiſe what all other men purſue; to ſhew himſelf equal to the higheſt places without ever ſeeking any; and to be as active and intrepid from public virtue alone, as others are under the influence of the moſt reſtleſs ambition; theſe are the noble peculiarities of the character of Waſhington.

Events occurred during his chief magiſtracy, which convulſed the whole political world, and which tried moſt ſeverely his moderation and prudence. The French revolution took place.

Both friends and enemies have agreed in ſtating that Waſhington, from the beginning of that revolution, had no great confidence in its beneficial operation. He muſt indeed have deſired the abolition of deſpotiſm, but he is not to be called the enemy of liberty if he dreaded the ſubſtitution of a more oppreſſive deſpotiſm. It is extremely probable that his wary and practical underſtanding, inſtructed by the experience of popular commotions, augured little good from the daring ſpeculations of inexperienced viſionaries. The progreſs of the revolution was not adapted to cure his diſtruſt, and when, in the year 1793, France, then groaning under the moſt intolerable and hideous tyranny, became engaged in war with almoſt all the governments of the civilized world, it is ſaid to have been a matter of deliberation with the Preſident of the United States, whether the republican envoy, or the agent of the French princes ſhould be received in America as the diplomatic repreſentative of France. But whatever might be his private feelings of repugnance and horror, his public conduct was influenced only by his public duties. As a virtuous man he muſt have abhorred the ſyſtem of crimes which was eſtabliſhed in France. But as the firſt magiſtrate of the American Commonwealth, he was bound only to conſider how far the intereſt and ſafety of the people whom he governed, were affected by the conduct of France. He ſaw that it was wiſe and neceſſary for America to preſerve a good underſtanding and a beneficial intercourſe with that great country, in whatever manner ſhe was governed, as long as ſhe abſtained from committing injury againſt the United States. Guided by this juſt and ſimple principle, uninfluenced by the abhorrence of crimes which he felt and which others affected, he received Mr Genet, the miniſter of the French Republic. The hiſtory of the outrages which that miniſter committed, or inſtigated, or countenanced againſt the American government, muſt be freſh in the memory of all our readers. The conduct of Waſhington was a model of firm and dignified moderation. Inſults were offered to his authority in official papers, in anonymous libels, by incendiary declaimers, and by tumultuous meetings. The law of nations was trampled under foot. His confidential miniſters were ſeduced to betray him, and the deluded populace were ſo inflamed by the arts of their enemies that they broke out into inſurrection. No vexation, however galling, could diſturb the tranquillity of his mind, or make him deviate from the policy which his ſituation preſcribed. With a more confirmed authority, and at the head of a longer eſtabliſhed government, he might perhaps have thought greater vigour juſtifiable. But in his circumſtances he was ſenſible that the nerves of authority were not ſtrong enough to bear being ſtrained. Perſuaſion, always the moſt deſirable inſtrument of government, was in his caſe the ſafeſt. Yet he never overpaſſed the line which ſeparates conceſſion from meanneſs. He reached the utmoſt limits of moderation, without being betrayed into puſillanimity. He preſerved external and internal peace by a ſyſtem of mildneſs, without any of thoſe virtual confeſſions of weakneſs, which ſo much diſhonour and enfeeble ſupreme authority. During the whole of that arduous ſtruggle, his perſonal character gave that ſtrength to a *new magiſtracy*, which in other countries ariſes from ancient habits of obedience and reſpect. The authority of his virtue was more efficacious for the preſervation of America than the legal powers of his office.

During the turbulent period of the French revolution, Waſhington was re-elected to the office of the Preſidency of the United States, which he held from April 1789, till September 1796. Probably no magiſtrate of any commonwealth, ancient or modern, ever occupied a place ſo painful and perilous. Certainly no man was ever called upon ſo often to ſacrifice his virtuous feelings (he had no other ſacrifices to make) to his public duty. Two circumſtances of this ſort deſerve to be particularly noticed. In the ſpring of 1794, he ſent an embaſſador to Paris with credentials, addreſſed to his "Dear friends the citizens compoſing the Committee of Public Safety of the French Republic," whom he prays God "to take under his holy protection." Fortunately the American embaſſador was ſpared the humiliation of preſenting his credentials to theſe bloody tyrants. Their power was ſubverted, and a few of them had ſuffered the puniſhment of their crimes, which no puniſhment could expiate, before his arrival at Paris. The dignity of the nature of man was not ſo degraded, as that the embaſſador of the moſt reſpectable republic in the world ſhould be preſented to

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ruffians and aſſaſſins, who had the incredible effrontery to call their tyranny by the profaned name of republic. But hiſtorians who relate heroic ſacrifices of feeling to duty, when they tell us, that Brutus thought himſelf obliged to condemn his ſon to death, will not forget to add, that Waſhington was compelled to call Roberſpierre "his friend!" In the contemplation of ſuch ſcenes good men for a moment forget their deliberate opinions, and are led to curſe civil government itſelf with all the ſevere duties which it impoſes, and all the cruel ſacrifices which it demands.

Another ſtruggle of feeling and duty Waſhington had to encounter, when he was compelled to ſuppreſs the inſurrection in the weſtern counties of Pennſylvania by force of arms. But here he had a conſolation. The exerciſe of mercy conſoled his mind for the neceſſity of having recourſe to arms. Never was there a revolt quelled with ſo little blood. Scarcely ever was the baſeſt daſtard ſo tender of his own life, as this virtuous man was of the lives of his fellow citizens. The value of his clemency is enhanced by recollecting, that he was neither without provocations to ſeverity, nor without pretexts for it. His character and his office had been reviled in a manner almoſt unexampled among civilized nations.—His authority had been inſulted.—His ſafety had been threatened. Of his perſonal and political enemies ſome might, perhaps, have been ſuſpected of having inſtigated the inſurrection; a greater number were thought to wiſh well to it; and very few ſhewed much zeal to ſuppreſs it. *Is habitus animorum fuit, ut peſſimum facinus auderent pauci, plures vellent, omnes paterentur.* But neither reſentment, nor fear, nor even policy itſelf, could extinguiſh the humanity of Waſhington. This ſeems to have been the only ſacrifice which he was incapable of making to the intereſt of his country.

Throughout the whole courſe of his ſecond preſidency, the danger of America was great and imminent almoſt beyond example. The ſpirit of change indeed, at that period, ſhook all nations. But in other countries, it had to encounter ancient and ſolidly eſtabliſhed power. It had to tear up by the roots long habits of attachment in ſome nations for their government, of awe in others, of acquieſcence and ſubmiſſion in all. But in America the government was new and weak. The people had ſcarce time to recover from the ideas and feelings of a recent civil war. In other countries the volcanic force muſt be of power to blow up the mountains, and to convulſe the continents that held it down, before it could eſcape from the deep caverns in which it was impriſoned:—in America it was covered only by the aſhes of a late convulſion, or at moſt by a little thin ſoil, the produce of a few years quiet.

To theſe difficulties were added others, which, if duly weighed, will perhaps diſpoſe us to conſider the preſervation of America from confuſion under the government of Waſhington, by means ſo mild, and apparently ſo inadequate, as either one of the greateſt maſter pieces of civil prudence that ever diſtinguiſhed an adminiſtration, or one of the moſt fortunate accidents that ever befel a ſtate. To thoſe who may repreſent it as mere good fortune, we may anſwer with FONTENELLE, who, when ſomebody congratulated him on the *good fortune* of his friend *Lamotte*, in the ſucceſs of his tragedy of "Inez de Caſtro," anſwered—"*Oui; mais c'eſt une* FORTUNE *qui n'arrive jamais aux ſots.*"—The names of liberty and republic were ſo naturally and juſtly dear to the Americans, that, far from its being difficult to range them under any banners on which theſe words were inſcribed, it was very far indeed from being eaſy to perſuade them, that ſuch ſounds could repreſent any thing but juſtice, benevolence, and happineſs. The government of America had none of thoſe prejudices to employ, which in every other country were uſed with ſucceſs to enflame the people againſt the French revolution. They had, on the contrary, to contend with the prejudices of their people in the moſt moderate precautions againſt internal confuſion, in the moſt meaſured and guarded reſiſtance to the unparalleled inſults and enormous encroachments of France. Without zealous ſupport from the people, the American government was impotent. It required a conſiderable time, and it coſt an arduous and dubious ſtruggle, to direct the popular ſpirit againſt a ſiſter republic, eſtabliſhed among a people to whoſe aid the Americans aſcribed the eſtabliſhment of their independence. It is probable indeed, that no policy could have produced this effect, unleſs it had been powerfully aided by the crimes of the French government, which have proved the ſtrongeſt allies of all eſtabliſhed governments; which have produced ſuch a general diſpoſition to ſubmit to any *known* tyranny, rather than ruſh into all the unknown and undefinable evils of civil confuſion, with the horrible train of new and monſtrous *tyrannies* of which it is uſually the forerunner. But with what juſtice ſoever ſome governments may be accuſed of having engrafted ſervility on the rational and generous horror of their ſubjects againſt the atrocities of the French revolution, moſt certain it is, that the adminiſtration of Waſhington cannot be charged with having ſo perverted ſuch a juſt and noble ſentiment. He employed it for the moſt honeſt and praiſeworthy purpoſes; to preſerve the internal quiet of his country; to aſſert the dignity, and to maintain the rights of the commonwealth which he governed, againſt foreign enemies. He avoided war without incurring the imputation of puſillanimity. He cheriſhed the deteſtation of Americans for anarchy, without weakening the ſpirit of liberty; and he maintained, and even conſolidated, the authority of government, without abridging the privileges of the people.

Among the many examples of change and viciſſitude in political connexion, which are amuſing from their ſingularity, and which would be moſt uſeful if they were received as leſſons of moderation by contending parties; there is none, perhaps, more remarkable, than that which may be obſerved in the life of General Waſhington. In 1776, he was conſidered in England as a proſcribed rebel. In 1796, he was regarded as the leader of the Engliſh party in America. In 1776, his deſtruction was thought the only means of preſerving America to Great Britain. In 1796, his authority was thought the principal ſecurity againſt her falling under the yoke of France. In 1776, he looked to the aid of France, as his only hope of guarding the liberties of America againſt England. In 1796, he muſt have conſidered the power of Great Britain as one main barrier of the ſafety of America againſt France. Never, perhaps, did twenty years in the life of any individual, produce ſo ſtriking and ſo important a change. But there was no inconſiſtency in his character. There was no change in his *principles* or *objects*. There was a

great

great change of *circumſtances* which required a correſpondent variety in the *means* to be employed for the attainment of his objects, in the aid to be ſought, the connexions to be cultivated, the meaſures to be adopted for giving effect to his principles. Means, plans, and connections, muſt always vary with the infinite variety in the ſituations of men and of ſtates. But the principles of public virtue, which were the principles of Waſhington, are immortal and unchangeable. A good man always deſires the liberty and happineſs of his country, and, as far as poſſible, of the whole human race. But a wiſe man varies his means according to the changing circumſtances of the world, to ſecure the attainment of the ſame end. There would be no more real conſiſtency in the oppoſite conduct, that if a man were to continue the ſame precautions againſt being froſt-bitten at Bencoolen, which he had found neceſſary in Greenland; or employ the ſame anxious care to ſave himſelf from a *coup de ſoleil* in Canada, which might have been very prudent in Bengal.

The reſignation of Waſhington in 1796, is one of thoſe meaſures of his life in which his patriotiſm and prudence ſeem the moſt eminently conſpicuous. Nothing was more certain than his re-election, if he had thought it wiſe to offer himſelf as a candidate. In that unſettled ſtate of public affairs, it might at firſt ſight appear, that the man of moſt influence and weight in America ought to have remained at the helm. The conduct which he purſued was, certainly, however the moſt wiſe. All the enemies, and many of the friends, of the American government believed, that it had a ſevere trial to encounter, when the aid of Waſhington's character ſhould be withdrawn from its executive government. Many apprehended, that it had ſcarce vigour enough to ſurvive the experiment. And, if the trial had been delayed till the death of Waſhington, the event might perhaps have been more doubtful. It was neceſſary, that ſo critical an experiment ſhould be performed under his eye. It was fit that the Americans ſhould have an example of a quiet election and a proſperous adminiſtration, apparently independent of the perſonal influence of the great founder of their liberty, though, in reality, ſupported by the whole ſtrength of his character. It was fit, that the world ſhould ſee that the American government *was able to move by itſelf*; but it was alſo fit, that ſo hazardous a trial ſhould be made while that guardian wiſdom was at hand, which could guide and help its movements. The election of the firſt ſucceſſor of Waſhington was the moſt critical event in the hiſtory of the infant republic, and the example was likely to be of great and laſting importance. America and her friends, after the happy iſſue of this trial, may with confidence expect, that a government which has ſtood ſuch a teſt, will maintain itſelf againſt all future ſhocks; and that a people with ſuch an example before them, will ſo exerciſe their great and hazardous right of electing a firſt magiſtrate, as to preſerve the quiet of their country and the protecting power of the laws. In that caſe their fortune will be the more admirable, becauſe we have no authority from the experience of paſt times to expect ſuch a degree of prudence, moderation, and equanimity in any great community, as to make it ſafe for themſelves to be entruſted with that magnificent, but dangerous and generally fatal, privilege. If theſe happy conſequences enſue, America will have as much reaſon to be grateful to Waſhington for the ſeaſonable reſignation of his authority, as for its wiſe and honeſt exertions.

When he reſigned his preſidency, he publiſhed a valedictory addreſs to his countrymen, as he had before done when he quitted the command of the army in 1783. In theſe compoſitions, the whole heart and ſoul of Waſhington are laid open. Other ſtate-papers have, perhaps, ſhewn more ſpirit and dignity, more eloquence, greater force of genius, and a more enlarged comprehenſion of mind. But none ever diſplayed more ſimplicity and ingenuouſneſs, more moderation and ſobriety, more good ſenſe, more prudence, more honeſty, more earneſt affection for his country and for mankind, more profound reverence for virtue and religion; more ardent wiſhes for the happineſs of his fellow creatures, and more juſt and rational views of the means which alone can effectually promote that happineſs. It is difficult for any human compoſition to ſhew more clearly a well-diſciplined underſtanding and a pure heart.

From his reſignation till the month of July 1798, he lived in retirement at Mount Vernon. At this latter period, it became neceſſary for the United States to arm. They had endured with a patience, of which there is no example in the hiſtory of ſtates, all the contumely and wrong which ſucceſſive adminiſtrations in France had heaped upon them. Their ſhips were every where captured, their miniſters were detained in a ſort of impriſonment at Paris; while incendiaries, clothed in the ſacred character of embaſſadors, ſcattered over their peaceful provinces the fire-brands of ſedition and civil war. An offer was made to terminate this long courſe of injuſtice, for a bribe to the French miniſters.—This offer was made by perſons who *appeared* to be in the confidence of M. Talleyrand, who *profeſſed* to act by his authority; who have been ſince, indeed, diſavowed by him; but who never will be believed not to have been his agents, till he convicts them of impoſture by legal evidence, and procures them to be puniſhed for ſo abominable a fraud.

The United States reſolved to arm by land and ſea. The command of the army was beſtowed on General Waſhington; which he accepted, becauſe he was convinced, that "every thing we hold dear and ſacred was ſeriouſly threatened;" though he had flattered himſelf, "that he had quitted for ever the boundleſs field of public action, inceſſant trouble and high reſponſibility, in which he had long acted ſo conſpicuous a part." In this office he continued during the ſhort period of his life which ſtill remained.—On Thurſday the 12th December 1799, he was ſeized with an inflammation in his throat, which became conſiderably worſe the next day; and of which, notwithſtanding the efforts of his phyſicians, he died on Saturday the 14th of December 1799, in the 68th year of his age, and in the 23d year of the independence of the United States, of which he may be conſidered as the founder. The ſame calmneſs, ſimplicity and regularity, which had uniformly marked his demeanor, did not forſake him in his dying moments. He ſaw the approaches of death without fear:—he met them without parade.—Even the perfectly well-ordered ſtate of the moſt minute particulars of his private buſineſs, bore the ſtamp of that conſtant authority of prudence and practical reaſon over his actions, which was a diſtinguiſhing feature of his character. He died with thoſe ſentiments of piety, which had given vigour and conſiſtency to his virtue, and adorned every part of his blameleſs and illuſtrious life.

His will, which has been publiſhed ſince his death, is, like all his compoſitions, characteriſtic of his mind. It has been very well obſerved by a writer of genius, in a Daily Paper, that thoſe diſpoſitions of the will which regard the future emancipation of the ſlaves are peculiarly deſerving of attention. A commentary on that part of the will would, perhaps, be the beſt ſyſtem of rules for rational reform, that has ever been given to the world. The generous and juſt determination to emancipate the ſlaves, combined with the ſacred regard for law in its harſheſt regulations, and property in its moſt odious form; the tender and provident ſolicitude for the emancipated ſlaves themſelves, for the education of the young, and the ſupport of the infirm; every thing in ſhort indicates that union of benevolence and prudence which conſtitutes the true character of a REFORMER, and which diſtinguiſhes him from thoſe reſtleſs and fierce diſturbers of the world, who uſurp the name of Reformers, and bring laſting diſcredit on the cauſe of reformation. The reforms of which Waſhington has furniſhed ſo beautiful a model in miniature, are thoſe in which the heart is warm, and the head cool; in which the Reformer not only earneſtly deſires to do good, but deeply conſiders the beſt manner of doing it; in which he purſues his generous end with ardour, but examines with the utmoſt caution and deliberation the moſt effectual and the ſafeſt means of attaining it; in which he takes a large view of all the relations and tendencies of the change which he is about to introduce, of all its direct and indirect conſequences; and guards his reform by every ſecurity that human prudence can deviſe, againſt any poſſibility of injury, either from the act or the example, to the rights or the happineſs of any human being.

But to return from this digreſſion: it is ſufficient to ſay, that theſe diſpoſitions of Waſhington's will bear the mark of his pure, temperate, and ſedate character, which was not only free from the groſs vices of ſordid avarice and ſelfiſh ambition, but from the more refined and better diſguiſed, though equally pernicious, vices of inordinate zeal even for good, of a violent paſſion for glory; in which there was nothing diſorderly, nothing precipitate, nothing exceſſive, nothing oſtentatious, of which uſefulneſs was the object, and good ſenſe the guide, and of which the grandeur ariſes only from the magnitude of the benefits which he conferred on his country. His character is ſurrounded with no glare.—There is little in it to dazzle. It has nothing to gratify thoſe, who reliſh only that irregular and monſtrous greatneſs, which faſcinates the vulgar of all ranks and in all times. But thoſe whoſe moral taſte is more pure, will always admire in George Waſhington the neareſt approach to uniform propriety, and perfect blameleſſneſs, which has ever been attained by man, or which is perhaps compatible with the condition of humanity.

This imperfect ſketch is neceſſarily defective in thoſe intereſting details of private life, which are the moſt important, as well as the moſt delightful part, of biography; but theſe defects will ſoon be amply ſupplied by the publication of the life of General Waſhington, which is now ready for the preſs. In the mean time the preſent article has been inſerted to preſerve in this work ſome memorial of a man who will always be dear to America, and to the wiſe and good in all nations.

WASHINGTON, a county of the Diſtrict of Maine, and the moſt eaſterly land in the United States. It is bounded ſouth by the ocean, weſt by Hancock county, north by Lower Canada, and eaſt by New-Brunſwick. It is about 200 miles in length, but its breadth is as yet undetermined. It was erected into a county in 1789; but has few towns yet incorporated. The coaſt abounds with excellent harbours. Although the winters are long and ſevere; yet the ſoil and productions are but little inferior to the other counties. The number of inhabitants in this county, according to the cenſus of 1790, was 2758; but the increaſe ſince muſt have been very conſiderable. Chief town, Machias.—*Morſe.*

WASHINGTON, a maritime county of the ſtate of Rhode Iſland; bounded north by Kent, ſouth by the N. Atlantic Ocean; weſt by the ſtate of Connecticut, and eaſt by Narraganſet Bay. It is divided into ſeven townſhips, and contains 18,075 inhabitants, including 339 ſlaves. Chief town, South Kingſtown.—*ib.*

WASHINGTON, a county of New York; bounded north by Clinton county, ſouth by Renſſelaer, ſouth-weſt by Saratoga, weſt by Herkemer, and eaſt by the State of Vermont. Until 1784 it was called Charlotte. It contained, in 1790, 14,042 inhabitants, including 742 ſlaves. In 1796, there were 3,370 of the inhabitants qualified electors. It is ſubdivided into 12 townſhips, of which Salem is the chief.—*ib.*

WASHINGTON, a county of Pennſylvania; ſituated in the ſouth-weſt corner of the State; bounded north by Alleghany county, ſouth by Monongalia county, in Virginia; eaſt by Monongahela river, which divides it from Fayette county, and weſt by Ohio county in Virginia; agreeably diverſified with hills, which admit of eaſy cultivation quite to their ſummits. It is divided into 21 townſhips, and contains 23,866 inhabitants, including 263 ſlaves. Mines of copper and iron ore have been found in this county.—*ib.*

WASHINGTON, the capital of the above county, and a poſt-town, is ſituated on a branch of Charter's Creek, which falls into Ohio river, a few miles below Pittſburg. It contains a brick court-houſe, a ſtone gaol, a large brick building for the public offices, an academy of ſtone, and nearly 100 dwelling-houſes. It is 22 miles ſouth-ſouth-weſt of Pittſburg; 22 miles north-weſt of Brownſville, 60 miles north by weſt of Morgantown, in Virginia, and 325 weſt by north of Philadelphia. N. lat. 40 13, W. long. 80 6 40. It is remarkable for its manufactures, for ſo young a town. There are 3 other townſhips of the ſame name in Pennſylvania, viz. in Fayette, Franklin, and Weſtmoreland counties.

WASHINGTON, a county of Maryland, on the weſtern ſhore of Cheſapeak Bay; bounded north by the State of Pennſylvania; eaſt by Frederick county, from which it is divided by South Mountain; ſouth-weſt by Patowmack river, which divides it from the State of Virginia, and weſt by Sideling-Hill-Creek, which ſeparates it from Alleghany county. This is called the garden of Maryland, lying principally between the North and South Mountains, and includes the rich, fertile and well cultivated valley of Conegocheague. Its ſtreams furniſh excellent mill-ſeats, and the lands are thought to be the moſt fertile in the State. Lime-ſtone and iron-ore are found here. Furnaces and forges have been erected,

erected, and conſiderable quantities of pig and bar iron are manufactured. Chief town, Elizabeth-Town.—*ib.*

Washington, a county of Virginia; bounded E. and N. E. by Wythe; north-weſt by Ruſſell; ſouth by the ſtate of North Carolina, and weſt by Lee. It is watered by the ſtreams which form Holſton, Clinch and Powell's rivers. There is a natural bridge in this county ſimilar to that in Rockbridge county. It is on Stock Creek, a branch of Peleſon river. It contains 5625 inhabitants, including 450 ſlaves. Chief town, Abingdon.—*ib.*

Washington, a diſtrict of the Upper Country of South Carolina, perhaps the moſt hilly and mountainous in the ſtate. It lies weſt of Ninety-Six diſtrict, of which it was formerly a part, and is bounded north by the ſtate of North Carolina. It contains the counties of Pendleton and Greenville; has 14,619 inhabitants, and ſends to the ſtate legiſlature five repreſentatives and two ſenators. Chief town, Pickenſville. A number of old deſerted Indian towns of the Cherokee nation, are frequently met with on the Keowee river, and its tributary ſtreams which water this country.—*ib.*

Washington, a county of Kentucky, bounded north-eaſt by Mercer, north-weſt by Nelſon, ſouth-eaſt by Lincoln, and weſt by Hardin.—*ib.*

Washington, a diſtrict of the State of Tenneſſee, ſituated on the waters of the rivers Holſton and Clinch, and is divided from Mero diſtrict on the weſt by an uninhabited country. It is divided into the counties of Waſhington, Sullivan, Greene, and Hawkins. It contained, according to the State cenſus of 1795, 29,531 inhabitants, including 4693 ſlaves.—*ib.*

Washington, a county of Tenneſſee, in the above diſtrict, contained in 1795, 10,105 inhabitants, incluſive of 978 ſlaves. Waſhington college is eſtabliſhed in this county by the legiſlature.—*ib.*

Washington, a county of the N. W. Territory, erected in 1788 within the following boundaries, viz. beginning on the bank of the Ohio where the weſtern line of Pennſylvania croſſes it, and running with that line to Lake Erie; thence along the ſouthern ſhore of that lake to the mouth of Cayahoga river, and up that river to the portage between it and the Tuſcarawa branch of Muſkingum; thence down that branch to the forks of the croſſing-place above Fort Lawrence; thence with a line to be drawn weſterly to the portage on that branch of the Big Miami, on which the fort ſtood which was taken from the French in 1752, until it meets the road from the Lower Shawaneſe town to Sanduſky; thence ſouth to the Sciota river to the mouth, and thence up the Ohio to the place of beginning.—*ib.*

Washington, a county of the Upper Diſtrict of Georgia, which contains 4,552 inhabitants, including 694 ſlaves. Fort Fidus is ſituated in the weſternmoſt part of the county, on the eaſt branch of Alatamaha river. The county is bounded on the N. E. by Ogeechee river. Numbers have lately moved here from Wilkes county, in order to cultivate cotton in preference to tobacco. This produce, though in its infancy, amounted to 208,000lbs. weight, in 1792. Chief town, Golphinton.—*ib.*

Washington, a townſhip of Vermont, Orange county, 12 miles weſt of Bradford, and contains 72 inhabitants.—*ib.*

Washington, a townſhip of Maſſachuſetts, in Berkſhire county, 7 miles ſouth-eaſt of Pittsfield, 8 eaſt of Lenox, and 145 weſt of Boſton. It was incorporated in 1777, and contains 588 inhabitants.—*ib.*

Washington, or *Mount Vernon*, a plantation of Lincoln county, Diſtrict of Maine, north-weſt of Hallowell, and 9 miles from Sterling. It conſiſts of 16,055 acres of land and water, of which the latter occupies 1641 acres. It contains 618 inhabitants, and was incorporated by the name of *Belgrade* in 1796.—*ib.*

Washington, a townſhip of New-York, in Dutcheſs county, bounded ſoutherly by the town of Beekman, and weſterly by Poughkeepſie and Clinton. It contains 5189 inhabitants, of whom 286 are electors, and 78 ſlaves.—*ib.*

Washington, a townſhip of New Hampſhire, in Cheſhire county, firſt called Camden. It was incorporated in 1776, and contains 545 inhabitants; it is 12 or 14 miles eaſt of Charleſtown.—*ib.*

Washington, a townſhip of Connecticut, in Litchfield county, about 7 miles ſouth-weſt of Litchfield.—*ib.*

Washington, a port of entry and poſt-town of N. Carolina, ſituated in Beaufort county, on the north ſide of Tar river, in lat. 35 30 N. 90 miles from Ocrecok Inlet, 40 from the mouth of Tar river, 61 ſouth-ſouth-weſt of Edenton, 38 north by eaſt of Newbern, 131 north-eaſt by north of Wilmington, and 460 from Philadelphia. It contains a court-houſe, gaol, and about 80 houſes. From this town is exported tobacco of the Peterſburg quality, pork, beef, Indian corn, peas, beans, pitch, tar, turpentine, roſin, &c. alſo pine boards, ſhingles, and oak ſtaves. About 130 veſſels enter annually at the cuſtom houſe in this town. The exports for a year, ending the 30th of September, 1794, amounted to 33,684 dollars.—*ib.*

Washington, a poſt-town of Kentucky, and the capital of Maſon county, about 3 miles ſouth by weſt of the landing at Limeſtone, on the ſouth ſide of Ohio river. It contains about 100 houſes, a Preſbyterian church, a handſome court-houſe and gaol; and is faſt increaſing in importance. It is 62 miles north-eaſt of Lexington, 75 north eaſt by eaſt of Frankfort, and 709 ſouth-weſt by weſt of Philadelphia. N. lat. 38 40, W. long. 84 30.—*ib.*

Washington *Court-Houſe*, in S. Carolina, is 10 miles from Greenville, and 16 from Pendleton.—*ib.*

Washington, a poſt-town of Georgia, and the capital of Wilkes county, 50 miles north-weſt by weſt of Auguſta, 58 north by weſt of Louiſville, 28 from Greenſborough, and 813 from Philadelphia. It ſtands on the weſtern ſide of Kettle Creek, a north branch of Little river, which empties into Savannah river from the eaſtward, about 36 miles E. of the town. It is regularly laid out, and contained, in 1788, 34 houſes, a court-houſe, gaol, and academy. The funds of the academy amount to about 800l. ſterling, and the number of ſtudents to between 60 and 70. On the eaſt ſide of the town, a mile and a half diſtant, is a medicinal ſpring, which riſes from a hollow tree 4 or 5 feet in length. The inſide of the tree is covered with a coat of matter an inch thick, and the leaves around the ſpring are incruſted with a ſubſtance as white as ſnow. It is ſaid to be a ſovereign remedy for the ſcurvy, ſcrophulous diſorders, conſumptions, gout, and every other diſorder ariſing from humours in the blood. This ſpring being

being ſituated in a fine, healthy part of the State, will no doubt be a pleaſant and ſalutary place of reſort for invalids from the maritime and unhealthy parts of Georgia, and the neighbouring ſtates. N. lat. 33 12. —*ib.*

WASHINGTON *City*, in the territory of Columbia, was ceded by the State of Virginia and Maryland to the United States, and by them eſtabliſhed as the ſeat of their government, after the year 1800. This city, which is now building, ſtands at the junction of the river Patowmack, and the Eaſtern Branch, latitude 38 53 N. extending nearly 4 miles up each, and including a tract of territory, exceeded in point of convenience, ſalubrity and beauty, by none in America. For although the land in general appears level, yet by gentle and gradual ſwellings, a variety of elegant proſpects are produced, and a ſufficient deſcent formed for conveying off the water occaſioned by rain. Within the limits of the city are a great number of excellent ſprings; and by digging wells, water of the beſt quality may readily be had. Beſides, the never-failing ſtreams that now run through that territory, may alſo be collected for the uſe of the city. The waters of Reedy Branch, and of Tiber Creek, may be conveyed to the Preſident's houſe. The ſource of Tiber Creek is elevated about 236 feet above the level of the tide in ſaid Creek. The perpendicular height of the ground on which the capital ſtands, is 78 feet above the level of the tide in Tiber Creek. The water of Tiber Creek may therefore be conveyed to the capitol, and after watering that part of the city, may be deſtined to other uſeful purpoſes. The Eaſtern Branch is one of the ſafeſt and moſt commodious harbours in America, being ſufficiently deep for the largeſt ſhips for about 4 miles above its mouth, while the channel lies cloſe along the bank adjoining the city, and affords a large and convenient harbour. The Patowmack, although only navigable for ſmall craft, for a conſiderable diſtance from its banks next the city, (excepting about half a mile above the junction of the rivers) will nevertheleſs afford a capacious ſummer harbour; as an immenſe number of ſhips may ride in the great channel, oppoſite to, and below the city. The ſituation of this metropolis is upon the great poſt-road, equi-diſtant from the northern and ſouthern extremities of the Union, and nearly ſo from the Atlantic and Pittſburg, upon the beſt navigation, and in the midſt of a commercial territory, probably the richeſt, and commanding the moſt extenſive internal reſource of any in America. It has therefore many advantages to recommend it, as an eligible place for the permanent ſeat of the general government; and as it is likely to be ſpeedily built, and otherwiſe improved, by the public ſpirited enterpriſe of the people of the United States, and even by foreigners, it may be expected to grow up with a degree of rapidity hitherto unparalleled in the annals of cities. The plan of this city appears to contain ſome important improvements upon that of the beſt planned cities in the world, combining, in a remarkable degree, convenience, regularity, elegance of proſpect, and a free circulation of air. The poſitions of the different public edifices, and for the ſeveral ſquares and areas of different ſhapes as they are laid down, were firſt determined on the moſt advantageous ground, commanding the moſt extenſive proſpects, and from their ſituation, ſuſceptible of ſuch improvements as either uſe or ornament may hereafter require. The capitol is ſituated on a moſt beautiful eminence, commanding a complete view of every part of the city, and of a conſiderable part of the country around. The Preſident's houſe ſtands on a riſing ground, poſſeſſing a delightful water proſpect, together with a commanding view of the capitol, and the moſt material parts of the city. Lines, or avenues of direct communication, have been deviſed to connect the moſt diſtant and important objects. Theſe tranſverſe avenues, or diagonal ſtreets, are laid out on the moſt advantageous ground for proſpect and convenience, and are calculated not only to produce a variety of charming proſpects, but greatly to facilitate the communication throughout the city. North and ſouth lines, interſected by others running due eaſt and weſt, make the diſtribution of the city into ſtreets, ſquares, &c. and thoſe lines have been ſo combined, as to meet at certain given points, with the divergent avenues, ſo as to form, on the ſpaces *firſt determined*, the different ſquares or areas. The grand avenues, and ſuch ſtreets as lead immediately to public places, are from 130 to 160 feet wide, and may be conveniently divided into foot-ways, a walk planted with trees on each ſide, and a paved way for carriages. The other ſtreets are from 90 to 110 feet wide. In order to execute this plan, Mr Ellicot drew a true meridional line by celeſtial obſervation, which paſſes through the area intended for the capitol. This line he croſſed by another, running due eaſt and weſt, which paſſes through the ſame area. Theſe lines were accurately meaſured, and made the baſes on which the whole plan was executed. He ran all the lines by a tranſit inſtrument, and determined the acute angles by actual meaſurement, leaving nothing to the uncertainty of the compaſs. Waſhington, or the Federal City, is ſeparated from Georgetown, in Montgomery county, Maryland, on the W. by Rock Creek, but that town is now within the territory of Columbia. It is 42 miles S. W. by S. of Baltimore, 876 from Paſſamaquoddy, in the Diſtrict of Maine, 500 from Boſton, 248 from New York, 144 from Philadelphia, 133 from Richmond, in Virginia, 232 from Halifax, in N. Carolina, 630 from Charleſton, S. Carolina, and 794 from Savannah, in Georgia. —*ib.*

WASHINGTON, *Fort*, in the Territory N. W. of the Ohio, is ſituated on the north bank of the river Ohio, weſtward of Little Miami river, and 45 miles north-weſt of Waſhington, in Kentucky.—*ib.*

WASHINGTON, *Mount*, a ſmall townſhip of Maſſachuſetts, Berkſhire county, in the ſouth-weſt corner of the ſtate, 150 miles ſouth-weſt by ſouth of Boſton. It was incorporated in 1779, and contains 261 inhabitants. —*ib.*

WASHINGTON, *Mount*, one of the White Mountains of New Hampſhire, which makes ſo majeſtic an appearance all along the ſhore of the eaſtern counties of Maſſachuſetts.—*ib.*

WASHINGTON'S *Iſlands*, on the north-weſt coaſt of North America. The largeſt is of a triangular ſhape, the point ending on the ſouthward at Cape St James's, in N. lat. 51 58. Sandy Point, at its north-eaſt extremity, is in lat. 54 22 N. Its longitude weſt extends from Hope Point, the north-weſt extremity 226° 37′ to Sandy Point, in 228° 45′. Port Ingraham, Perkins and Magee Sound lie on the weſtern ſide of the iſland; on the eaſtern ſide are the following ports from north to ſouth—Skeetkiſs, or Skitkiſs Harbour, Port Cummaſhawa, Kleiws Point, Smoke Port, Kanſkeeno Point, Port Geyers, Port Ueah, and Port Sturgis. Capt. Cook, when he paſſed this iſland, ſuppoſed it to be a part of the continent, as the weather at the time was thick, and the wind boiſterous, which obliged him to keep out at ſea, till he made the weſtern cape of the continent in about lat. 55 N. Capt. Dixon diſcovered theſe iſlands in 1787, and named them Queen Charlotte's Iſlands. Capt. Gray diſcovered them in 1789, and called them Waſhington's Iſlands. There are three principal iſlands, beſides many ſmall ones. It is conjectured that they make a part of the Archipelago of St Lazarus.—*ib.*

WASKEMASHIN, an iſland in the Gulf of St Lawrence, on the coaſt of Labrador. N. lat. 50 3, W. long. 59 55.—*ib.*

WATAGUAKI *Iſles*, on the coaſt of Labrador, and in the Gulf of St Lawrence, lies near the ſhore, north-eaſt of Ouapitougan Iſle, and ſouth-weſt of Little Mecatina, about 10 or 12 leagues from each.—*ib.*

WATAUGA, a river of Tenneſſee, which riſes in Burke county, North-Carolina, and falls into Holſton river, 15 miles above Long-Iſland.—*ib.*

WATCH *Point*, lies to the northward of Fiſher's Iſland, in Long-Iſland Sound, and weſt-ſouth-weſt 7 leagues from Block Iſland.—*ib.*

WATCHWORK. Our intention in this article does not extend to the manual practice of this art, nor even to all the parts of the machine. We mean to conſider the moſt important and difficult part of the conſtruction, namely, the method of applying the maintaining power of the wheels to the regulator of the motion, ſo as not to hurt its power of regulation. Our obſervations would have come with more propriety under the title SCAPEMENT, that being the name given by our artiſts to this part of the conſtruction. Indeed they were intended for that article, which had been unaccountably omitted in the body of the Dictionary under the words CLOCK and WATCH. But the bad health and occupations of the perſon who had engaged to write the article, have obliged us to defer it to the laſt opportunity which the alphabetical arrangement affords us; and, even now, the ſame cauſes unfortunately prevent the author from treating the ſubject in the manner he intended and which it well deſerves. But we truſt that, from the account which is here given, the reader, who is converſant in mathematical philoſophy will perceive the juſtneſs of the concluſions, and that an intelligent artiſt will have no heſitation in acceding to the propriety of the maxims of conſtruction deduced from them.

The regulator of a clock or watch is a pendulum or a balance. Without this check to the motion of the wheels, impelled by a weight or a ſpring, the machine would run down with a motion rapidly accelerating, till friction and the reſiſtance of the air induced a ſort of uniformity, as they do in a kitchen jack. But if a pendulum be ſo put in the way of this motion, that only one tooth of a wheel can paſs it at each vibration, the revolution of the wheels will depend on the vibration of the pendulum. This has long been obſerved to have a certain conſtancy, inſomuch that the aſtronomers of the Eaſt employed pendulums in meaſuring the times of their obſervations, patiently counting their vibrations during the phaſes of an eclipſe or the tranſits of the ſtars, and renewing them by a little puſh with the finger when they became too ſmall. Gaſſendi, Riccioli, and others, in more recent times, followed this example. The celebrated phyſician Sanctorius is the firſt perſon who is mentioned as having applied them as regulators of clock movements. Machines, however, called *clocks*, was a train of toothed wheels, leading round an index of hours, had been contrived long before. The earlieſt of which we have any account is that of Richard of Wallingford, Abbot of St Alban's, in 1326 (A). It appears to have been regulated by a fly like a kitchen jack*. Not long after this Giacomo Dondi made one at Padua, which had a *motus ſuccuſſorius*, a hobbling or trotting motion; from which expreſſion it ſeems probable that it was regulated by ſome alternate movement. We cannot think that this was a pendulum, becauſe, once it was introduced, it never could have been ſupplanted by a balance. The alternate motion of a pendulum, and its ſeeming uniformity, are among the moſt familiar obſervations of common life; and it is ſurpriſing that they were not more early thought of for regulating time meaſurers. The alternate motions of the old balance is one of the moſt far-fetched means that can be imagined, and might paſs for the invention of a very reflecting mind, while a pendulum only requires to be drawn aſide from the plumb-line, to make it vibrate with regularity. The balance muſt be put in motion by the clock, and that motion muſt be ſtopped, and the contrary motion induced; and we muſt know that the ſame force and the ſame checks will produce uniform oſcillations. All this muſt be previouſly known before we can think of it as a regulator; yet ſo it is that clocks, regulated by a balance, were long uſed, and very common through Europe, before Galileo propoſed the pendulum, about the year 1600. Pendulum clocks then came into general uſe, and were found to be greatly preferable to balance clocks as accurate meaſurers of time. Mathematicians ſaw that their vibrations had ſome regular dependance on uniform gravity, and in their writings we meet with many attempts to determine the time and demonſtrate the iſochroniſm of the vibrations. It is amuſing to read theſe attempts. We wonder at the awkwardneſs and inſufficiency of the explanation given of the motions of pendulums, even by men of acknowledged eminence. Merſennus carried on a moſt uſeful correſpondence with all the mathematicians of Europe, and was the means of making them acquainted with each other; nay, he was himſelf well converſant in the ſcience; yet one cannot but ſmile at his reaſonings on this ſubject. Standing on the ſhoulders of our predeceſſors, we look around us, in great ſatiſfaction with our own powers of obſervation, not thinking how we are raiſed up, or that we are trading with the ſtock left

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* *Conradi Geſneri Epitome*, p. 604.

(A) Profeſſor Beckmann, in the firſt volume of his *Hiſtory of Inventions*, expreſſes a belief that clocks of this kind were uſed in ſome monaſteries ſo early as the 11th century, and that they were derived to the monks from the Saracens. His authorities, however, are diſcordant, and ſeem not completely ſatiſfactory even to himſelf.

left us by the diligent and ſagacious philoſophers of the 17th century (B). Riccioli, Gaſſendus, and Galileo, made ſimilar attempts to explain the motion of pendulums; but without ſucceſs. This honour was reſerved for Mr Huyghens, the moſt elegant of modern geometers. He had ſucceeded in 1656 or 1657 in adapting the machinery of a clock to the maintaining of the vibrations of a pendulum. Charmed with the accuracy of its performance, he began to inveſtigate with ſcrupulous attention the theory of its motion. By the moſt ingenious and elegant application of geometry to mechanical problems, he demonſtrated that the wider vibrations of a pendulum employed more time than the narrower, and that the time of a ſemicircular vibration is to that of a very ſmall one nearly as 34 to 29; and aided by a new department of geometrical ſcience invented by himſelf, namely, the evolution of curves, he ſhewed how to make a pendulum ſwing in a cycloid, and that its vibrations in this curve are all performed in equal times, whatever be their extent.

But before this time, Dr Hooke, the moſt ingenious and inventive mechanician of his age, had diſcovered the great accuracy of pendulum clocks, having found that the manner in which they had been employed had obſcured their real merit. They had been made to vibrate in very large arches, the only motion that could be given them by the contrivances then known; and in 1656 he invented another method, and made a clock which moved with aſtoniſhing regularity. Uſing a heavy pendulum, and making it ſwing in very ſmall arches, the clocks ſo conſtructed were found to excel Mr Huyghens's cycloidal pendulums; and thoſe who were unfriendly to Huyghens had a ſort of triumph on the occaſion. But this was the reſult of ignorance. Mr Huyghens had ſhewn, that the error of $\frac{1}{100}$ of an inch, in the formation of the parts which produced the cycloidal motion, cauſed a greater irregularity of vibration than a circular vibration could do, although it ſhould extend five or ſix degrees on each ſide of the perpendicular. It has been found that the unavoidable inaccuracies, even of the beſt artiſts, in the cycloidal conſtruction, make the performance much inferior to that of a common pendulum vibrating in arches which do not exceed three or four degrees from the perpendicular. Such clocks alone are now made, and they exceed all expectation.

We have ſaid that a pendulum needed only to be removed from the perpendicular, and then let go, in order to vibrate and meaſure time. Hence it might ſeem, that nothing is wanted but a machinery ſo connected with the pendulum as to keep a regiſter, as it were, of the vibration. It could not be difficult to contrive a method of doing this; but more is wanted. The air muſt be diſplaced by the pendulum. This requires ſome force, and muſt therefore employ ſome part of the momentum of the pendulum. The pivot on which it ſwings occaſions friction—the thread, or thin piece of metal by which it is hung, in order to avoid this friction, occaſions ſome expenditure of force by its want of perfect flexibility or elaſticity. Theſe, and other cauſes, make the vibrations grow more and more narrow by degrees, till at laſt the pendulum is brought to reſt. We muſt therefore have a contrivance in the wheelwork which will reſtore to the pendulum the ſmall portion of force which it loſes in every vibration. The action of the wheels therefore may be called a *maintaining power*, becauſe it keeps up the vibrations.

But we now ſee that this may affect the regularity of vibration. If it be ſuppoſed that the action of gravity renders all the vibrations iſochronous, we muſt grant that the additional impulſion by the wheels will deſtroy that iſochroniſm, unleſs it be ſo applied that the ſum total of this impulſion and the force of gravity may vary ſo with the ſituation of the pendulum, as ſtill to give a ſeries of forces, or a law of variation, perfectly ſimilar to that of gravity. This cannot be effected, unleſs we know both the law which regulates the action of gravity, producing iſochroniſm of vibration, and the intenſity of the force to be derived from the wheels in every ſituation of the pendulum.

The neceſſary requiſite for the iſochronous motion of the pendulum is, that the force which urges it toward the perpendicular, be proportional to its diſtance from it (ſee DYNAMICS, n° 103. Cor. 7. *Suppl.*); and therefore, ſince pendulums ſwinging in ſmall circular arches are ſenſibly iſochronous, we muſt infer that ſuch is the law by which the accelerating action of gravity on them is really accommodated to every ſituation in thoſe arches.

It will greatly conduce to the better underſtanding of the effect of the maintaining power, if the reader keep in continual view the chief circumſtances of a motion of this kind. Therefore let AC*d* (fig. 1.) repreſent the arch paſſed over by the pendulum, ſtretched out into a ſtraight line. Let C be its middle point, when the pendulum hangs perpendicular, and A and *a* be the extremities of the oſcillation. Let AD be drawn perpendicular to AC, to repreſent the accelerating action of gravity on the pendulum when it is at A. Draw the ſtraight line DC*d*, and *ad*, perpendicular to A*a*. About C, as a centre, deſcribe the ſemicircle AFH*a*. Through any points B, K, *k*, *b*, &c. of A*a*, draw the perpendiculars BFE, KLM, &c. cutting both the ſtraight line and the ſemicircle. Then,

Plate XLVIII.

1. The actions of gravity on the pendulum, when in the ſituations B, K, &c. by which it is urged toward C, are proportional to, and may be repreſented by, the ordinates BE, KL, *be*, *kl*, &c. to the ſtraight line DC*d*.

2. The velocities acquired at B, K, &c. by the acceleration along AB, AK, &c. are proportional to the ordinates BF, KM, &c. to the ſemicircle AH*a*; and, therefore, the velocity with which the pendulum paſſes through the middle point C, is to its velocity in any other point B, as CH to BF.

3. The times of deſcribing the parts AB, BK, KC, &c. of the whole arch of oſcillation, are proportional to, and may be repreſented by, the arches AF, FM, MH, &c. of the ſemicircle.

4. If

(B) We are provoked to make this obſervation, by obſerving at this moment, in a literary journal, a pert and petulant upſtart ſpeaking of Newton's optical diſcoveries in terms of ridicule and abuſe, employing theſe very diſcoveries to diminiſh his authority. Is it not thus that Chriſtianity is now ſlighted by thoſe who enjoy the fruits of the pure morality which it introduced?

4. If one pendulum deſcribe the arch repreſented by AC*a*, and another deſcribe the arch KC*k*, they will deſcribe them in equal times, and their maximum velocities (viz. their velocities in the middle point), are proportional to AC and KC; that is, the velocities in the middle point are proportional to the width of the oſcillations.

The ſame proportions are true with reſpect to the motions outwards from C. That is, when the pendulum deſcribes CA, with the initial velocity CH, its velocity at K is reduced to KM by the retarding action of gravity. It is reduced to BF at B, and to nothing at A; and the times of deſcribing CK, KB, BA, CA, are as HM, HF, HA. Another pendulum ſetting out from C, with the initial velocity CO, reaches only to K, CK being = CO. Alſo the times are equal.—If we conſider the whole oſcillation as performed in the direction A*a*, the forces AD, BE, KL accelerate the pendulum, and the ſimilar forces *ad*, *be*, *kl*, on the other ſide, retard it. The contrary happens in the next oſcillation *a*CA.

5. The areas DABE, DAKL, &c. are proportional to the ſquares of the velocities acquired by moving along AB, AK, &c. or to the diminution of the ſquares of the velocities ſuſtained by moving outwards along BA or KA, &c.

The conſideration of this figure will enable the reader (even though not a mathematician) to form ſome notion of the effect of any propoſed application of a maintaining power by means of wheelwork: For, knowing the weight of the pendulum, we know the accelerating action of that weight in any particular ſituation A of the pendulum. We alſo know what addition or ſubtraction we produce on the pendulum in that ſituation by the wheel-work. Suppoſe it is an addition of preſſure equal to a certain number of grains. We can make AD to $D\delta$ as the firſt to the laſt; and then $A\delta$ will be the whole force urging the pendulum toward C. Doing the ſame for every point of AC, we obtain a line $\delta\varepsilon\lambda c$, which is a new ſcale of forces, and the ſpace $DC\delta$, comprehended between the two ſcales CD and $C\delta$, will expreſs the addition made to the ſquare of the velocity in paſſing along AC by the joint action of gravity and the maintaining power. Alſo, by drawing a line $\kappa\pi$ perpendicular to AC, making the ſpace $C\pi\kappa$ equal to CAD, the point π will be the limit of the oſcillation outward from C, where the initial velocity HC is extinguiſhed. If the line $\kappa\pi$ cut the ſame circle in θ, one-half the arch θA will nearly expreſs the contraction made in the time of the outward oſcillation by the maintaining power. An accurate determination of this laſt circumſtance is operoſe, and even difficult; but this ſolution is not far from the truth, and will greatly aſſiſt our judgment of the effect of any propoſal, even though $\kappa\pi$ be drawn only by the judgment of the eye, making the area left out as nearly equal to the area taken in as we can eſtimate by inſpection. This is ſaid from experience.

Since the motion of a pendulum or balance is alternate, while the preſſure of the wheels is conſtantly in one direction, it is plain that ſome art muſt be uſed to accommodate the one to the other. When a tooth of the wheel has given the balance a motion in one direction, it muſt quit it, that it may get an impulſion in the oppoſite direction. The balance or pendulum thus eſcaping from the tooth of the wheel, or the tooth eſcaping from the balance, has given to the general contrivance the name of SCAPEMENT among our artiſts, from the French word *echappement*. We proceed, therefore, to conſider this ſubject more particularly, firſt conſidering the ſcapements which are peculiarly ſuited to the ſmall vibrations of pendulums, and then thoſe which muſt produce much wider vibrations in balances. This, with ſome other circumſtances, render the ſcapements for pendulums and balances very different.

I. *Of the Action of a Wheel and Pallet.*

THE ſcapement which has been in uſe for clocks and watches ever ſince their firſt appearance in Europe, is extremely ſimple, and its mode of operation is too obvious to need much explanation. In fig. 2. XY repreſents a horizontal axis, to which the pendulum P is attached by a ſlender rod, or otherwiſe. This axis has two leaves C and D attached to it, one near each end, and not in the ſame plane, but ſo that when the pendulum hangs perpendicularly, and at reſt, the piece C ſpreads a few degrees to the right hand, and D as much to the left. They commonly make an angle of 70, 80, or 90 degrees. Theſe two pieces are called PALLETS. AFB repreſents a wheel, turning round on a perpendicular axis EO, in the order of the letters AFEB. The teeth of this wheel are cut into the form of the teeth of a ſaw, leaning forward, in the direction of the motion of the rim. As they ſomewhat reſemble the points of an old faſhioned royal diadem, this wheel has got the name of the CROWN WHEEL. In watches it is often called the *balance wheel*. The number of teeth is generally odd; ſo that when one of them B is preſſing on a pallet D, the oppoſite pallet C is in the ſpace between two teeth A and I. The figure repreſents the pendulum at the extremity of its excurſion to the right hand, the tooth A having juſt eſcaped from the pallet C, and the tooth B having juſt dropped on the pallet D. It is plain, that as the pendulum now moves over to the left, in the arch PG, the tooth B *continues* to preſs on the pallet D, and thus accelerates the pendulum, both during its deſcent along the arch PH, and its aſcent along the arch HG. It is no leſs evident, that when the pallet D, by turning round the axis XY, raiſes its point above the plane of the wheel, the tooth B eſcapes from it, and I drops on the pallet C, which is now nearly perpendicular. I preſſes C to the right, and accelerates the motion of the pendulum along the arch GP. Nothing can be more obvious than this action of the wheel in maintaining the vibrations of the pendulum. We can eaſily perceive, alſo, that when the pendulum is hanging perpendicularly in the line XH, the tooth B, by preſſing on the pallet D, will force the pendulum a little way to the left of the perpendicular, and will force it ſo much the farther as the pendulum is lighter; and, if it be ſufficiently light, it will be forced ſo far from the perpendicular that the tooth B will eſcape, and then I will catch on C, and force the pendulum back to P, where the whole operation will be repeated. The ſame effect will be produced in a more remarkable degree, if the rod of the pendulum be continued through the axis XY, and a ball Q put on the other end to balance P. And, indeed, this is the contrivance which was firſt applied to clocks all over Europe, before the application of the pendulum. They were balance clocks. The force of the wheel was of a certain magnitude, and therefore able, during its action on a pallet, to communicate a certain quantity of motion and velocity to the balls of the balance. When the tooth B eſcapes from the pallet D, the balls are then moving with a certain velocity and momentum. In this condition, the balance is checked by the tooth I catching on the pallet C. But it is not inſtantly ſtopped. It continues its motion a little to the left, and the pallet C forces the tooth I a little backward. But it *cannot* force it ſo far as to eſcape over the top of the tooth I; becauſe all the momentum of the balance was generated by the force of the tooth B; and the tooth I is equally powerful. Beſides, when I catches on C, and C continues its motion to the left, its lower point applies to the face of the tooth I, which now acts on the balance by a long and powerful lever, and ſoon ſtops its farther motion in that direction, and now, continuing to preſs on C, it urges the balance in the oppoſite direction.

Thus we ſee that in a ſcapement of this kind, the motion of the wheel muſt be very hobbling and unequal, making a great ſtep forward, and a ſhort ſtep backward, at every beat. This has occaſioned the contrivance to get the name of the RECOILING SCAPEMENT, the recoiling pallets. This hobbling motion is very obſervable in the wheel of an alarm.

Thus have we obtained two principles of regulation. The firſt and moſt obvious, as well as the moſt perfect, is the natural iſochronous vibration of a pendulum. The only uſe of the wheelwork here, beſides regiſtering the vibrations, is to give a gentle impulſion to the pendulum, by means of the pallet, in order to compenſate friction, &c. and thus maintain the vibrations in their primitive magnitude. But there is no ſuch native motion in a balance, to which the motion of the wheels muſt accommodate itſelf. The wheels, urged by a determined preſſure, and acting through a determined ſpace (the face of the pallet), muſt generate a certain determined velocity in the balance; and therefore the time of the oſcillation is alſo determined, both during the progreſſive and the retrograde motion of the wheel. The actions being ſimilar, and through equal ſpaces, in every oſcillation, they muſt employ the ſame time. Therefore a balance, moved in this manner, muſt be iſochronous, and a regulator for a time-keeper.

By thus employing a balance, the horizontal poſition of the axis XY is unneceſſary. Accordingly, the old clocks had this axis perpendicular, by which means the whole weight of the balance reſted on the point of the pivot Y or X, according as the balance PQ was placed above or below. By making the ſupporting pivot of hard ſteel, and very ſharp, friction was greatly diminiſhed. Nay, it was entirely removed from this part of the machine by ſuſpending the balance by a thread at the end X, inſtead of allowing it to reſt on the point of the pivot Y.

As the balance regulator of the motion admits of every poſition of the machine, thoſe clocks were made in an infinite variety of fanciful forms, eſpecially in Germany, a country famous for mechanical contrivances. They were made of all ſizes, from that of a great ſteeple clock, to that of an ornament for a lady's toilet. The ſubſtitution of a ſpring in place of a weight, as a firſt mover of the wheel-work, was a moſt ingenious thought. It was very gradual. We have ſeen, in the Emperor's muſeum at Bruſſels, an old (perhaps the firſt) ſpring clock, the ſpring of which was an old ſword blade, from the point of which a catgut was wound round the barrel of the firſt wheel. Some ingenious German ſubſtituted the ſpiral ſpring, which both took leſs room, and produced more revolutions of the firſt wheel.

When clocks had been reduced to ſuch ſmall ſizes, the wiſh to make them portable was very natural; and the means of accompliſhing this were obvious, namely, a farther reduction of their ſize. This was accompliſhed very early; and thus we obtained pocket watches, moved by a ſpiral ſpring, and regulated by a balance with the recoiling ſcapement, which is ſtill in uſe for common watches. The hobbling motion of the crown wheel is very eaſily ſeen in all of them.

It is very uncertain who firſt ſubſtituted a pendulum in place of the balance (CLOCK, *Encycl.*). Huyghens, as we have already obſerved, was the firſt who inveſtigated the motions of pendulums with ſucceſs, and his book *De Horologio Oſcillatorio* may be conſidered as the elements of refined mechanics, and the ſource of all the improvements that have been made in the conſtruction of ſcapements. But it is certain that Dr Hooke had employed a pendulum for the regulation of a clock many years before the publication of the abovementioned treatiſe, and he claims the merit of the invention of the *only proper* method of employing it. We imagine therefore that Dr Hooke's invention was nothing more than a ſcapement for a pendulum making ſmall vibrations, without making uſe of the oppoſite motions of the two ſides of the crown wheel. Dr Hooke had contrived ſome ſcapement more proper for pendulums than the recoiling pallets, becauſe certainly thoſe might be employed, and are actually employed as a ſcapement for pendulum clocks to this day, although they are indeed very ill adapted to the purpoſe. He had not only remarked the great ſuperiority of ſuch pendulum clocks as were made before Huyghens's publication of the cycloidal pendulum over the balance clocks, but had alſo ſeen their defects, ariſing from the light pendulums and wide arches of vibration, and invented a ſcapement of the nature of thoſe now employed. The pendulum clock which he made in 1658 for Dr Wilkins, afterwards Biſhop of Cheſter, is mentioned by the inventor as peculiarly ſuited to the moderate ſwing of a pendulum; and he oppoſes this circumſtance to a general practice of wide vibrations and trifling pendulums. The French are not in the practice of aſcribing to us any thing that they can claim as their own; yet Lepaute ſays that the *Echappement à l' Ancre* came from England about the year 1665. It is alſo admitted by him that clock-making flouriſhed in England at that time, and that the French artiſts went to London to improve in it. Putting theſe and other circumſtances together, we think it highly probable that we are indebted to Dr Hooke for the ſcapement now in uſe. The principle of this is altogether different from the ſimple pallets and direct impulſe already deſcribed; and is ſo far from being obvious, that the manner of action has been miſunderſtood, even by men of ſcience, and writers of ſyſtems of mechanics.

In this ſcapement we employ thoſe teeth of the wheel which are moving in one direction; whereas in the former ſcapement, oppoſite teeth were employed moving in contrary directions. Yet even here we muſt communicate an alternate motion to the axis of the pallets. The contrivance, in general, was as follows: On the axis A (See fig. 3.) of the pendulum or balance is fixed a piece of metal BAC, called the CRUTCH by our artiſts, and the ANCHOR by the French. It terminates in two faces B *b* C *c* of tempered ſteel, or of ſome hard ſtone. Theſe are called the PALLETS, and it is on them that the teeth of the wheel act. The faces B *b* C *c* are ſet in ſuch poſitions that the teeth puſh them out of the way. Thus B puſhes the pallet to the left, and C puſhes its pallet to the right. Both puſh their pallets ſidewiſe outward from the centre of the wheel. The pallet B is uſually called the *leading*, and C the *driving* pallet by the artiſts, although it appears to us that theſe names ſhould be reverſed, becauſe B *drives* the pallet out of the way, and C *pulls* or leads it out of the way. They might be called the *firſt* and *ſecond* pallet, in the order in which they are acted on by the wheel. We ſhall uſe either denomination. The figure is accommodated to the inactive or reſting poſition of the pendulum Suppoſe the pendulum drawn aſide to the right at Q, and then let go. It is plain that the tooth B, preſſing on the face of the pallet β B *b* all the way from β to *b*, thruſts it aſide outwards, and thus, by the connection of the crutch with the pendulum rod, aids the pendulum's motion along the arch QPR. When the pendulum reaches R, the point of the tooth B has reached the angle *b* of the pallet, and eſcapes from it. The wheel preſſing forward, another tooth C drops on the pallet face C *c*, and, by preſſing this pallet outward, evidently aids the pendulum in its motion from R to P. The tooth C eſcapes from this pallet at the angle *c*, and now a tooth B′ drops on the firſt pallet, and again aids the pendulum; and this operation is repeated continually.

The mechaniſm of this communication of motion is thus explained by ſeveral writers of elements. The tooth B (fig. 2.) is urged forward in the direction BD, perpendicular to the radius MB of the SWING WHEEL. It therefore preſſes on the pallet, which is moveable only in the direction BE, perpendicular to BA the radius of the pallet. Therefore the force BD muſt be reſolved into two, *viz*. BE, in the direction in which alone the pallet can move, and ED, or BF, perpendicular to that direction. The laſt of theſe only preſſes the pallet and crutch againſt the pivot hole A. BE is the only uſeful force, or the force communicated to the pallet, enabling it to maintain the pendulum's motion, by reſtoring the momentum loſt by friction and other cauſes.

But this is a very erroneous account of the *modus operandi*, as may be ſeen at once, by ſuppoſing the radius of the pallets to be a tangent to the wheel. This is a poſition moſt frequently given to them, and is the very poſition in fig. 3. In this caſe MB is perpendicular to BA, and therefore BD will coincide with BA, and there will be no ſuch force as BE to move the pendulum. It is a truth deducible from what we know of the mechanical conſtitution of ſolid bodies, and confirmed by numberleſs obſervations, that when two ſolid bodies preſs on each other, either in impulſion or in dead preſſure, the direction in which the mutual preſſure is exerted is always perpendicular to the touching ſurfaces, whatever has been the direction of the impelling body (See IMPULSION, *Suppl.* n° 66. MACHINERY, *Suppl.* n° 35. and ſeveral other parts of this Work.) Moreover this preſſure is mutual, equal, and oppoſite. Whatever the ſhapes of the faces of the tooth and pallet, we can draw a plane BN, which is the common tangent to both ſurfaces, and a line HBI through the point of contact perpendicular to BN. It is farther demonſtrated in the article MACHINERY, *Suppl.* n° 35, &c. that the action of the wheel on the pendulum is the ſame as if the whole crutch were annihilated, and in its ſtead there were two rigid lines AH, MI, from the centres of the crutch and wheel, perpendicular to HI, and connected by a third rigid line or rod HI, touching the two in H and I.

For if a weight V be hung at v, the extremity of the horizontal radius M v of the wheel, it will act on the lever v MI, preſſing its point I upwards in the direction IH perpendicular to MI; the upper end of this rod IH will, in like manner, preſs the extremity H of the rod HA, and this will urge the pendulum from P toward R. To withſtand this, the pendulum rod AP may be withheld by a weight z, hanging by a thread on the extremity of the horizontal lever A z, equal to M v, and connected with the crutch and pendulum. The weights V and z may be ſo proportioned to each other that by acting perpendicularly on the crooked levers v MI, and z AH, the preſſures at H and I ſhall be equal, and juſt balance each other by the intervention of the rod HI. When this is the caſe, we have put things into the ſame mechanical ſtate, in reſpect of mutual action, as is effected by the crutch, pallets, and wheel, which, in like manner, produce equal preſſures at B the point of contact, in the direction BH and BI. The weight V may be ſuch as produces the very ſame effect at B that is produced by the previous train of wheel-work. The weight z therefore muſt be juſt equal to the force produced by the wheel-work on the point z of the pendulum rod, becauſe by acting in the oppoſite direction it juſt balances it. Let us ſee therefore what force is communicated to the pendulum by the wheels.

Let x be the upward preſſure excited at I, and y the equal oppoſite preſſure excited at H. Then, by the property of the lever, we have $\mathrm{MI} : \mathrm{M}\,v = \mathrm{V} : x$, and $x \times \mathrm{MI} = \mathrm{V} \times \mathrm{M}\,v$. In like manner $y \times \mathrm{AH} = \mathrm{Z} \times \mathrm{A}\,z$. Therefore, becauſe $x = y$, and $\mathrm{A}\,z = \mathrm{M}\,v$, we have $\mathrm{V} : \mathrm{Z} = \mathrm{MI} : \mathrm{AH}$. That is, the force exerted by the tooth of the wheel in the direction of its motion is to the force impreſſed on the pendulum rod at a diſtance equal to the radius of the wheel as MI to AH. The force impreſſed on the ball of the pendulum is leſs than this in the proportion of AP to A z, or M v.

Cor. 1. If the perpendiculars MN, AV, be drawn on the tangent plane, the forces at B and z will be as BN to BO. For theſe lines are reſpectively equal to MI and AH.

Cor. 2. If HI meet the line of the centres AC in S, the forces will be as SM to SA; that is $\mathrm{V} : \mathrm{Z} = \mathrm{SM} : \mathrm{SA}$.

Cor. 3. If the face β B *b* of the pallet be the evolutrix of a circle deſcribed with the radius AH, and the face of the tooth be the evolutrix of a circle deſcribed with the radius MI, the force impreſſed on the pendulum

dulum by the wheels will be conſtant during the whole vibration (MACHINERY, n° 36.) But theſe are not the only forms which produce this conſtancy. The forms of teeth deſcribed by different authors, ſuch as De la Hire, Camus, &c. for producing a conſtant force in trains of wheel-work, will have the ſame effect here. It is alſo eaſy to ſee that the force impreſſed on the pendulum may be varied according to any law, by making theſe faces of a proper form. Therefore the face, from B outwards, may be ſo formed that the force communicated to the pendulum by the wheels, during its deſcent from Q to P, may be in one conſtant proportion to the acceleration of gravity, and then the ſum of the forces will be ſuch as produce iſochronous vibrations. If the inner part B b of the face be formed on the ſame principle, the difference of the forces will have the ſame law of variation. If the face β b be the evolutrix of a circle, and the tooth B terminate in a point gently rounded, or quite angular, the force on the pendulum will continually increaſe as the tooth ſlides from β to b. For the line AH continues of the ſame magnitude, and MI diminiſhes. The contrary will happen, if the pallet be a point, either ſharp or rounded, and if the face of the tooth be the evolutrix now mentioned; for MI will remain the ſame, while AH diminiſhes. If the tooth be pointed, and β b be a ſtraight line, the force communicated to the pendulum will diminiſh, while the tooth ſlides from β to b. For in this caſe AH diminiſhes and MI increaſes.

Cor. 4. In general the force on the pendulum is greater as the angle MB b increaſes, and as AB b diminiſhes.

Cor. 5. The angular velocity of the wheel is to that of the pendulum, in any part of its vibration, as AH to MI. This is evident, becauſe the rod IH moving (in the moment under conſideration) in its own direction, the points H and I move through equal ſpaces, and therefore the angles at A and M muſt be inverſely as the radii.

All that has now been ſaid of the firſt pallet AB may be applied to the ſecond pallet AC.

If the perpendiculars C s be drawn to the touching plane o C n, cutting AM in s, we ſhall have $V : z = s$ M : s A, as in Cor. 2. And if the perpendiculars M i, A h, be drawn on C s, we have $V : Z =$ M i : A h, as in the general theorem. The only difference between the action on the two pallets is, that if the faces of both are plain, the force on the pendulum increaſes during the whole of the action on the pallet C, whereas it diminiſhes during the progreſs of the tooth along the other pallet.

The reader will doubtleſs remark that each tooth of the wheel acts on both pallets in ſucceſſion; and that, during its action on either of them, the pendulum makes one vibration. Therefore the number of vibrations during one turn of the wheel is double the number of the teeth: conſequently, while the tooth ſlides along one of the pallets, it advances half the ſpace between two ſucceſſive teeth; and when it eſcapes from the pallet, the other tooth *may* be juſt in contact with the other pallet. We ſay it *may* be ſo; in which caſe there will be no dropping of the teeth from pallet to pallet. This, however, requires very nice workmanſhip, and that every tooth be at preciſely the ſame diſtance from its neighbour. Should the tooth which is juſt going to apply to a pallet chance to be a little too far advanced on the wheel, it would touch the pallet before the other had eſcaped. Thus, ſuppoſe that before B eſcapes from the point b of the pallet, the tooth C is in contact with the pallet CG, B cannot eſcape. Therefore when the pendulum returns from R towards Q, the pallet β b, returning along with it, will puſh back the tooth B of the wheel. It does this in oppoſition to the force of the wheel. Therefore, whatever motion the wheel had communicated to the pendulum, during its ſwing from P to Q, will now be taken from it again. The pendulum will not reach Q, becauſe it had been aided in its motion from Q, and had proceeded further than it would have done without this help. Its motion toward Q is further diminiſhed by the friction of the pallet. Therefore it will now return again from ſome nearer point q, and will not go ſo far as in the laſt vibration, but will return through a ſtill ſhorter arch: And this will be ſtill more contracted in the next vibration, &c. &c. Thus it appears that if a tooth chances to touch the pallet before the eſcape of the other, the wheel will advance no farther, and ſoon after the pendulum will be brought to reſt.

For ſuch reaſons it is neceſſary to allow one tooth to eſcape *a little before* the other reaches the pallet on which it is to act, and to allow a ſmall drop of the teeth from pallet to pallet. But it is accounted bad workmanſhip to let the drop be conſiderable, and *cloſe ſcapement* is accounted a mark of care and of good workmanſhip. It is evidently an advantage, becauſe it gives a longer time of action on each pallet. This freeing the ſcapement cannot be accompliſhed by filing ſomething from the face of the tooth; becauſe this being done to all, the diſtance between them is diminiſhed rather than augmented. The pallets muſt be firſt ſcaped as cloſe as poſſible. This obliges the workman to be careful in making the teeth equidiſtant. Then a ſmall matter is taken from the point of each pallet, by filing off the back b r of the pallet. The tooth will now eſcape before it has moved through half a ſpace.

From all that has been ſaid on this particular, it appears that the interval between the pallets muſt comprehend a certain number of teeth, and half a ſpace more.

The firſt circumſtance to be conſidered in contriving a ſcapement is the angular motion that is intended to be given to the pendulum during the action of the wheel. This is uſually called the *angle of ſcapement*, or the *angle of action*. Having fixed on an angle a that we think proper, we muſt ſecure it by the poſition and form of the face of the pallets. Knowing the number of teeth in the ſwing-wheel, divide 180° by this number, and the quotient is the angle b of the wheel's motion during one vibration of the pendulum. In the line AM, joining the centres of the crutch and wheel, make SM to SA, and s M to s A, as the angle a to the angle b; and then, having determined how many teeth ſhall be comprehended between the pallets, call this number n. Multiply the angle b by $n + 1$, and take the half of the product. Set off this half in the circumference of the wheel (at the points of the teeth) on each ſide of the line joining the centres of the crutch and wheel, as at TB and TC. Through S and s draw SB and s C, and through B draw β B b perpendicular to SB, for the medium poſition of the face of the firſt pallet; that is, for

for its poſition when the pendulum hangs perpendicular. In like manner, drawing $\omicron C \nu$ perpendicular to ςC, we have the medium poſition of the ſecond pallet. The demonſtration of this conſtruction is very evident from what has been ſaid.

We have hitherto ſuppoſed that the pendulum finiſhes its vibration at the inſtant that a tooth of the wheel eſcapes from a pallet, and another tooth drops on the other pallet. But this is never, or ſhould never be, the caſe. The pendulum is made to ſwing ſomewhat beyond the angle of ſcapement: for if it do not when the clock is clean and in good order, but ſtop preciſely at the drop of a tooth, then, when it grows foul, and the vibration diminiſhes, the teeth will not eſcape at all, and the clock will immediately ſtop. Therefore the force communicated by the wheels during the vibration within the limits of ſcapement, muſt be increaſed ſo as to make the pendulum *throw* (as the artiſts term it) farther out; and a clock is more valued when it throws out conſiderably beyond the angle of ſcapement. There are good reaſons for this. The momentum of the pendulum, and its power to regulate the clock (which Mr Harriſon ſignificantly called its *dominion*), is proportional to the width of its vibrations very nearly.

This circumſtance of exceeding the angle of ſcapement has a very great influence on the performance of the clock, or greatly affects the dominion of the pendulum. It is eaſy to ſee that, when the face βb of the leading pallet is a plane, if the pendulum continue its motion to the right, from P toward Q, after the tooth B has dropped on it, the pallet will puſh the wheel back again, while the tooth ſlides outward on the pallet toward β. Such pallets therefore will make a *recoiling ſcapement*, reſembling, in this circumſtance, the old pallet employed with the crown wheel, and will have the properties attached to this circumſtance. One conſequence of this is, that it is much affected by any inequalities of the maintaining power. It is a matter of the moſt familiar obſervation, that a common watch goes ſlower when within a quarter of an hour of being down, when the action of the ſpring is very weak, in conſequence of its not pulling by a radius of the fuſee. We obſerve the ſame thing in the beating of an alarum clock. Alſo if we at any time preſs forward the wheelwork of a common watch with the key, we obſerve its beats accelerate immediately. The reaſon of this is pretty plain. The balance, in conſequence of the acceleration in the angle of ſcapement, would have gone much farther, employing a conſiderable time in the excurſion. This is checked abruptly, which both ſhortens the vibration and the time employed in it. In the return of the pendulum, the motion is accelerated the whole way, along an arch which is ſhorter than what correſponds to its velocity in the middle point; for it is again checked on the other ſide, and does not make its full excurſion. Moreover, all this irregularity of force, or the great deviation from a reſiſtance to the excurſion proportional to the diſtance from the middle point, is exerted on the pendulum when it is near the end of the excurſion, where the velocity being ſmall, this irregular force acts long upon it, at the very time that it has little force wherewith to reſiſt it. All temporary inequalities of force, therefore, will be more felt in this ſituation of the balance than if they had been exerted in the middle of its motion. And although the regulating power of a pendulum greatly exceeds that of the light balances uſed in pocket watches, ſomething of the ſame kind may be expected even in pendulum clocks. Accordingly this appears by a ſeries of experiments made by Mr Berthoud, a celebrated watchmaker of Paris. A clock, with a half ſecond pendulum weighing five drams, was furniſhed with a recoiling ſcapement, whoſe pallets were planes. The angle of ſcapement was $5\frac{1}{2}$ degrees. When actuated with a weight of two pounds, it ſwung 8°, and loſt 15″ per hour; with four pounds, it ſwung 10°, and loſt 6″. Thus it appears that by doubling the maintaining power, although the vibration was increaſed in conſequence of the greater impulſe, the time was leſſened 9″ per hour, viz. about $\frac{1}{400}$. It is plain, from what was ſaid when we deſcribed the firſt ſcapement, that an increaſe of maintaining power muſt render the vibration more frequent. We ſaw, on that occaſion, that, even when the gravity of the pendulum is balanced by a weight on the other end of the rod, the force of the wheels will produce a vibratory motion, and that an augmentation of this force will increaſe it, or make the vibrations more rapid. The preciſe effect of any particular form of teeth can be learned only by computing the force on the pendulum in every poſition, and then conſtructing the curve $\delta \varepsilon \lambda C$ of fig. 1. The rapid increaſe of the ordinates beyond thoſe of the triangle ADC, forms a conſiderable area $DA\tau\omicron$, to compenſate the area $\kappa\omicron C$, and thus makes a conſiderable contraction $A\pi$ of the vibration, and a ſenſible contraction $\frac{A\theta}{2}$ of the time.

Mr George Graham, the celebrated watchmaker in London, was alſo a good mathematician, and well qualified to conſider this ſubject ſcientifically. He contrived a ſcapement, which he hoped would leave the pendulum almoſt in its natural ſtate. The acting face of the pallet *a b c* (fig. 4) is a plane. The tooth drops on *a*, and eſcapes from *c*, and is on the middle point *b* when the pendulum is perpendicular. Beyond *a*, the face of the pallet is an arch *a d*, whoſe centre is A, the centre of the crutch. The maintaining power is made ſo great as to produce a much greater vibration than the angle of active ſcapement *a* A *c*. The conſequence of this is that, when the tooth drops on the angle *a*, the pendulum, continuing its motion, carries the crutch along with it, and the tooth paſſes on the arch *a d*, in a direction paſſing through the centre of the crutch. This preſſure can neither accelerate nor retard the motion of the crutch and pendulum. As the pendulum was accelerated after it paſſed the perpendicular, by the other pallet, it will (if quite unobſtructed) throw out farther than what correſponds to the velocity which it had in the middle point of its vibration; perhaps till the tooth paſſes from *a* to *e* on the circular arch of the pallet. But although it ſuſtains no contrary action from the wheels during this excurſion beyond the angle of ſcapement, it will not proceed ſo far, but will ſtop when the tooth reaches *d*; becauſe there muſt be ſome reſiſtance ariſing from the friction of the tooth along the arch *a d*, and from the clammineſs of the oil employed to lubricate it: but this reſiſtance is exceedingly minute, not amounting to $\frac{1}{8}$th of the preſſure on the arch. Nay, we think that it appears from the experiments of Mr Coulomb that, in the caſe of ſuch minute preſſures on a ſurface covered with oil, there is no ſenſible retardation analogous to that produced by friction, and that what retardation we obſerve ariſes entirely from the clammineſs of the oil. We are ſo imperfectly acquainted with the manner in which friction and viſcidity obſtruct the motions of bodies, that we cannot pronounce deciſively what will be their effect in the preſent caſe. Friction does not increaſe much, if at all, by an increaſe of velocity, and appears like a fixed quantity when the preſſure is given. This makes all motions which are obſtructed by friction terminate abruptly. This will ſhorten both the length and the time of the outward excurſion of the pendulum. The viſcidity of the oil reſiſts differently, and more nearly in the proportion of the velocities. The diminution of motion will not be in this proportion, becauſe in the greater velocities it acts for a ſhorter time. Were this accurately the caſe, the reſiſtance of viſcidity would alſo be nearly conſtant, and it would operate as friction does. But it does not ſtop a motion abruptly, and the motions are extinguiſhed gradually. Therefore, although viſcidity muſt always diminiſh the extent of the excurſion, it may ſo vary as not to diminiſh the time. We apprehend, however, that it generally does. But whatever happens in the excurſion, the return will certainly be ſlower, and employ more time than if it had not been obſtructed, becauſe the velocity in every point is leſs than if perfectly free. The whole arch, conſiſting of a returning arch and an excurſion on the other ſide, may be either ſlower or quicker, according as the compenſation is complete or not, or is even overdone.

All theſe reflections occurred to Mr Graham; and he was perſuaded that the time of the tooth's remaining on the arch *a d*, both aſcending and deſcending, would differ very little from that of the deſcription of the ſame arch by a free pendulum. The great cauſes of irregularity ſeemed to be removed, viz. the inequalities in the action of the wheels in the vicinity of the extremity of the vibration, where the pendulum having little momentum is, long in the ſame little ſpace, expoſed to their action. The derangement produced by any force depends on the time of its action, and therefore muſt be greateſt when the motion is ſloweſt. The pendulum gets its impulſe in the very middle of its vibration, where its velocity is the greateſt; and therefore the inequalities of the maintaining power act on it only for a ſhort time, and make a very trifling alteration in the time of its deſcribing the arch of ſcapement. Beyond this, it is nearly in the ſtate of a free pendulum; nay, even though it be affected by an inequality of the maintaining power, and it be accelerated beyond its uſual rate in that arch, the chief effect of this will be to cauſe it to deſcribe a larger arch of excurſion. The ſhortening of the time of this deſcription by the friction will be the ſame as before, happening at the very end of the excurſion; but the return will be more retarded by the friction on a longer arch. And, by this, a compenſation may be made for the trifling contraction of the time of deſcribing the arch of ſcapement.

This circumſtance of giving the impulſe in the middle of the vibration, where its time of action is the ſmalleſt poſſible, and whereby the pendulum is ſo long left free from the action of the wheels, is of the very firſt importance in all ſcapements, and ſhould ever be in the mind of the mechanician. When this is adhered to, the form of the face *abc* is ſcarcely of any moment. Much has been written on this form, and many attempts have been made to make it ſuch that the action of the wheels ſhall be proportional to the action of gravity. To do this is abſolutely impoſſible. Mr Graham made them planes, not only becauſe of eaſieſt execution, but becauſe a plane really conſpires pretty well with the change of gravity. While the pendulum moves from Q to P (fig. 3.), the force of gravity, acting in the direction QP, is continually diminiſhing. So is the accelerating power of the pallet from *a* to *b*. When the pendulum riſes from P to R, a force in the oppoſite direction RP continually increaſes. This is analogous to the continual diminution of a force in the direction PR. Now we have ſuch a diminution of ſuch a force, in the action of the pallet from *b* to *c*, and ſuch an augmentation in the action of the other pallet.

For all theſe reaſons, this conſtruction of a ſcapement appeared very promiſing. Mr Graham put it in practice, and it anſwered his moſt ſanguine expectation, and is now univerſally adopted in all nice clocks. Mr Graham, however, did not think it prudent to cauſe a tooth to drop on the very angle *a* of the pallet. He made it drop on a point *f* of the arch of excurſion. This has alſo the advantage of diminiſhing the angle of action, which we have proved to be of ſervice. It requires, indeed, a greater maintaining power; but this can eaſily be procured, and is leſs affected by the changes to which it is liable by the effect of heat and cold on the oil. Our obſervations on the effects of friction and viſcidity in the arch *a d* ſeem to be confirmed by the obſervations of ſeveral artiſts, who agree in ſaying that a great increaſe of maintaining power increaſes the vibrations, but makes them perceptibly ſlower. When they wrote, much oil was applied to diminiſh the friction on the arch of repoſe; but, ſince that time, the rubbing parts were made ſuch as required no oil, and this retardation diſappeared. In the clock of the tranſit room of the Royal Obſervatory, the angle of action ſeldom exceeds one-third of the ſwing of the pendulum. The pallets are of oriental ruby, and the wheel is of ſteel tempered to the utmoſt degree of hardneſs. This clock never varies a whole ſecond from equable motion in the courſe of five days.

This contrivance is known by the name of the DEAD BEAT, the DEAD SCAPEMENT; becauſe the ſeconds index ſtands ſtill after each drop, whereas the index of a clock with a recoiling ſcapement is always in motion, hobbling backward and forward.

Theſe ſcapements, both recoiling and dead beat, have been made in a thouſand forms; but any perſon tolerably acquainted with mechanics, will ſee that they are all on the ſame principles, and differ only in ſhape or ſome equally unimportant circumſtance. Perhaps the moſt convenient of any is that repreſented in fig. 5. where the ſhaded part is the crutch, made of braſs or iron, and A and B are two pieces of agate, flint, or other hard ſtone, cut into the proper ſhape for a pallet of either kind, and firmly fixed in proper ſockets. They project half an inch, or thereabouts, in front of the crutch, ſo that the ſwing wheel is alſo before the crutch, diſtant about $\frac{1}{10}$th of an inch or ſo. Pallets of ruby, driven by a hard ſteel ſwing wheel, need no oil, but merely to be once rubbed clean with an oily cloth.

Sometimes the wheel has pins inſtead of teeth. They are ranged round the rim of the wheel, perpendicular to its plane, and both pallets are on one ſide of the wheel, ſtanding perpendicular to its plane. One of theſe pins drops from the firſt to the ſecond pallet at once. The pallets are placed on two arms, as in fig. 6. in which caſe the pins are alternately on different ſides of the wheel; or on one, as in fig. 7. By the motion of the pendulum to the right, the pin (in fig. 7.), after reſting on the concave arch *d a*, acts on the face *a c*, and drops from *c* on the other concave arch *i g*, which continues to move a little way to the right. It then returns, and the pin ſlides and acts on the pallet *i h*, and eſcapes at *h*; and the next pin is then on the arch of repoſe *d a*.

It being evident that the recoiling ſcapement accelerates the vibrations beyond the rate of a free pendulum, and it alſo appearing to many of the firſt artiſts that the dead ſcapement retards them, they have attempted to form a ſcapement which ſhall avoid both of theſe defects, by forming the arches *a d*, *i g*, ſo as to produce a very ſmall recoil. Mr Berthoud does this in a very ſimple manner, by placing the centre of *a d* at a ſmall diſtance from that of the crutch, ſo as to make the riſe of the pallet above the concentric arch about one-third of the arch itſelf. Applying ſuch a crutch to the light pendulum mentioned in a former paragraph, he found that doubling, and even trebling the maintaining power, produced no change in the time of vibration, though it increaſed the width from 8° to 12° and 14°. We have no doubt of the efficacy of this contrivance, and think it very proper for all clocks which require much oil, ſuch as turret clocks, &c. But we apprehend that no rule can be given for the angle that the recoiling arch ſhould make with the concentric one. We imagine that this depends entirely on the ſhare which friction and oil have in producing the retardation of the dead beat.

Other artiſts have endeavoured to avoid the inconveniences of friction and oil on the arch of repoſe in another way. Inſtead of allowing the tooth of the wheel to drop on the back of the pallet, which we called the *arch of excurſion*, and others call the *arch of repoſe*, it drops on a detent *o t a* (fig. 8.), of which the part *t a* is part of an arch whoſe centre is A, the centre of the crutch, and the part *t o* is in the direction of the radius. This piece does not adhere to the pallet, but is on the end of an arm *o* A, which turns round the axis A of the crutch on fine pivots: it is made to apply itſelf to the back of the pallet by means of a ſlender ſpring A*p*, attached to the pallet, and preſſing inward on a pin *p*, fixed in the arm of the detent. When ſo applied, its arch *t a* makes the repoſe, and its point *a* makes a ſmall portion of the face *a c* of the pallet.

The action of this apparatus is very eaſily underſtood. When a tooth eſcapes from the ſecond pallet, by the motion of the pendulum from the left to the right, another tooth drops on this pallet (which the figure ſhews to be the firſt or leading pallet) at the angle *t*, and reſts on the ſmall portion *t a* of an arch of repoſe. But the crutch continuing its motion to the right, immediately quits the arm *o* A, carrying the pallet *a c r* along with it, and leaving the wheel locked on the detent *o t a*. By and bye the pendulum finiſhes its excurſion to the right, and returns. When it enters the arch of action, the pallet has applied itſelf to the detent *o t a*, and withdraws it from the tooth. The tooth immediately acts on the face *a c* of the pallet, and reſtores the motion loſt during the laſt vibration. The uſe of the ſpring is merely to keep the detent applied to the pallet without ſhaking. It is a little bent during their ſeparation, and adds ſomething of an oppoſing force to the aſcent of the pendulum on the other ſide of the wheel, and accelerates its return. A ſimilar detent on the back of the ſecond pallet performs a ſimilar office, ſupporting the wheel while the pendulum is beyond the arch of ſcapement, and quitting it when the pendulum enters that arch.

We do not know who firſt practiſed this very ingenious and promiſing invention. Mr Mudge certainly did ſo early as 1753 or 1754. Mr Berthoud ſpeaks obſcurely of contrivances of the ſame nature. So does Le Roy, and (we think) Le Paute. We ſay that it is very promiſing. Friction is almoſt annihilated by transferring it to the pivots at A; ſo that, in the excurſion beyond the angle of ſcapement, the pendulum ſeems almoſt free. Indeed ſome artiſts of our acquaintance have even avoided the friction of the pivots at A, by making the arm of the detent a ſpring of conſiderable thickneſs, except very near to A, where it is made very thin and broad. But we do not find that this conſtruction, though eaſily executed, and ſuſceptible of great preciſion and ſteadineſs of action, is much practiſed. We preſume that the performance has not anſwered expectations. It has not been ſuperior to the incomparably more ſimple dead ſcapement of Graham. Indeed we think that it cannot. A part of the friction ſtill remains, which cannot be removed; namely, while the arch *t a* is drawn from between the tooth and pallet. Nay, we apprehend that ſomething more than friction muſt be overcome here. The tooth is apt to force the detent outward, unleſs the part *t a* be a little elevated at its point *a* like a claw, above the concentric arch, and the face of the tooth be made to incline forward, ſo as to fit this ſhape of the detent. This will conſume ſome force, when the momentum of the pendulum is by no means at its maximum. Should the clock be foul, and the excurſions beyond ſcapement be very ſmall, this diſturbance muſt be exceedingly pernicious. But we have a much greater objection. During the whole excurſion beyond ſcapement, there is a new force of a ſpring acting on the pendulum, which deviates conſiderably from the proportions of the accelerating power of gravity. It does not commence its action till the detent ſeparates from the arm of the crutch. Then the ſpring of the detent acts as a retarding force againſt the excurſion of the pendulum, now on the other ſide, bringing it ſooner to reſt, and then accelerating it in its way back to the beginning of the arch of ſcapement. In ſhort, this conſtruction ſhould have the properties of a recoiling ſcapement. We got a clock-maker to make ſome experiments on one which he had made for an amateur, which fully confirmed our conjecture. When the detent ſpring was ſtrong, an increaſe of maintaining power made the vibrations both wider and more rapid. The artiſt reduced the ſtrength of the ſpring till this effect was rendered very ſmall. It might perhaps be quite removed by means of a ſtill weaker ſpring: But the ſpring was already ſo weak that a hard ſtep on the floor of the room did ſometimes diſengage the detent from the wheel. It appears, therefore, that nothing can be reaſonably expected from this conſtruction that is not as well performed by the dead ſcapement of Mr Graham, of much eaſier execution, and more certain performance.

Very ſimilar to this conſtruction (at leaſt in the excurſion beyond the angle of ſcapement) is the conſtruction of Mr Cumming, and it has the ſame defects. His pallets are carried, as in the one deſcribed, by the crutch. The detents preſs on them behind by their weight only: therefore when the tooth is locked on the detent of one pallet, its weight is taken off from the pendulum on that ſide, and the weight of the detent on the other ſide oppoſes the aſcent, and accelerates the deſcent of the pendulum.

Mr Cumming executed another ſcapement, conſiſting, like thoſe, of a pallet and detent. But the manner of applying the maintaining power is extremely different in principle from any yet deſcribed. It is exceedingly ingenious, and ſeems to do all that is poſſible for removing every ſource of irregularity in the maintaining power, and every obſtruction to free motion ariſing from friction and oil in the ſcapement. For this reaſon we ſhall give ſuch an account of its eſſential circumſtances as may ſuffice to give a clear conception of its manner of acting, and its good properties and defects; but referring the inquiſitive reader to Mr Cumming's Elements of Clock and Watch Work, publiſhed in 1766, for a more full account.

In the ſcapements laſt deſcribed, the pallets were fixed to the crutch and pendulum, and the maintaining power, during its action, was applied to the pendulum by means of the pallets, in the ſame way as in ordinary ſcapements. The detents were unconnected with the pendulum, and it was free during the whole excurſion. In the preſent ſcapement both the pallets and detents are detached from the pendulum, except in the moment of unlocking the wheel; ſo that the pendulum may be ſaid to be free during its whole vibration, except during this ſhort moment.

ABC (fig. 9.) repreſents a portion of the ſwing wheel, of which O is the centre, and A one of the teeth; Z is the centre of the crutch, pallets, and pendulum. The crutch or detent is repreſented of a form reſembling the letter A, having in the circular croſs piece a ſlit *i k*, alſo circular, Z being the centre. This form is very different from Mr Cumming's, and inferior to his, but was adopted here in order to avoid a long deſcription. The arm ZF forms the firſt detent, and the tooth A is repreſented as locked on it at F. D is the firſt pallet on the end of the arm Z *d* moveable round the ſame centre with the detents, but moveable independently of them. The arm *d e*, to which the pallet D is attached, lies altogether behind the arm ZF of the detent, being fixed to a round piece of braſs *e f g*, which has pivots turning concentric with the verge or axis of the pendulum. To the ſame round piece of braſs is fixed the horizontal arm *e* H, carrying at its extremity the ball H, of ſuch ſize that the action of the tooth A on the pallet D is juſt able (but without any riſk of failing) to raiſe it up to the poſition here drawn. ZP*p* repreſents the fork, or the pendulum rod, behind both detent and pallet. A pin *p* projects forward, coming through the ſlit *i k*, without touching the upper or under margin of it. There is alſo attached to the fork the arm *m n* (and a ſimilar one on the other ſide), of ſuch length that, when the pendulum rod is perpendicular, as is repreſented here, the angular diſtance of *n q* from the rod *e q* H is preciſely equal to the angular diſtance of the left ſide of the pin *p* from the left end *i* of the ſlit *i k*.

The mode of action on this apparatus is abundantly ſimple. The natural poſition of the pallet D is at δ, repreſented by the dotted lines, reſting on the back of the detent F. It is naturally brought into this poſition by its own weight, and ſtill more by the weight of the ball H. The pallet D, being ſet on the fore ſide of the arm at Z, comes into the ſame plane with the detent F and the ſwing-wheel. It is drawn, however, in the figure in another poſition. The tooth C of the wheel is ſuppoſed to have eſcaped from the ſecond pallet, on which the tooth A immediately engages with the pallet D, ſituated at δ, forces it out, and then reſts on the detent F, the pallet D leaning on the tip of the tooth. F is brought into this ſituation in a way that will appear preſently. After the eſcape of C, the pendulum, moving down the arch of ſemivibration, is repreſented as having attained the vertical poſition. Proceeding ſtill to the left, the pin *p* reaches the extremity *i* of the ſlit *i k*; and, at the ſame inſtant, the arm *n* touches the rod *e* H in *q*. The pendulum proceeding a hair's breadth further, withdraws the detent F from the tooth, which now even puſhes off the detent, by acting on the ſlant face of it. The wheel being now unlocked, the tooth following C on the other ſide acts on its pallet, puſhes it off, and reſts on its detent, which has been rapidly brought into a proper poſition by the action of A on the ſlant face of F. It was a ſimilar action of C on its detent, in the moment of eſcape which brought F into a fit poſition for locking the wheel by the tooth A. The pendulum ſtill going on, the arm *m n* carries the weight of the ball H, and the pallet connected with it, and it comes to reſt before the pin *p* again reaches the end of the ſlit, which had been ſuddenly withdrawn from it by the action of A on the ſlant face of F. The pendulum now returns towards the right, loaded on the left with the ball H, which reſtores the motion which it had loſt during the laſt vibration. When, by its motion to the right, the pin *p* reaches the end *k* of the ſlit *i k*, it unlocks the wheel on the right ſide. At the ſame inſtant the weight H ceaſes to act on the pendulum, being now raiſed up from it by the action of a tooth like B on the pallet D.

Let us now conſider the mechaniſm of theſe motions. The prominent feature of the contrivance is the almoſt complete diſengagement of the regulator from the wheels. The wheels, indeed, act on the pallets; but the pallets are then detached from the pendulum. The ſole uſe of the wheel is to raiſe the little weights while the pendulum is on the other ſide, in order to have them in readineſs at the arrival of the pendulum. They are then laid on the pendulum, and ſupply an accelerating force, which reſtores to the pendulum the momentum loſt during the preceding vibration. Therefore no inequalities in the action of the wheel on the pallets, whether ariſing from friction or oil, has any effect on the maintaining power. It remains always the ſame, namely, the rotative momentum of the two weights. The only circumſtance, in which the irregularity of the action of the wheels can affect the pendulum is at the moment of unlocking. Here indeed the regulator may be affected; but this moment is ſo ſhort, in compariſon with

Fig.1.

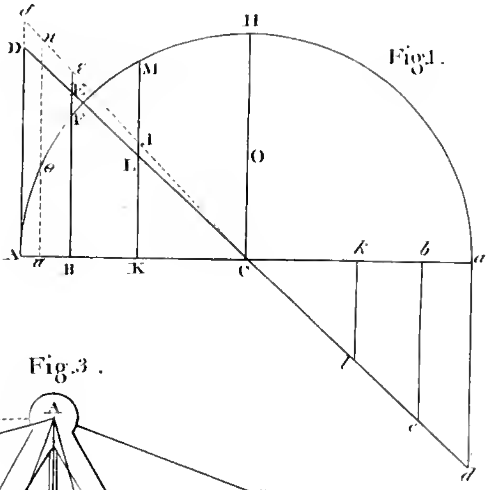

Fig. 2.

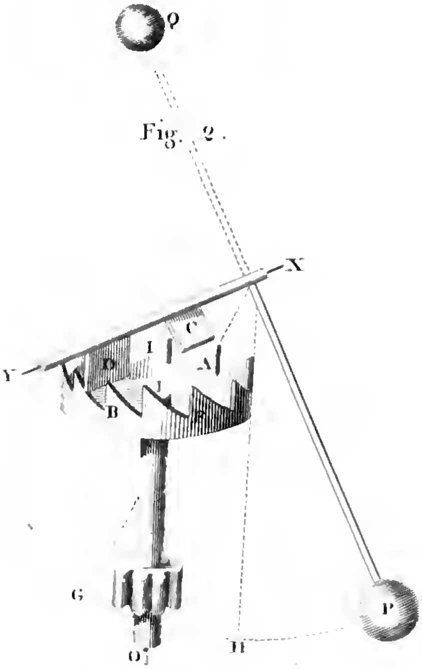

Fig.3.

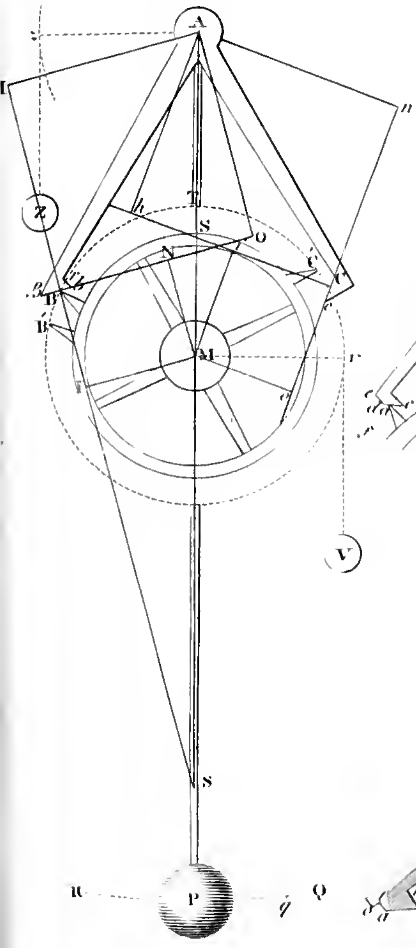

Fig.4.

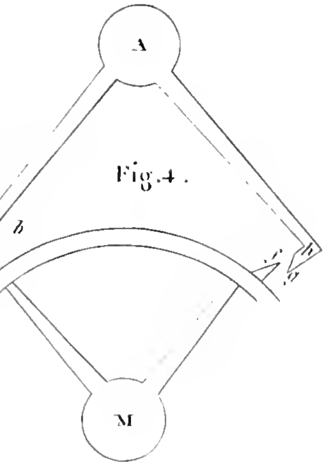

Fig. Z.

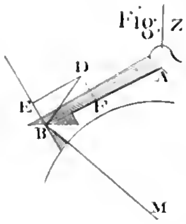

Fig.5.

Fig.8.

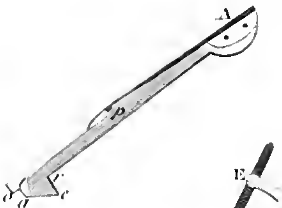

Fig.9.

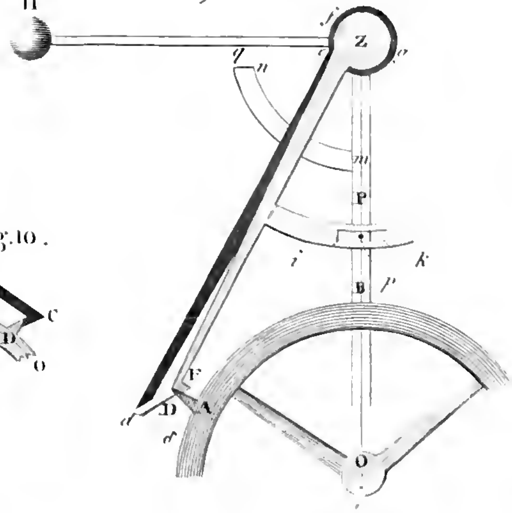

Fig.10.

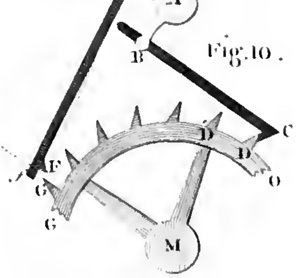

Fig. 6.

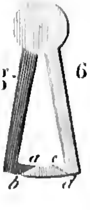

Fig. 7.

Lowry sc.

other ſcapements, that it muſt be conſidered as a real improvement.

It is very uncandid to refuſe the author a claim to the character of an ingenious artiſt on account of this contrivance, as has been done by a very ingenious univerſity Profeſſor, who taxes Mr Cumming with ignorance of the *firſt elements of mechanics*, and ſays that the beſt thing in his book is his advice to ſuſpend the pendulum from a great block of marble, firmly fixed in the wall*. This is certainly a good advice, and we doubt not but that the Profeſſor's clock would have performed ſtill better if he had condeſcended to follow it. It is ſtill leſs candid to queſtion the originality of the invention. We know for certain that it was invented at a time and place where the author *could* not know what had been done by others. It would have been more like the urbanity of a well-educated man to have acknowledged the genius, which, without ſimilar advantages, had done ſo much.

*e Lud- Eſſay.

But while we thus pay the tribute of juſtice to Mr Cumming, we do not adopt all his opinions. The clock has the ſame defects of the former in reſpect of the laws of the force which accelerates the pendulum. The ſudden addition of the ſmall weight, and this almoſt at the extremity of the vibration, would derange it very much, if the addition were ſuſceptible of any ſenſible variation. The irregularity of the action of the wheels *may* ſenſibly affect the motion during the unlocking, when the clock is foul, and the pendulum *juſt* able to unlock; for any diſturbance at the extremity of the vibration greatly affects the time. We acknowledge that the parts which we here ſuppoſe to be foul may not be ſo in the courſe of twenty years, theſe parts being only the pivots of the ſcapement. The great defect of the ſcapement is its liableneſs to unlock by any jolt. It is more ſubject to this than the others already mentioned. This riſk is much increaſed by the ſlender make of the parts, in Mr Cumming's drawings, and in the only clock of the kind we have ſeen; but this is not neceſſary: and it ſhould be avoided for another reaſon; the interpoſing ſo many ſlender and crooked parts between the moving power and the pendulum weakens the communication of power, and requires a much more powerful wheelwork.

All theſe, however, are ſlight defects, and only the laſt can be called a fault. The clocks made on this principle have gone remarkably well, as may be ſeen by the regiſters of his majeſty's private obſervatory. But the greateſt objection is, that they do not perform better than a well-made dead ſcapement; and they are vaſtly more troubleſome to make and to manage. This is ſtrictly true, and is a ſerious objection. The fact is, that the dominion of a heavy pendulum is ſo great, that if *any one* of the ſcapements now deſcribed be well executed with pallets of agate, and a wheel of hard ſteel, and if the pendulum be ſuſpended agreeably to Mr Cumming's advice, there is hardly any difference to be obſerved in their performance. We ſhall content ourſelves with a ſingle proof of this from fact. The clock invented by the celebrated Harriſon is *at leaſt equal* in its performance to any other. Friction is almoſt annihilated, and no oil is required. It went fourteen years without being touched, and during that time did not vary one complete ſecond from one day to another, nor ever deviated half a minute by accumulation from equable motion: Yet the ſcapement, in ſo far as it reſpects the law of the accelerating force, deviates more from the proportion of the ſpaces than the moſt recoiling ſcapement that ever was put to a good clock. It is ſo different from all hitherto deſcribed, both in form and principle, that we muſt not omit ſome account of it, and with it we ſhall conclude our ſcapements for clocks.

Let GDO repreſent the ſwing-wheel, of which M is the centre. A is the verge or axis of the pendulum. It has two very ſhort arms AB, AE. A ſlender rod BC turns on fine pivets in the joint B, and has at its extremity C a hook or claw, which takes hold of a tooth D of the ſwing-wheel when the pendulum moves from the right ſide to the left. This claw, when at liberty, ſtands at right angles, or, at leaſt, in a certain determinate angle, with regard to the arm AB; and when drawn a little from that poſition, it is brought back to it again by a very ſlender ſpring. The arm AE is furniſhed with a detent EF, which alſo, when at liberty, maintains its poſition on the arm by means of a very ſlender ſpring.

Let us now ſuppoſe that the tooth D is preſſing on the claw C, while the pendulum is moving to the right. The joint B yields, by its motion round A, to the preſſure of the tooth on the claw. By this yielding, the angle ABC opens a little. In the mean time, the ſame motion round A cauſes the point F of the detent on the other ſide to approach the circumference of the wheel in the arch of a circle, and the tooth G at the ſame time advances. They meet, and the point of G is lodged in the notch under the projecting heel *f*. When this takes place, it is evident that any farther motion of the point E round A muſt puſh the tooth G a little backward, by means of the detent EF. It cannot come any nearer to the wheel, becauſe the point of the tooth ſtops the heel *f*. The inſtant that F puſhes G back, the tooth D is withdrawn from the claw C, and C flies out, by the action of its ſpring, and reſumes its poſition at right angles to BA; and the wheel is now free from the claw, but is puſhing at the detent F (c). The pendulum, having finiſhed its excurſion to the right (in which it cauſes the wheel to recoil by means of the detent F), returns toward the left. The wheel now advances again, and by preſſing on F, aids the pendulum through the whole angle of ſcapement. By this motion the claw C deſcribes an arch of a circle round A, and approaches the wheel, till it take hold of another tooth, namely, the one following D, and pulls it back a little. This immediately frees the detent F from the preſſure of the tooth G, and it flies out a little from the wheel, reſuming its natural poſition by means of

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(c) The reader may here remark the manner in which the preſſure of the tooth G on the detent is transferred to the joint E by the intervention of the ſhank FE, and from the joint E to the pendulum rod, by the intervention of the arm EA. This communication of preſſure is preciſely the ſame that we made uſe of in explaining the common ſcapement. MG, FE, and EA, in this fig. 10. are performing the offices which we then gave to the lines MB, BH, and HA, in fig. 3. Harriſon's pallet realiſes the abſtract theory.

of its ſpring. Soon after, the motion of the pendulum to the left ceaſes, and the pendulum returns; D pulling forward the hook C to aid the pendulum, and the former operation is repeated, &c. &c.

Such is the operation of the pallets of Harriſon and Hindley. Friction is almoſt totally avoided, and oil entirely (n). The motion is given to the pendulum by a fair pull or puſh, and the teeth of the wheel only apply themſelves to the detents without rubbing. There is no drop, and the ſcapement makes no noiſe, and is what the artiſts call *a ſilent ſcapement.* The mechanician will readily perceive, that by properly diſpoſing the arms AB, AE, and diſpoſing the pallets on the circumference of the wheel, the law, by which the action of the wheel on the pendulum is regulated, may be greatly varied, ſo as to harmonize, as far as the nature of ſcapement, alternately puſhing and pulling, will admit, with the action of gravity.

But this is evidently a recoiling ſcapement, and one of the worſt kind; for the recoil is made at the very confines of the vibration, where every diſturbance of the regular cycloidal vibration occaſions the greateſt diſturbance to the motion. Yet this clock kept time with moſt unexampled preciſion, far excelling all that had been made before, and equal to any that have been made ſince. This is entirely owing to the immenſe ſuperiority of the momentum of the pendulum over the maintaining power.

II. *Of Scapements for a Watch.*

The execution of a proper ſcapement for watches is a far more delicate and difficult problem than the foregoing, on account of the ſmall ſize, which requires much more accurate workmanſhip, becauſe the error of the hundredth part of an inch has as great a proportion to the dimenſions of the regulator as an inch in a common houſe clock. It is much more difficult on another account. We have no ſuch means of accumulating ſuch a dominion (to uſe Mr Harriſon's expreſſive term) over the wheel-work in the regulator of a watch as in that of a clock. The heavieſt balance that we can employ, without the certainty of ſnapping its pivots by every ſlight jolt, is a mere trifle, in compariſon with the pendulum of the moſt ordinary clock. A dozen or twenty grains is the utmoſt weight of the balance, even of a very large pocket watch. The only way that we can accumulate any notable quantity of regulating power in ſuch a ſmall pittance of matter is by giving it a very great velocity. This we do by accumulating all its weight in the rim, by giving it very wide vibrations, and by making them extremely frequent. The balance-rim of a middling good watch ſhould paſs through at leaſt ten inches in every ſecond. Now, when we reflect on the ſmall momentum of this regulator, the inevitable inequalities of the maintaining power, and the great arch of vibration on which theſe inequalities will operate, and the comparative magnitude even of an almoſt inſenſible friction or clammineſs, it appears almoſt chimerical to expect any thing near to equability in the vibrations, and incredible that a watch can be made which will not vary more than one beat in 86400. Yet ſuch have been made. They muſt be conſidered as the moſt maſterly exertions of human art. The performance of a reflecting teleſcope is a great wonder: the worſt that can find a market muſt have its mirrors executed without an error of the ten-thouſandth part of an inch; but we now know that this accuracy is attained almoſt in ſpite of us, and that we ſcarcely *can* make them of a worſe figure. But the caſe is far otherwiſe in watch-work. Here all thoſe wonderful approaches to perfection are the reſults of rational diſcuſſion, by means of ſound principles of ſcience; and, unleſs the artiſt who puts theſe principles into practice be more than a mere copyiſt, unleſs the principles themſelves are perceived by him, and actually direct his hand, the watch may ſtill be good for nothing. Surely, then, this is a liberal art, and far above a manual knack. The ſtudy of the means by which ſuch wonders are ſteadily effected, is therefore the ſtudy of a gentleman.

In the account given above of the ſcapements for pendulums, we aſſumed as one leading principle that *the natural vibrations of a pendulum are performed in equal times, whether wide or narrow.* This is ſo nearly true, when the arches on each ſide of the perpendicular do not exceed four degrees, that the retardation of the wider arches within that limit will not become ſenſible, though accumulated for a long time. The common ſcapement with a plane face of the pallet, helps to correct even this ſmall inequality much better than the niceſt form of the cycloidal checks propoſed by Huyghens.

In watch-work we aſſume a ſimilar principle, namely, that *the oſcillations of a balance, urged by its ſpring, and undiſturbed by all foreign forces, are performed in equal times, whether they be wide or narrow.* This principle was aſſumed by the celebrated mechanician Dr Robert Hooke, on the authority of many experiments which he had made on the bending and unbending of ſprings. He found that the force neceſſary for retaining a ſpring in any conſtrained poſition was proportional to its tenſion, or deflection from its natural form. He expreſſed this in an anagram, which he publiſhed about the year 1660, in order to eſtabliſh his claim to the diſcovery, and yet conceal it, till he had made ſome important application of it. When the anagram was explained ſome years afterwards, it was, "*Ut tenſio, ſic vis.*" Dr Hooke thought of applying this diſcovery to the regulation of watch movements. For, if a ſlender ſpring be *properly* applied to the axis of a watch balance, it will put that balance in a certain determinate poſition. If the balance

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(n) Mr Harriſon was at firſt by profeſſion a carpenter in a country place. Being extremely ingenious and inventive, he had made a variety of curious wooden clocks. He made one, in particular, for a turret in a gentleman's houſe. Its expoſure made it waſte oil very faſt, and the maker was often obliged to walk two or three miles to renew it, and got nothing for his trouble. In trudging home, not in very good humour, he pondered with himſelf how to make a clock go without oil. He changed all his pinion leaves into rollers; which anſwered very well. But the pallets required it more than any other part. After various other projects, he contrived thoſe now repreſented, where there was no friction, and no oil is wanted. The turret clock continued to go without being touched till Mr Harriſon left the country.

lance be turned aſide from this poſition, it ſeems to follow that it will be urged back toward it by a force proportional to its diſtance from it. He immediately made the application to an old watch, which he afterward gave to Dr Wilkins, Biſhop of Cheſter. This was in 1658. Its motion was ſo amazingly improved, that Hooke was perſuaded of the perfection of his principle, and thought that nothing was now wanting for making a watch of this kind a perfect chronometer but the hand of a good workman. For his watch ſeemed almoſt perfect, though made in a ſmall country town, in a very coarſe manner. Mr Huyghens alſo claims this diſcovery. He publiſhed his claim about the year 1675, and propoſed to make watches for diſcovering the longitude of a ſhip at ſea. But there is the moſt unqueſtionable evidence of Dr Hooke's priority by fifteen years, and of his having made ſeveral watches of this kind. One of them was in the poſſeſſion of his majeſty king Charles II. Dr Hooke's firſt balance ſpring was ſtraight, and acted on the balance in a very imperfect manner. But he ſoon ſaw the imperfections, and made ſeveral ſucceſſive alterations; and, among others, he employed the cylindrical ſpiral now employed by Mr Arnold; but he gave it up for the flat ſpiral: and the king's watch had one of this kind before Mr Huyghens publiſhed his invention. His project of longitude watches had been carried on along with Lord Brouncker and Sir Robert Moray, and they had quarrelled ſome years before that publication. See WATCH, *Encycl.*

But both Dr Hooke and Mr Huyghens were too ſanguine in their expectations. We, by no means, have the evidence for the truth of this principle that we have for the accelerating action of gravity on a pendulum. It reſts on the nicety and the propriety of the experiments; and long experience has ſhewn that it is ſenſibly true only within certain limits. The demonſtrations by which Bernoulli ſupports the unqualified principle of Mr Huyghens, proceed on hypothetical doctrines concerning the nature of elaſticity. And even theſe ſhew that the law of elaſticity which he aſſumed was ſelected, not becauſe founded on ſimpler principles than any other, but becauſe it was conſiſtent with the experiments of Hooke and Huyghens. Beſides, although this ſhould be the true law of a ſpring, it does not follow that this ſpring, applied in *any way* to the axis of a balance, will urge that balance agreeably to the ſame law: and if it did, it ſtill does not follow that the oſcillations of the balance will be iſochronous; for the force has to move not only the balance but alſo the ſpring. Part of the reſtoring force of the ſpring is employed in reſtoring it rapidly to its quieſcent ſhape, and thus enabling it to *follow and ſtill impel* the yielding balance. It is therefore only the ſurplus which is employed in actually moving the balance, and it is uncertain whether this ſurplus varies according to the ſame law, being always the ſame proportion of the whole force of the ſpring. We find it an extremely difficult problem to determine the law of variation of this ſurplus, even in the ſimpleſt form of the ſpring; nay, it is by no means an eaſy problem to determine the law of oſcillation of a ſpring, unloaded with any balance; and we can eaſily ſhew that there are ſuch forms of a ſpring, that although the velocity with which the different parts approach to their quieſcent poſition be exactly as their excurſion from it, this is by no means the law of velocity which this ſpring will produce in a balance. The matter of fact is, that when the ſpring is a ſimple ſtraight ſteel wire, ſuſpending the balance in the direction of its axis, the motions of it, if not immoderate, are preciſely agreeable to Huyghens's and Hooke's rule; and that the motion of a balance urged by a ſpring wound up into a flat, or a cylindrical ſpiral, as in common watches, and thoſe of Arnold, deviates ſenſibly from it, unleſs a certain analogy be preſerved between the length and the elaſticity of the ſpring. If the ſpring be immoderately long, the wide vibrations are ſlower than the narrow ones; and the contrary is obſerved when the ſpring is immoderately ſhort. A certain taper, or gradual diminution of the ſpring, is alſo found to have an effect in equalizing the wide and narrow vibrations. There is alſo a great difference between the force with which a part of the ſpring unbends itſelf, and the action of that force in urging the balance round its axis; and the performance of many watches, good in other reſpects, is often faulty from the manner in which this unbending force is employed.

But, ſince theſe corrections are in our power in a conſiderable degree, we may ſuppoſe them applied, and the true motion (which we ſhall call the cycloidal) attained; and we may then adapt the conſtruction of the ſcapement to the preſerving this motion undiſturbed. And here we muſt ſee at once that the problem is incomparably more delicate than in the caſe of pendulums. The vibrations muſt be very wide, and the angular motion rapid, that it may be little affected by external motions. The ſmalleſt inequalities of maintaining power acting through ſo great a ſpace, muſt bear a conſiderable proportion to the very minute momentum of a watch balance. Oil is as clammy on the pallets of a watch as on thoſe of a clock; a viſcidity which would never be felt by a pendulum of 20 pounds weight will ſtop a balance of 20 grains altogether. For the ſame reaſon, it is evident that any impropriety in the form of the pallet muſt be incomparably more pernicious than in the caſe of a pendulum; the deviation which this may occaſion from a force proportional to the angular diſtance from the middle point, muſt bear a great proportion to the whole force.

The common recoiling ſcapement of the old clocks ſtill holds its place in the ordinary pocket watches, and anſwers all the common purpoſes of a watch very well. A well finiſhed watch, with a recoiling ſcapement will keep time within a minute in the day. This is enough for the ordinary affairs of life. But ſuch watches are ſubject to great variation in their rate of going, by any change in the power of the wheels. This is evident; for if the watch be held back, or preſſed forward, by the key applied to the fuſee ſquare, we hear the beating greatly retarded or accelerated. The maintaining power, in the beſt of ſuch watches, is never leſs than one-fifth of the regulating power of the ſpring. For, if we take off the balance ſpring, and allow the balance to vibrate by the impulſe of the wheels alone, we ſhall find the minute hand to go forward from 25 to 30 minutes per hour. Suppoſe it 30. Then, ſince the wheels act through equal ſpaces with or without a ſpring, the forces are as the ſquares of the acquired velocities. (DYNAMICS, *Suppl.* n° 95.) The velocity in this caſe is double; therefore the accelerating force is quad-

Watch-work.

ruple, and the force of the ſpring is three times that of the wheels. If the hand goes forward 25 minutes, the force of the wheels is about one-fifth of that of the ſpring. This great proportion is neceſſary, as already obſerved, that the watch may go as ſoon as unſtopped.

We have but little to ſay on this ſcapement; its principle and manner of action, and its good and bad qualities, being the ſame with thoſe of the ſimilar ſcapement for pendulums. It is evident that the maintaining power being applied in the moſt direct manner, and during the whole of the vibration, it will have the greateſt poſſible influence to move the balance. A given mainſpring and train will keep in motion a heavier balance by means of this ſcapement than by any other. But, on the other hand, and for the ſame reaſon, the balance has leſs dominion over the wheel work, and its vibrations are more affected by any irregularities of the wheel-work. Moreover, the chief action of the wheel being at the very extremities of the vibrations, and being very abrupt, the variations in its force are moſt hurtful to the iſochroniſm of the vibrations.

Although this ſcapement is extremely ſimple, it is ſuſceptible of more degrees of goodneſs or imperfection than almoſt any other, by the variation of the few particulars of its conſtruction. We ſhall therefore briefly deſcribe that conſtruction which long experience has ſanctioned as approaching near to the beſt performance that can be obtained from the common ſcapement. Fig. 11. repreſents it in what are thought its beſt proportions, as it appears when looking ſtraight down on the end of the balance arbor. C is the centre of the balance and verge. CA and CB are the two pallets; CA being the upper pallet, or the one next to the balance, and CB being the lower one. F and D are two teeth of the crown wheel, moving from left to right; and E, G, are two teeth on the lower part of the circumference, moving from right to left. The tooth D is repreſented as juſt eſcaped from the point of CA, and the lower tooth E as juſt come in contact with the lower pallet. The ſcapement ſhould not, however, be quite ſo cloſe, becauſe an inequality on the teeth might prevent D from eſcaping at all. For if E touch the pallet CB before D has quitted CA, all will ſtand ſtill. This fault will be corrected by withdrawing the wheel a little from the verge, or by ſhortening the pallets.

The proportions are as follow. The diſtance between the front of the teeth (that is, of G, F, E, D) and the axis C of the balance is one-fifth of FA, the diſtance between the points of the teeth. The length CA, CB of the pallets is three-fifths of the ſame diſtance. The pallets make an angle ACB of 95 degrees, and the front DH or FK of the teeth make an angle of 25° with the axis of the crown-wheel. The ſloping ſide of the tooth muſt be of an epicycloidal form, ſuited to the relative motion of the tooth and pallet.

From theſe proportions it appears that the pallet A can *throw out*, by the action of the tooth D, till it reaches *a*, 120 degrees from CL, the line of the crown-wheel axis. For it can throw out till the pallet B ſtrike againſt the front of E, which is inclined 25° to CL. To this add BCA, = 95°, and we have LC*a* = 120. In like manner B will throw out as far on the other ſide. From 240, the ſum of theſe angles, take the angle of the pallets 95°, and there remains 145° for the greateſt vibration which the balance can make without ſtriking the front of the teeth. This extent of vibration ſuppoſes the teeth to terminate in points, and the acting ſurfaces of the pallets to be planes directed to the very axis of the verge. But the points of the teeth muſt be rounded off a little for ſtrength, and to diminiſh friction on the face of the pallets. This diminiſhes the angle of ſcapement very conſiderably, by ſhortening the teeth. Moreover, we muſt by no means allow the point of the pallet to bank or ſtrike on the foreſide of a tooth. This would greatly derange the vibration by the violence and abruptneſs of the check which the wheel would give to the pallet. This circumſtance makes it improper to continue the vibrations much beyond the angle of ſcapement. One-third of a circle, or 120°, is therefore reckoned a very proper vibration for a ſcapement made in theſe proportions. The impulſe of the wheels, or the angle of ſcapement, may be increaſed by making the face of the pallets a little concave (preſerving the ſame angle at the centre). The vibration may alſo be widened by puſhing the wheel nearer to the verge. This would alſo diminiſh the recoil. Indeed this may be entirely removed by bringing the front of the wheel up to C, and making the face of the pallet not a radius, but parallel to a radius and behind it, *i. e.* by placing the pallet CA ſo that its acting face may be where its back is juſt now. In this caſe, the tooth D would droop on it at the centre, and lie there at reſt, while the balance completes its vibration. But this would make the banking (as the ſtroke is called) on the teeth almoſt unavoidable. In ſhort, after varying every circumſtance in every poſſible manner, the beſt makers have ſettled on a ſcapement very nearly ſuch as we have deſcribed. Preciſe rules can ſcarcely be given; becauſe the law by which the force acting on the pallets varies in its intenſity, deviates ſo widely from the action of the balance ſpring, eſpecially near the limits of the excurſions.

The diſcoveries of Huyghens and Newton in rational mechanics engaged all the mathematical philoſophers of Europe in the ſolution of mechanical problems, about the end of the laſt century. The vibrations of elaſtic plates or wires, and their influence on watch balances, became familiar to every body. The great requiſites for producing iſochronous vibrations were well underſtood, and the artiſts were prompted by the ſpeculatiſts to attempt conſtructions of ſcapements proper for this purpoſe. It appeared clearly, that the moſt effectual means for this purpoſe was to leave the balance unconnected with the wheels, eſpecially near the extremities of the vibration, where the motion is languid, and where every inequality of maintaining power muſt act for a longer time, and therefore have a great effect on the whole duration of the vibrations. The maxim of conſtruction that naturally ariſes from theſe reflections is to *confine*, if poſſible, *the action of the wheels to the middle of the vibration*, where the motion is rapid, and where the chief effect of an increaſe or diminution of the maintaining power will be to enlarge or contract the angular motions, but will make little change on their duration; becauſe the greateſt part of the motion will be effected by the balance ſpring alone. This maxim was inculcated in expreſs terms by John Bernoulli, in his *Recherches Mechaniques et Phyſiques*; but it had been ſuggeſted by common ſenſe to ſeveral unletterred artiſts before that time. About the beginning of the 18th century

watches

watches were made in London, where the verge had a portion *e d b* (fig. 12.) of a ſmall cylinder, having its centre *c* in the axis, and a radial pallet *b a* proceeding from it. Suppoſe a tooth juſt eſcaped from the point of the pallet, moving in the direction *b d e*, the cylindrical part was ſo ſituated that the next tooth dropped on it at a ſmall diſtance from its termination. While the verge continues turning in the direction *b d e*, the tooth continues reſting on the cylinder, and the balance ſuſtains no *action* from the wheels, and has only to overcome the minute frictions on the poliſhed ſurface of a hard ſteel cylinder. This motion may perhaps continue till the pallet acquires the poſition *f*, almoſt touching the tooth. It then ſtops, its motion being extinguiſhed by the increaſing force of the ſpring. It now returns, moving in the direction *e d b;* and when the pallet has acquired the poſition *c i*, the tooth *g* quits the circumference of the cylinder, and drops in on the pallet at the very centre. The crooked form of the tooth allows the pallet to proceed ſtill farther, before there is any danger of banking on the tooth. This vibration being alſo ended, the balance reſumes its firſt direction, and the tooth now acts on the face of the pallet, and reſtores to the balance all the motion which it had loſt by friction, &c. during the two preceeding vibrations.

It is evident that this conſtruction obviates all the objections to the former recoiling ſcapement, and that, by ſufficiently diminiſhing the diameter of the cylindrical part, the friction may be reduced to a very ſmall quantity, and the balance be made to move by the action of the ſpring during the whole of the excurſion, and of the returning vibration. Yet this conſtruction does not ſeem to have come much into uſe, owing, in all probability, to the great difficulty of making the drop ſo accurate in all the teeth. The ſmalleſt inequality in the length of a tooth would occaſion it to drop ſooner or later; and if the cylinder was made very ſmall, to diminiſh friction, the formation of the notch was almoſt a microſcopical operation, and the ſmalleſt ſhake in the axis of the verge or the balance-wheel would make the tooth ſlip paſt the cylinder, and the watch run down amain.

About the ſame time, a French artiſt in London (then the ſchool of this art) formed another ſcapement, with the ſame views. We have not any diſtinct account of it; but are only informed (in the 7th volume of the *Machines approuvées par l'Acad. des Sciences*) that the tooth reſted on the ſurface of a hollow cylinder, and then eſcaped by acting on the inclined edge of it. But we may preſume that it had merit, being there told that Sir Iſaac Newton wore a watch of this kind.

A much ſuperior ſcapement, on the ſame principle, was invented by Mr Geo. Graham, at the ſame time that he changed the recoiling ſcapement for pendulums into the dead beat. Indeed it is the ſame ſcapement, accommodated to the large vibrations of a balance. In fig. 13. DE repreſents part of the rim of the balance-wheel, A and C are two of its teeth, having their faces *b e* formed into planes, inclined to the circumference of the wheel, in an angle of about 15 degrees; ſo that the length *b e* of the face is nearly quadruple of its height *e m*. Suppoſe a circular arch ABC deſcribed round the centre of the wheel, and through the middle of the faces of the teeth. The axis of the balance paſſes through ſome point B of this arch, and we may ſay that the mean circumference of the teeth paſſes through the centre of the verge. On this axis is fixed a portion of a thin hollow cylinder *b c d*, made of hard tempered ſteel, or of ſome hard and tough ſtone, ſuch as ruby or ſapphire. Agates, though very hard, are brittle. Chalcedony and cornelian are tough, but inferior in hardneſs. This cylinder is ſo placed on the verge, that when the balance is in its quieſcent poſition, the two edges *b* and *d* are in the circumference which paſſes through the points of the teeth. By this conſtruction the portion of the cylinder will occupy 210° of the circumference, or 30° more than a ſemicircle. The edge *b*, to which the tooth approaches from without, is rounded off on both angles. The other edge *d* is formed into a plane, inclined to the radius about 30°.

Now, ſuppoſe the wheel preſſed forward in the direction AC. The point *b* of the tooth, touching the rounded edge, will puſh it outwards, turning the balance round in the direction *b c d*. The heel *e* of the tooth will eſcape from this edge when it is in the poſition *h*, and *e* is in the poſition *f*. The point *b* of the tooth is now at *d*, but the edge of the cylinder has now got to *i*. The tooth, therefore, reſts on the inſide of the cylinder, while the balance continues its vibration a little way, in conſequence of the ſhove which it has received from the action of the inclined plane puſhing it out of the way, as the mould board of a plough ſhoves a ſtone aſide. When this vibration is ended, by the oppoſition of the balance-ſpring, the balance returns, the tooth (now in the poſition B) rubbing all the while on the inſide of the cylinder. The balance comes back into its natural poſition *b c d*, with an accelerated motion, by the action of its ſpring, and would, of itſelf, vibrate as far, at leaſt, on the other ſide. But it is aided again by the tooth, which, preſſing on the edge *d*, puſhes it aſide, till it come into the poſition *k*, when the tooth eſcapes from the cylinder altogether. At this moment the other edge of the cylinder is in the poſition *l*, and therefore is in the way of the next tooth, now in the poſition A. The balance continues its vibration, the tooth all the while reſting, and rubbing on the outſide of the cylinder. When this vibration, in the direction *d c b*, is finiſhed, the balance reſumes its firſt motion *b c d*, by the action of the ſpring, and the tooth begins to act on the firſt edge *b*, as ſoon as the balance gets into its natural poſition, ſhoves it aſide, eſcapes from it, and drops on the inſide of the cylinder. In this manner are the vibrations produced, gradually increaſed to their maximum, and maintained in that ſtate. Every ſucceeding tooth of the wheel acts firſt on the edge *b*, and then on the edge *d*; reſting firſt on the outſide, and then on the inſide of the cylinder. The balance is under the influence of the wheels while the edge *b* paſſes to *h*, and while *d* paſſes to *k*; and the reſt of the vibration is performed without any *action* on the part of the wheels, but is a little obſtructed by friction, and by the clammineſs of the oil. In the conſtruction now deſcribed, the arch of action or ſcapement is evidently 30°, being twice the angle which the face of a tooth makes with the circumference.

The reader will perceive, that when this ſcapement is executed in ſuch a manner that the ſucceeding tooth is in contact with the cylinder at the inſtant that the preceding one eſcapes from it, the face of the tooth muſt be equal to the inſide diameter of the cylinder, and

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that the diſtance between the heel of one tooth and the point of the following one muſt be equal to the outſide diameter. When the ſcapement is ſo cloſe there is no drop. A good artiſt approaches as near to this adjuſtment as poſſible; becauſe, while a tooth is dropping, but not yet in contact, it is not acting on the balance, and ſome force is loſt. The execution is accounted very good, if the diſtance between the centres of two teeth is twice the external diameter of the cylinder. This allows a drop equal to the thickneſs of the cylinder, which is about $\frac{1}{10}$th of its diameter.

We muſt alſo explain how this cylinder is ſo connected with the verge as to make ſuch a great revolution round the tooth of the wheel. The triangular tooth *e b m* is placed on the top of a little pillar or pin fixed into the extremity of the piece of braſs *m* D formed on the rim of the wheel. Thus the wedge-tooth has its plane parallel to the plane of the wheel, but at a ſmall diſtance above it. Fig. B repreſents the verge, a long hollow cylinder of hard ſteel. A great portion of the metal is cut out. If it were ſpread out flat, it would have the ſhape of Fig. C. Suppoſe this rolled up till the edges GH and G′H′ are joined, and we have the exact form. The part acted on by the point of the tooth is the dotted line *b d*. The part DIFE′ ſerves to connect the two ends. Thus it appears to be a very ſlender and delicate piece; but being of tempered ſteel, it is ſtrong enough to reſiſt moderate jolts. The ruby cylinders are much more delicate.

Such is the cylinder ſcapement of Mr Graham, called alſo the HORIZONTAL SCAPEMENT, becauſe the balance wheel is parallel to the others. Let us ſee how far it may be expected to anſwer the intended purpoſes. If the excurſions of the balance beyond the angle of impulſion were made altogether unconnected with the wheels, the *whole vibration* would be quicker than one of the ſame extent, made by the action of the balance-ſpring alone, becauſe the middle part of it is accelerated by the wheels. But the excurſions are obſtructed by friction and the clammineſs of oil. The effect of this in *obſtructing* the motion is very conſiderable. Mr Le Roy placed the balance ſo, that it reſted when the point of the tooth was on the middle of the cylindric ſurface. When the wheel was allowed to preſs on it, and it was drawn 80° from this poſition, it vibrated only during 4½ ſeconds. When the wheel was not allowed to touch the cylinder, it vibrated 90 ſeconds, or 20 times as long; ſo much did the friction on the cylinder exceed that of the pivots. We are not ſufficiently acquainted with the laws of either of theſe obſtructions to pronounce decidedly whether they will increaſe or diminiſh the *time* of the whole vibrations. We obſerve diſtinctly, in motions with conſiderable friction, that it does not increaſe nearly ſo faſt as the velocity of the motion; nay, it is often leſs when the velocity is very great. In all caſes it is obſerved to terminate motions abruptly. The friction requires a certain force to overcome it, and if the body has any leſs it will ſtop. Now this will not only contract the excurſion of the balance, but will ſhorten the time. But the return to the angle of impulſion will undoubtedly be of longer duration than the excurſion; for the arch of return, from the extremity of the excurſion to its beginning, where the angle of impulſion ends, is the ſame with the arch of excurſion. The velocity which the balance has in any point of the return is leſs than what it had in the ſame point of the excurſion; becauſe, in the excurſion, it had velocity enough to carry it to the extremity, and alſo to overcome the friction. In the return, it could, even without friction, only have the velocity which would have carried it to the extremity; and this ſmaller velocity is diminiſhed by friction during the return. The velocity being leſs through the whole return than during the excurſion, the time muſt be greater. It may therefore happen that this retardation of the return may compenſate the contraction of the excurſion and the diminution of its duration. In this caſe the vibration will occupy the ſame time as if the balance had been free from the wheels. But it may more than compenſate, and the vibrations will then be ſlower; or it may not fully compenſate, and they will be quicker. We cannot therefore ſay *à priori*, which of the two will happen: but we may venture to ſay that an increaſe of the force of the wheels will make the watch go ſlower: for this will exert a greater preſſure, give a greater impulſion, produce a wider excurſion, and increaſe the friction during that greater excurſion, making the wide vibrations ſlower than the narrow ones: becauſe the angle of impulſion remaining the ſame, the preſſures exerted muſt be quadrupled, in order to double the excurſion (ſee DYNAMICS, nº 95. *Suppl.*), and therefore the friction will be increaſed in a greater proportion than the momentum which is to overcome it. But, with reſpect to the obſtruction ariſing from the viſcidity of the oil, we know that it follows a very different law. It bears a manifeſt relation to the velocity, and is nearly proportional to it. But ſtill it is difficult to ſay how this will affect the whole vibration. The duration of the excurſion will not be ſo much contracted as by an equal obſtruction from friction, becauſe it will not terminate the motion abruptly. There are therefore more chances of the increaſed duration of the return exceeding the diminution of it in the excurſion. All that we can ſay, therefore, is, that there will be a compenſation in both caſes. The time of excurſion will be contracted, and that of return augmented.

Now, as the friction may be greatly diminiſhed by fine poliſh, fine oil, and a ſmall diameter of the cylinder, we may reaſonably expect that the vibrations of ſuch a balance will not vary nearly ſo much from iſochroniſm as with a recoiling ſcapement, and will be little affected by changes in the force of the wheels. Accordingly, Graham's cylindrical ſcapement ſupplanted all others as ſoon as it was generally known. We cannot compare the vibrations with thoſe of a free balance, becauſe we have no way of making a free balance vibrate for ſome hours. But we find that doubling or trebling the force of the wheels makes very little alteration in the rate of the watch, though it greatly enlarges the angular motion. Any one may perceive the immenſe ſuperiority of this ſcapement over the common recoiling ſcapement, by preſſing forward the movement of a horizontal watch with the key, or by keeping it back. No great change can be obſerved in the frequency of the beats, however hard we preſs. But a more careful examination ſhews that an increaſe of the power of the wheels generally cauſes the watch to go ſlower; and that this is more remarkable as the watch has been long going without being cleaned. This ſhews that the cauſe is to be aſcribed to the friction and oil operating on the wide arches of excurſion. But when this ſcapement is well executed, in the beſt proportions of the parts, the performance is extremely good. We know ſuch watches, which have continued for ſeveral weeks without ever varying more than 7″ in one day from equable motion. We have ſeen one whoſe cylinder was not concentric with the balance, but ſo placed on the verge that the axis of the verge was at *o* (fig. 13.), between the centre B of the cylinder and the entering edge *b*, and B*e* was equal to the thickneſs of the cylinder. The watch was made by Emery of London, and was ſaid to go with aſtoniſhing regularity, ſo as to equal any time piece while the temperature of the air did not vary; and when clean, was ſaid to be leſs affected by the temperature than a watch with a free ſcapement, but unprovided with a compenſation piece. It is evident that this watch muſt have a minute recoil. This was ſaid to be the aim of the artiſt, in order to compenſate for the obſtruction cauſed by friction during the return of the balance from its excurſions. It indeed promiſes to have this effect; but we ſhould fear that it ſubjects the excurſions to the influence of the wheels. We ſuſpect that the indifferent performance of cylinder watches may often ariſe from the cylinder being off the centre in ſome diſadvantageous manner.

The watch from which the proportions here ſtated were taken, is a very fine one made by Graham for Archibald Duke of Argyle, which has kept time with the regularity now mentioned. We believe that there are but few watches which have ſo large a portion of the cylinder: few indeed have more than one half, or 180° of the circumference. But this is too little. The tooth of the wheel does not begin to act on the reſting cylinder till its middle point A or B touch one of the edges. To obtain the ſame angle of ſcapement, the inclination of the face of the tooth muſt be increaſed (it muſt be doubled); and this requires the maintaining power to be increaſed in the ſame proportion. Beſides, in ſuch a ſcapement it may happen that the tooth will never reſt on the cylinder; becauſe the inſtant that it quits one edge it falls on the other, and puſhes it aſide, ſo that the balance acquires no wider vibration than the angle of ſcapement, and is continually under the influence of the wheels. The ſcapement is in its beſt ſtate when the portion of the cylinder exceeds 180° by twice the inclination of the teeth to the circumference of the wheel.

It would employ volumes to deſcribe all the ſcapements which have been contrived by different artiſts, aiming at the ſame points which Graham had in view. We ſhall only take notice of ſuch as have ſome eſſential difference in principle.

Fig. 14. repreſents a ſcapement invented in France, and called the *Echappement à* VIRGULE, becauſe the pallet reſembles a comma. The teeth A, B, C, of the balance wheel are ſet very oblique to the radius, and there is formed on the point of each a pin, ſtanding up perpendicular to the plane of the wheel. This greatly reſembles the wheel of Graham's ſcapement, when the triangular wedge is cut off from the top of the pin on which it ſtands. The axis *c* of the verge is placed in the circumference paſſing through the pins. The pallet is a plate of hard ſteel *aefdb*, having its plane parallel to the plane of the wheel. The inner edge of this plate is formed into a concave cylindrical ſurface between *o* and *b*, whoſe axis *c* coincides with the axis of the verge. Adjoining to this is the acting face *bd* of the pallet. This is either a ſtraight line *bd*, making an angle of nearly 30° with a line *cbg* drawn from the centre, or it is more generally curved, according to the noſtrum of the artiſt. The back of the pallet *aef* is alſo a cylindrical ſurface (convex) concentric with the other. This extends about 100° from *a* to *f*. The part between *f* and *d* may have any ſhape. The interval *ao* is formed into a convex ſurface, in ſuch a manner as to be everywhere interſected by the radius in an angle of 30° nearly; *i. e.* it is a portion of an equiangular ſpiral. The whole of this is connected with the verge by a crank, which paſſes perpendicularly through it between *f* and *e*; and the plate is ſet at ſuch height on the crank or verge, that it can turn round clear of the wheel, but not clear of the pins. The teeth of the wheel are ſet ſo obliquely, and made ſo ſlender, that the verge may turn almoſt quite round without the crank's banking on the teeth. The part *fdb*, called the horn, is of ſuch a length, that when one pin B reſts on the outſide cylinder at *a*, the point *d* is juſt clear of the next pin A.

When the wheel is not acting, and the balance ſpring is in equilibrio, the poſition of the balance is ſuch that the point *d* of the horn is near *i*, about 30° from *d*. The figure repreſents it in the poſition which it has when the tooth A has juſt eſcaped from the point *d* of the horn. In this poſition the next tooth B is applied to the convex cylinder, a very little way (about 5°) from its extremity *a*. This deſcription will enable the reader to underſtand the operation of the virgule ſcapement.

Now ſuppoſe the pin A juſt eſcaped from the horn. The ſucceeding pin B is now in contact with the back of the cylinder; and the balance, having got an impulſe by the action of A along the concave pallet *bd*, continues its motion in the direction *dgh*, till its force is ſpent, the point of the horn arriving perhaps at *h*, more than 90° from *d*. All this while the following tooth B is reſting on the back *ef* of the cylinder. The balance now returns, by the action of its ſpring; and when the horn is at *i*, the pin gets over the edge *ao*, and drops on the oppoſite ſide of the concave cylinder, where it reſts, while the horn moves from *i* to *k*, where it ſtops, the force of the balance being again ſpent. The balance then returns; and when the horn comes within 30° of *d*, the pin gets out of the hollow cylinder, ſhoves the horn out of its way, and eſcapes at *d*. Beſides the impulſe which the balance receives by the action of the wheel on the horn *bd*, there is another, though ſmaller, action in the contrary direction, while the point of B paſſes over the ſurface *ao*; for this ſurface being inclined to the radius, the preſſure on it urges the balance round in the direction *bdi*.

The chief difference of this ſcapement from the former is that the inclined plane is taken from the teeth of the wheel, and placed on the verge. This alone is a conſiderable improvement; for it is difficult to ſhape all the teeth alike; whereas the horn *bd* is invariable. Moreover, the reſting parts, although they be drawn large in this figure for the ſake of diſtinctneſs, may be made vaſtly ſmaller than Graham's cylinder, which muſt be big enough to hold a tooth within it. By this change, the friction, during the repoſe of the wheel,

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that is, during the excurſions of the balance, may be vaſtly diminiſhed. The inſide cylinder need be no bigger than to receive the pin. But although the performance of theſe ſcapements is excellent, they have not come into general uſe in this country. The cauſe ſeems to be the great nicety requiſite in making the pins of the wheel paſs exactly through the axis of the verge. The leaſt ſhake in the pivots of the balance and balance-wheel muſt greatly change the action. A very minute increaſe of diſtance between the pivots will cauſe the pin B to ſlide from the edge *a* to the horn, without reſting at all on the inſide cylinder; and when it does ſo, it will ſtop the balance at once, and, immediately after, the watch will run down. The ſame irregularities will happen if all the pins be not at preciſely the ſame diſtance from the axis of the wheel.

This ſcapement was greatly improved, and, in appearance, totally changed, by Mr Lepaute of Paris in 1753. By placing the pins alternately on the two ſides of the rim of the balance-wheel, he avoided the uſe of the outſide cylinder altogether. The ſcapement is of ſuch a ſingular form, that it is not eaſy to repreſent it by any drawing. We ſhall endeavour, however, to deſcribe it in ſuch a manner as that our readers, who are not artiſts, will underſtand its manner of acting. Artiſts by profeſſion will eaſily comprehend how the parts may be united which we repreſent as ſeparate.

Let ABC (fig. 15.) repreſent part of the rim of the balance-wheel, having the pins 1, 2, 3, 4, 5, &c. projecting from its faces; the pins 1, 3, 5, being on the ſide next the eye, but the pins 2 and 4 on the farther ſide. D is the centre of the balance and verge, and the ſmall circle round D repreſents its thickneſs. But the verge in this place is crooked, like a crank, that the rim of the wheel may not be interrupted by it. This will be more particularly deſcribed by and bye. There is attached to it a piece of hard tempered ſteel *abcd*, of which the part *abc* is a concave arch of a circle, having D for its centre. It wants about 30° of a ſemicircle. The reſt of it *cd* is alſo an arch of a circle, having the ſame radius with the balance-wheel. The natural poſition of the balance is ſuch, that a line drawn from D, through the middle of the face *cd*, is a tangent to the circumference of the wheel. But, ſuppoſe the balance turned round till the point *d* of the horn comes to *d'*, and the point *c* comes to 2, in the circumference in which the pins are placed. Then the pin, preſſing on the beginning of the horn or pallet, puſhes it aſide, ſlides along it, and eſcapes at *d*, after having generated a certain velocity in the balance. So far this ſcapement is like the virgule ſcapement deſcribed already. But now let another pallet, ſimilar to the one now deſcribed, be placed on the other ſide of the wheel, but in a contrary poſition, with the acting face of the pallet turned away from the centre of the wheel. Let it be ſo placed at E, that the moment that the pin 1, on the upper ſide of the wheel, eſcapes from the pallet *cd*, the pin 4, on the under ſide of the wheel, falls on the end of the circular arch *efg* of the other pallet. Let the two pallets be connected by means of equal pulleys G and F on the axis of each, and a thread round both, ſo that they ſhall turn one way. The balance on the axis D, having gotten an impulſe from the action of the pin 1, will continue its motion from A towards *i*, and will carry the other pallet with a ſimilar motion round the centre E from *h* towards *k*. The pin 4 will therefore reſt on the concave arch *gfe* as the pallet turns round. When the force of the balance is ſpent, the pallet *cd* returns towards its firſt poſition. The pallet *gh* turns along with it; and when the point of the firſt has arrived at *d*, the beginning *g* of the other arrives at the pin 4; and, proceeding a little farther, this pin eſcapes from the concave arch *efg*, and ſlides along the pallet *gh*, puſhing it aſide, and therefore urging the pallet round the centre E, and conſequently (by means of the connection of the pulleys) urging the balance on the axis D round at the ſame time, and in the ſame direction. The pin 4 eſcapes from the pallet *gh*, when *h* arrives at 3; but in the time that the pin 4 was ſliding along the yielding pallet *gh*, the pin 3 is moving in the circumference BDA; and the inſtant that the pin 4 eſcapes from *h* at 3, the pin 3 arrives at 2, and finds the beginning *c* of the concave arch *cba* ready to receive it. It therefore reſts on this arch, while the balance continues its motion. This perhaps continues till the point *b* of the arch comes to 2. The balance now ſtops, its force being ſpent, and then returns; and the pin 3 eſcapes from the circle at *c*, ſlides along the yielding pallet *cd*, and when it eſcapes at 1, another pin on the under ſide of the wheel arrives at 4, and finds the arch *gfe* ready to receive it. And in this manner will the vibration of the balance be continued.

This deſcription of the mode of action at the ſame time points out the dimenſions which muſt be given to the parts of the pallet. The length of the pallet *cd* or *gh* muſt be equal to the interval between two ſucceeding pins, and the diſtance of the centres D and E muſt be double of this. The radius D*c* or E*g* may be as ſmall as we pleaſe. The concave arches *cba* and *gfe* muſt be continued far enough to keep a pin reſting on them during the whole excurſion of the balance. The angle of ſcapement, in which the balance is under the influence of the wheels, is had by drawing D*c* and D*d*. This angle *c*D*d* is about 30°, but may be made greater or leſs.

Fig. B will give ſome notion how the two pallets may be combined on one verge. KL repreſents the verge with a pivot at each end. It is bent into a crank MNO, to admit the balance wheel between its branches. BC repreſents this wheel, ſeen edgewiſe, with its pins, alternately on different ſides. The pallets are alſo repreſented edgewiſe by *bcd* and *hgf*, fixed to the inſide of the branches of the crank, fronting each other. The poſition of their acting faces may be ſeen in the preceding figure, on the verge D, where the pallet *gh* is repreſented by the dotted line 2 *i*, as being ſituated behind the pallet *cd*. The remote pallet 2 *i* is placed ſo, that when the point *d* of the near pallet is juſt quitted by a pin 1 on the upper ſide of the wheel, the angle formed by the face and the arch of reſt of the other pallet is juſt ready to receive the next pin 2, which lies on the under ſide of the rim. A little attention will make it plain, that the action will be preciſely the ſame as when the pallets were on ſeparate axes. The pin 1 eſcapes from *d*, and the pin 2 is received on the arch of reſt, and locks the wheel while the balance is continuing its motion. When it returns, 2 gets off the arch of reſt, puſhes aſide the pallet 2 *i*, eſcapes from it when *i* gets to 1, and then the pin 3 finds the point *c* ready

ready to receive it, &c. The vibrations may be increaſed by giving a ſufficient impulſe through the angle of ſcapement. But they cannot be more than a certain quantity, otherwiſe the top N of the crank will ſtrike the rim of the wheel. By placing the pins at the very edge of the wheel, the vibrations may eaſily be increaſed to a ſemicircle. By placing them at the points of long teeth, the crank may get in between them, and the vibrations extended ſtill farther, perhaps to 240°.

This ſcapement is unqueſtionably a very good one; and when equally well executed, ſhould excel Graham's, both by having but two acting faces to form (and theſe of hard ſteel or of ſtone), and by allowing us to make the circle of reſt exceedingly ſmall without diminiſhing the acting face of the pallet. This will greatly diminiſh the friction and the influence of oil. But, on the other hand, we apprehend that it is of very difficult execution. The figure of the pallets, in a manner that ſhall be ſuſceptible of adjuſtment and removal for repair, and yet ſufficiently accurate and ſteady, ſeems to us a very delicate job.

Mr Cumming, in his Elements of Clock and Watchwork deſcribes (ſlightly) pallets of the very ſame conſtruction, making what he conceives to be conſiderable improvements in the form of the acting faces and the curves of reſt. He has alſo made ſome watches with this ſcapement; but they were ſo difficult, that few workmen can be found fit for the taſk; and they are exceedingly delicate, and apt to be put out of order. The connection of the pallets with each other, and with the verge, makes the whole ſuch a contorted figure, that it is eaſily bent and twiſted by any jolt or unſkilful handling.

There remains another ſcapement of this kind, having the tooth of the balance-wheel reſting on a cylindrical ſurface on the axis of the verge during the excurſions of the balance beyond the angle of ſcapement, and which differs ſomewhat in the application of the maintaining power from all thoſe already deſcribed.

This is known by the name of *Dupleix's ſcapement*, and is as follows: Fig. 16. repreſents the eſſential parts greatly magnified. AD is a portion of the balance-wheel, having teeth *f*, *b*, *g*, at the circumference. Theſe teeth are entirely for producing the *reſt* of the wheel, while the balance is making excurſions beyond the ſcapement. This is effected by means of an agate cylinder *o p q*, on the verge. This cylinder has a notch *o*. When the cylinder turns round in the direction *o p q*, the notch eaſily paſſes the tooth B which is reſting on the cylindric ſurface; but when it returns in the direction *q p o*, the tooth B gets into the notch, and follows it, preſſing on one ſide of it till the notch comes into the poſition *o*. The tooth being then in the poſition *b*, eſcapes from the notch, and another tooth drops on the convex ſurface of the cylinder at B.

The balance wheel is alſo furniſhed with a ſet of ſtout flat-ſided pins, ſtanding upright on its rim, as repreſented by *a*, D. There is alſo fixed on the verge a larger cylinder GFC above the ſmaller one *o p q*, with its under ſurface clear of the wheel, and having a pallet C, of ruby or ſapphire, firmly indented into it, and projecting ſo far as juſt to keep clear of the pins on the wheel. The poſition of this cylinder, with reſpect to the ſmaller one below it, is ſuch that, when the tooth *b* is eſcaped from the notch, the pallet C has juſt paſſed the pin *a*, which was at A while B reſted on the ſmall cylinder: but it moved from A to *a*, while B moved to *b*. The wheel being now at liberty, the pin *a* exerts its preſſure on the pallet C in the moſt direct and advantageous manner, and gives it a ſtrong impulſion, following and accelerating it till another tooth ſtops on the little cylinder. The angle of ſcapement depends partly on the projection of the pallet, and partly on the diameter of the ſmall cylinder and the advance of the tooth B into the notch. Independent of the action on the ſmall cylinder, the angle of ſcapement would be the whole arch of the large cylinder between C and *x*. But *a* ſtops before it is clear of the pallet, and the arch of impulſion is ſhortened by all the ſpace that is deſcribed by the pin while a tooth moves from B to *b*. It ſtops at *a'*.

We are informed by the beſt artiſts, that this ſcapement gives great ſatisfaction, and equals, if it do not excel, Graham's cylindrical ſcapement. It is eaſier made, and requires very little oil on the ſmall cylinder, and none at all on the pallet. They ſay that it is the beſt for pocket watches, and is coming every day more into repute. Theory ſeems to accord with this character. The reſting cylinder may be made very ſmall, and the direct impulſe on the pallet gives it a great ſuperiority over all thoſe already deſcribed, where the action on the pallet is oblique, and therefore much force is loſt by the influence of oil. But we fear that much force is loſt by the tooth B ſhifting its place, and thus ſhortening the arch of impulſion; for we cannot reckon much on the action of B on the ſide of the notch, becauſe the lever is ſo extremely ſhort. Accordingly, all the watches which we have ſeen of this kind have a very ſtrong main ſpring in proportion to the ſize and vibration of the balance. If we leſſen this diminution of the angle of impulſion, by leſſening the cylinder *o p q*, and by not allowing B to penetrate far into the notch, the ſmalleſt inequality of the teeth, or ſhake in the pivots of the balance or wheel, will cauſe irregularity, and even uncertainties in the locking and unlocking the wheel by this cylinder.

A ſcapement exceedingly like this was applied long ago by Dutertre, a French artiſt, to a pendulum. The only difference is, that in the pendulum ſcapement the ſmall cylinder is cut through to the centre, half of it only being left; but the pendulum ſcapement gives a more effective employment of the maintaining power, becauſe the wheel acts on the pallet during the *whole* of the aſſiſted vibration. In a balance ſcapement, if we attempt to diminiſh the inefficient motion of the pin from A to *a*, by leſſening the diameter of the ſmall cylinder, the hold given to the tooth in the notch will be ſo trifling, that the tooth will be thrown out by the ſmalleſt play in the pivot holes, or inequality in the length of the teeth.

With this we conclude our account of ſcapements, where the action of the maintaining power on the balance is ſuſpended during the excurſion beyond the angle of impulſion, by making a tooth reſt on the ſurface of a ſmall concentric cylinder. In ſuch ſcapements, the balance, during its excurſions, is almoſt free from any connection with the wheels, and its iſochroniſm is diſturbed by nothing but the friction on this ſurface.—We come now to ſcapements of more artful conſtruction, in which the balance is really and completely free during the whole of its excurſion, being altogether diſengaged from the wheelwork. Theſe are called DETACHED SCAPEMENTS. They are of more recent date. We believe that Mr Le Roi was the firſt inventor of them, about the year 1748. In the Memoirs of the Academy of Paris for that year, and in the Collection of approved Machines and Inventions, we have deſcriptions of the contrivance. The balance-wheel reſts on a detent, while the balance is vibrating in perfect freedom. It has a pallet ſtanding out from the centre, which, in the courſe of vibration, paſſes cloſe by the point of a tooth of the wheel. At that inſtant a pin, connected with this pallet, withdraws the detent from the wheel, and the tooth juſt now mentioned follows the pallet with rapidity, and gives it a ſmart puſh forward. Immediately after, another tooth of the wheel meets the other claw of the detent, and the wheel is again locked. When the balance returns, the pin puſhes the detent back into its former place, where it again locks the wheel. Then the balance, reſuming its firſt direction, unlocks the wheel, and receives another impulſion from it. Thus the balance is unconnected with the wheels, except while it gets the impulſion, and at the moments of unlocking the wheels.

This contrivance has been reduced to the greateſt poſſible ſimplicity by the Britiſh artiſts, and ſeems ſcarcely capable of farther improvement. The following is one of the moſt approved conſtructions. In fig. 17. *a b c* repreſents the pallet, which is a cylinder of hard ſteel or ſtone, having a notch *a b*. A portion of the balance-wheel is repreſented by AB. It is placed ſo near to the cylinder that the cylinder is no more than clear of *two adjoining* teeth. DE is a long ſpring, ſo fixed to the watch-plate at E, as to preſs very gently on the ſtop pin G. A ſmall ſtud F is fixed to that ſide of the ſpring that is next to the wheel. The tooth of the wheel reſts on this ſtud, in ſuch a manner that the tooth *a* is juſt about to touch the cylinder, and the tooth *f* is juſt clear of it. Another ſpring, extremely ſlender, is attached to the ſpring DE, on the ſide next the balance-wheel, and claps cloſe to it, but keeping clear of the ſtud F, and having its point *o* projecting about $\frac{1}{50}$th of an inch beyond its extremity. When the point *o* is preſſed towards the wheel, it yields moſt readily; but, when preſſed in the oppoſite direction, it carries the ſpring DE along with it. The cylinder being ſo placed on the verge that the edge *a* of the notch is cloſe by the tooth *a*, a hole is drilled at *i*, cloſe by the projecting point of the ſlender ſpring, and a ſmall pin is driven into this hole. This is the whole apparatus; and this ſituation of the parts correſponds to the quieſcent poſition of the balance.

Now, let the balance be turned out of this poſition 80 or 90 degrees, in the direction *a b c*. When it is let go, it returns to this poſition with an accelerated motion. The pin *i* ſtrikes on the projecting point of the ſlender ſpring, and, preſſing the ſtrong ſpring DE outward from the wheel, withdraws the ſtud F from the tooth; and thus unlocks the wheel. The tooth *a* engages in the notch, and urges round the balance. The pin *i* quits the ſlender ſpring before the tooth quits the notch; ſo that when it is clear of the pallet, the wheel is locked again on the ſtud F, and another tooth *g* is now in the place of *a*, ready to act in the ſame manner. When the force of the balance is ſpent, it ſtops, and then returns toward its quieſcent poſition with a motion continually accelerated. The pin *i* arrives at the point *o* of the ſlender ſpring, raiſes it from the ſtrong ſpring without diſturbing the latter, and almoſt without *being* diſturbed by this trifling obſtacle; and it goes on, turning in the direction *a b c*, till its force is again ſpent; it ſtops, returns, again unlocks the wheel, and gets a new impulſion. And in this manner the vibrations are continued. Thus we ſee a vibration, almoſt free, maintained in a manner even more ſimple than the common crutch ſcapement. The impulſe is given direct, without any decompoſition by oblique action, and it is continued through the *whole* motion of the wheel. No part of this motion is loſt, as in Dupleix's ſcapement, by the *gradual* approach of the tooth to its active poſition. Very little force is required for unlocking the wheel, becauſe the ſpring DFE is made ſlender at the remote end E, ſo that it turns round E almoſt like a lever turning on pivots. A ſudden twitch of the watch, in the direction *b a*, might chance to unlock the wheel. But this will only derange one vibration, and even that not conſiderably, becauſe the teeth are ſo cloſe to the cylinder that the wheel cannot advance till the notch comes round to the place of ſcapement. A tooth will continue preſſing on the cylinder, and by its friction will change a little the extent and duration of a ſingle vibration. The greateſt derangement will happen if the wheel ſhould thus unlock by a jolt, while the notch paſſes through the arch of ſcapement in the returning vibration. Even this will not greatly derange it, when the watch is clean and vibrating wide; becauſe, in this poſition, the balance has its greateſt momentum, and the direction of the only jolt that can unlock the wheel tends to increaſe this momentum relatively. In ſhort, conſidering it theoretically, it ſeems an almoſt perfect ſcapement; and the performance of many of theſe watches abundantly confirms that opinion. They are known to keep time for many days together, without varying one ſecond from day to day; and this even under conſiderable variations of the maintaining power. Other detached ſcapements may equal this, but we ſcarcely expect any to exceed it; and its ſimplicity is ſo much ſuperior to any that we have ſeen, that, on this account, we are diſpoſed to give it the preference. We do not mean to ſay that it is the beſt for a pocket watch. Perhaps the ſcapement of Dupleix or Graham may be preferable, as being ſuſceptible of greater ſtrength, and more able to withſtand jolts. Yet it is a fact that ſome of the watches made in this form by Arnold and others have kept time in the wonderful manner abovementioned while carried about in the pocket.

Mr Mudge of London invented, about the year 1763, another detached ſcapement, of a ſtill more ingenious conſtruction. It is a counterpart of Mr Cumming's ſcapement for pendulums. The contrivance is to this effect. In fig. 18. *a b c* repreſents the balance. Its axis is bent into a large crank EFGHIK, ſufficiently roomy to admit within it two other axes M and L, with the proper cocks for receiving their pivots. The three axes form one ſtraight line. About theſe ſmaller axes are coiled two auxiliary ſprings, in oppoſite directions, having their outer extremities fixed in the ſtuds A and B. The balance has its ſpring alſo, as uſual, and the three ſprings are ſo diſpoſed that each of them

Fig 11

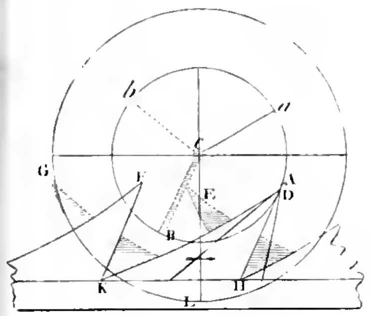


Fig 12

Fig 13

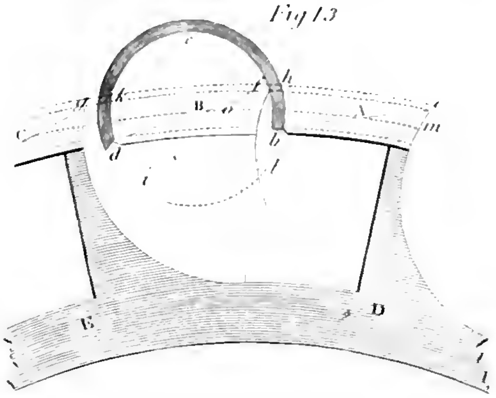
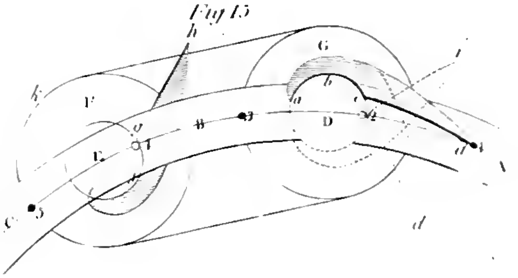


Fig 14.

Fig 15



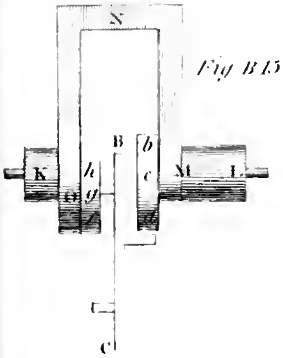


Fig B 15

Fig B 13

Fig C

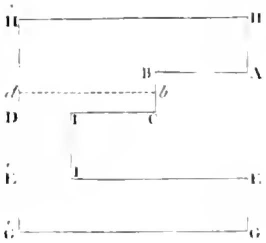


Fig.19

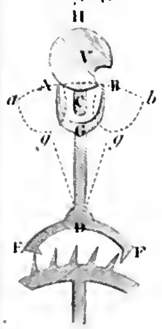


Fig.16.

Fig.17.

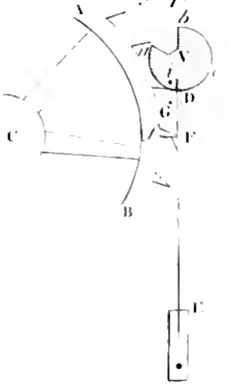
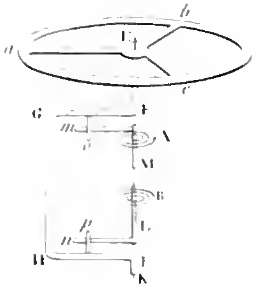


Fig 18



them alone would keep the balance at reſt in the ſame poſition, which we may ſuppoſe to be that repreſented in the figure. The auxiliary ſprings A and B are connected with the balance only occaſionally, by means of the arms *m* and *n* projecting from their reſpective axes. Theſe arms are catched on oppoſite ſides by the pins *o*, *p*, in the branches of the crank; ſo that when the balance turns round, it carries one or other of thoſe arms round with it, and, during this motion, it is affected by the auxiliary ſpring connected with the arm ſo carried round by it.

Let us ſuppoſe that the balance vibrates 120° on each ſide of its quieſcent poſition *a b c*, ſo that the radius E *a* acquires alternately, the poſitions E *b* and E *c*. The auxiliary ſprings are connected with the wheels by a common dead-beat pendulum ſcapement, ſo that each can be ſeparately wound up about 30°, and retained in that poſition. Let us alſo ſuppoſe that the ſpring A has been wound up 30° in the direction *a b*, by the wheel-work, and that the point *a* of the rim of the balance, having come from *c*, is paſſing through *a* with its greateſt velocity. When the radius E *a* has paſſed *a* 30° in its courſe toward *b*, the pin *o* finds the arm *m* in its way, and carries it along with it till *a* gets to *b*. But, by carrying away the arm *m*, it has unlocked the wheel-work, and the ſpring B is now wound up 30° in the other direction, but has no connection with the balance during this operation. Thus the balance finiſhes its ſemivibration *a b* of 120°, oppoſed by its own ſpring the whole way, and by the auxiliary ſpring A through an angle of 90°. It returns to the poſition E *a*, aided by A and by the balance ſpring, through an angle of 120°. In like manner, when E *a* has moved 30° toward the poſition E *c*, the pin *p* meets with the arm *n*, and carries it along with it through an angle of 90, oppoſed by the ſpring B, and then returns to the poſition E *a*, aſſiſted by the ſame ſpring through an arch of 120°.

Thus it appears that the balance is oppoſed by each auxiliary ſpring through an angle of 90°, and aſſiſted through an angle of 120°. This difference of action maintains the vibrations, and the neceſſary winding up of the auxiliary ſprings is performed by the wheel-work, at a time when they are totally diſengaged from the balance. No irregularity of the wheel-work can have any influence on the force of the auxiliary ſprings, and therefore the balance is completely diſengaged from all theſe irregularities, except in the ſhort moment of unlocking the wheel that winds up the ſprings.

This is a moſt ingenious conſtruction, and the neareſt approach to a free vibration that has yet been thought of. It deſerves particular remark that during the whole of the returning or accelerated ſemivibration, the united force of the ſprings is proportional to the diſtance from the quieſcent poſition. The ſame may be ſaid of the retarded excurſion beyond the angle of impulſe: therefore the only deviation of the forces from the law of cycloidal vibration is during the motion from the quieſcent poſition to the meeting with the auxiliary ſpring. Therefore, as the forces, on both ſides, beyond this angle, are in their due proportion, and the balance always makes ſuch excurſions, there ſeems nothing to diſturb the iſochroniſm, whether the vibrations are wide or narrow. Accordingly, the performance of this ſcapement, under the ſevereſt trials, equalled any that were compared with it, in as far as it depended on ſcapement alone. But it is evident that the execution of this ſcapement, though moſt ſimple in principle, muſt always be vaſtly more difficult than the one deſcribed before. There is ſo little room, that the parts muſt be exceedingly ſmall, requiring the moſt accurate workmanſhip. We think that it may be greatly ſimplified, preſerving all its advantages, and that the parts may be made of more than twice their preſent ſize, with even leſs load on the balance from the inertia of matter. This improvement is now carrying into effect by a friend.

Still, however, we do not ſee that this ſcapement is, theoretically, ſuperior to the laſt. The irregularities of maintaining power affect that ſcapement only in the arch of impulſion, where the velocity is great, and the time of action very ſmall. Moreover, the chief effect of the irregularities is only to enlarge the excurſions; and in theſe the wheels have no concern.

Mr Mudge has alſo given another detached ſcapement, which he recommends for pocket watches, and executed entirely to his ſatisfaction in one made for the Queen. A dead beat pendulum ſcapement is interpoſed, as in the laſt, between the wheels and the balance. The crutch EDF (fig. 19.) has a third arm DG, ſtanding outwards from the meeting of the other two, and of twice their length. This arm terminates in a fork AGB. The verge V has a pallet C, which, when all is at reſt, would ſtand between the points A, B of the fork. But the wheel, by its action on the pallet E, forces the fork into the poſition B *g b*, the point A of the fork being now where B was before, juſt touching the cylindrical ſurface of the verge. The ſcapement of the crutch EDF is not accurately a dead beat ſcapement, but has a very ſmall recoil beyond the angle of impulſion. By this circumſtance the branch A (now at B) is made to preſs moſt gently on the cylinder, and keeps the wheel locked, while the balance is going round in the direction BHA. The point A gets moving from A to B by means of a notch in the cylinder, which turns round at the ſame time by the action of the branch AG on the pallet C; but A does not touch the cylinder during this motion, the notch leaving free room for its paſſage. When the balance returns from its excurſion, the pallet C ſtrikes on the branch A (ſtill at B), and unlocks the wheel. This now acting on the crutch pallet F, cauſes the branch *b* of the fork to follow the pallet C, and give it a ſtrong impulſe in the direction in which it is then moving, cauſing the balance to make a ſemivibration in the direction AHB. The fork is now in the ſituation A *g a*, ſimilar to B *g b*, and the wheel is again locked on the crutch pallet E.

The intelligent reader will admit this to be a very ſteady and effective ſcapement. The lockage of the wheel is procured in a very ingenious manner; and the friction on the cylinder, neceſſary for effecting this, may be made as ſmall as we pleaſe, notwithſtanding a very ſtrong action of the wheel: For the preſſure of the fork on the cylinder depends entirely on the degree of recoil that is formed on the pallets E and F. *Preſſure* on the cylinder is not *indiſpenſably* neceſſary, and the crutch ſcapement might be a real dead beat. But a ſmall recoil, by keeping the fork in contact with the cylinder, gives the moſt perfect ſteadineſs to the motion. The ingenious inventor, a man of approved integrity and judgment, declares that her Majeſty's watch was the beſt pocket watch he had ever ſeen. We are not diſpoſed to queſtion its excellency. We ſaw an experiment watch of this conſtruction, made by a country artiſt, having a balance ſo heavy as to vibrate only twice in a ſecond. Every vibration was ſenſibly beyond a turn and a half, or 540°. The artiſt aſſured us, that when its proper balance was in, vibrating ſomewhat more than five times in a ſecond, the vibrations even exceeded this. He had procured it this great mobility by ſubſtituting a roller with fine pivots in place of the ſimple pallet of Mudge. This great extent of detached vibration is an unqueſtionable excellence, and is peculiar to thoſe two ſcapements of this ingenious artiſt.

Very ingenious ſcapements have been made by Ernſhaw, Howel, Hayley, and other Britiſh artiſts; and many by the artiſts of Paris and Geneva. But we muſt conclude the article, having deſcribed all that have any difference in principle.

The ſcapement having been brought to this degree of perfection, we have an opportunity of making experiments on the law of action of ſprings, which has been too readily aſſumed. We think it eaſy to demonſtrate, that the figure of a ſpring, which muſt have a great extent of rapid motion, will have a conſiderable influence on the force which it impreſſes on a balance in *actual motion*. The accurate determination of this influence is not very difficult in ſome ſimple caſes. It is the greateſt of all in the plane ſpiral, and the leaſt in the cylindrical; and in this laſt form, it is ſo much leſs as the diameter is leſs, the length of the ſpring being the ſame. By employing many turns, in order to have the ſame ultimate force at the extremity of the excurſion, this influence is increaſed. A particular length of ſpring, therefore, will make it equal to a given quantity; and it may thus compenſate for a particular magnitude of friction, and other obſtructions. This accounts for the obſervation of Le Roy, who found that every ſpring, *when applied to a movement*, had a certain length, which made the wide and narrow vibrations iſochronous. His method of trial was ſo judicious, that there can be no doubt of the juſtneſs of his concluſion. His time-keeper had no fuzee; and when the laſt revolution of the main wheel was going on, the vibrations were but of half the extent of thoſe made during the firſt revolution. Without minding the real rate of going, he only compared the duration of the firſt and laſt revolution of the minute hand. An artiſt of our acquaintance repeated theſe experiments, and with the ſame reſult: But, unfortunately, could derive little benefit from them; becauſe in one ſtate of the oil, or with one balance, he found the lengths of the ſame ſpring, which produced iſochronous vibrations, were different from thoſe which had this effect in another ſtate of the oil, or with another balance. He alſo obſerved another difference in the rate, ariſing from a difference of poſition, according as XII, VI, III, or IX, was uppermoſt; which difference plainly ariſes from the ſwagging of the ſpring by its weight, and, in that ſtate, acting as a pendulum. This unluckily put a ſtop to his attempts to leſſen this hurtful influence by employing a cylindrical ſpiral of ſmall diameter and great length.

WATEHOO, an iſland in the South Pacific Ocean; a beautiful ſpot, about 6 miles long and 4 broad. N. lat. 20 1, W. long. 158 15 —*Morſe*.

WATER-Blowing Machine, called in French *Soufflet d'eau* or *trompe*, is a machine which, by the action of falling water, ſupplies air to a blaſt furnace. It conſiſts of an upright pipe, through which a ſhower of water is made to fall; and this ſhower carries down with it a maſs of air, which is received beneath in a kind of tub, and conducted to the furnace by means of a pipe. The firſt idea of ſuch a machine was doubtleſs ſuggeſted by thoſe local winds, which are always produced by natural falls of water over precipices, and in the mountains (ſee page 577 of volume II.); but perhaps we are indebted for the firſt accurate theory of it to Profeſſor Venturi.

That philoſopher in his experimental reſearches concerning the lateral communication of motion in fluids, proves that the water blowing machine affords air to the furnace, by the accelerating force of gravity and the lateral communication of motion combined together. He begins with an idea, which, he candidly acknowledges, did not eſcape the penetration of Leonardo Da Vinci. Suppoſe a number of equal balls to move in contact with each other along the horizontal line AB (Plate XLVI. fig. 1.). Imagine them to paſs with an uniform motion, at the rate of four balls in a ſecond. Let us take BF, equal to 16 feet Engliſh. During each ſecond four balls will fall from B to F, and their reſpective diſtances in falling will be nearly BC = 1, CD, = 3, DE = 5, EF = 7. We have here a very evident repreſentation of the ſeparation, and ſucceſſive elongation, which the accelerating force of gravity produces between bodies which fall after each other.

The rain water flows out of gutters by a continued current; but during its fall it ſeparates into portions in the vertical direction, and ſtrikes the pavement with diſtinct blows. The water likewiſe divides, and is ſcattered in the horizontal direction. The ſtream which iſſues out of the gutter may be one inch in diameter, and ſtrike the pavement over the ſpace of one foot. The air which exiſts between the vertical and horizontal ſeparations of the water which falls, is impelled and carried downwards. Other air ſucceeds laterally; and in this manner a current of air or wind is produced round the place ſtruck by the water. Hence the following idea of a water-blowing machine:

Let BCDE (fig. 2.) repreſent a pipe, through which the water of a canal AB falls into the lower receiver MN. The ſides of the tube have openings all round, through which the air freely enters to ſupply what the water carries down in its fall. This mixture of water and air proceeds to ſtrike a maſs of ſtone Q; whence rebounding through the whole width of the receiver MN, the water ſeparates from the air, and falls to the bottom at XZ, whence it is diſcharged into the lower channel or drain, by one or more openings TV. The air being leſs heavy than the water, occupies the upper part of the receiver; whence being urged through the upper pipe O, it is conveyed to the forge.

It has been ſuppoſed by ſome eminent chemiſts, that the air which paſſes through the pipe O is furniſhed by the decompoſition of water. To aſcertain whether this be the caſe or not, our author formed a water-blowing engine of a ſmall ſize. The pipe BD was two inches in diameter, and four feet in height. When the water accurately filled the ſection BC, and all the lateral openings of the pipe BDEC were cloſed, the pipe O no longer offered any wind. It is therefore evident, that in the open pipes the whole of the wind comes from the atmoſphere, and no portion is afforded by the decompoſition of water. It remains, therefore, to determine the circumſtances proper to drive into the receiver MN the greateſt quantity of air, and to meaſure that quantity.

1. To obtain the greateſt effect from the acceleration of gravity, it is neceſſary that the water ſhould begin to fall at BC, (fig. 2) with the leaſt poſſible velocity; and that the height of the water FB ſhould be no more than is neceſſary to fill the ſection BC. Our author ſuppoſes the vertical velocity of this ſection to be produced by an height or head equal to BC.

2. We do not yet know, by direct experiment, the diſtance to which the lateral communication of motion between water and air can extend itſelf; but we may admit with confidence, that it can take place in a ſection double that of the original ſection with which the water enters the pipe. Let us ſuppoſe the ſection of the pipe BDEC to be double the ſection of the water at BC; and, in order that the ſtream of fluid may extend and divide itſelf through the whole double ſection of the pipe, ſome bars, or a grate, are placed in BC, to diſtribute and ſcatter the water through the whole internal part of the pipe.

3. Since the air is required to move in the pipe O with a certain velocity, it muſt be compreſſed in the receiver. This compreſſion will be proportioned to the ſum of the accelerations, which ſhall have been deſtroyed in the inferior part KD of the pipe. Taking KD $= 1,5$ feet, we ſhall have a preſſure ſufficient to give the requiſite velocity in the pipe O. The ſides of the portion KD, as well as thoſe of the receiver MN, muſt be exactly cloſed in every part.

4. The lateral openings in the remaining part of the pipe BK may be ſo diſpoſed and multiplied, particularly at the upper part, that the air may have free acceſs within the tube. We will ſuppoſe them to be ſuch that 0,1 foot height of water might be ſufficient to give the neceſſary velocity to the air at its introduction through the apertures.

All theſe conditions being attended to, and ſuppoſing the pipe BD to be cylindrical, it is required to determine the quantity of air which paſſes in a given time through the circular ſection KL. Let us take in feet $KB = 1,5$; $BC = BF = a$; $BD = b$. By the common theory of falling bodies, the velocity in KL will be $7,76 \surd (a + b - 1,4)$; the circular ſection $KL = 0,785 a^2$. Admitting the air in KL to have acquired the ſame velocity as the water, the quantity of the mixture of the water and air which paſſes in a ſecond through KL is $= 6, 1 a^2 \surd (a + b - 1.4)$. We muſt deduct from the quantity $(a + b - 1,4)$ that height which anſwers to the velocity the water muſt loſe by that portion of velocity which it communicates to the air laterally introduced; but this quantity is ſo ſmall that it may be neglected in the calculation. The water which paſſes in the ſame time of one ſecond through BC is $= 0,4 a^2 \surd (a + 0,1)$. Conſequently, the quantity of air which paſſes in one ſecond through KL, will be $= 6, 1 a^2 \surd (a + b - 1,4) - 0,4 a^2 \surd (a + 0,1)$, taking the air itſelf, even in its ordinary ſtate of compreſſion, under the weight of the atmoſphere. It will be proper, in practical applications, to deduct one-fourth from this quantity; 1. On account of the ſhocks which the ſcattered water ſuſtains againſt the inferior part of the tube, which deprive it of part of its motion; and, 2. Becauſe it muſt happen that the air in LK will not, in all its parts, have acquired the ſame velocity as the water.

If the pipe O do not diſcharge the whole quantity of air afforded by the fall, the water will deſcend at XZ; the point K will riſe in the pipe, the afflux of air will diminiſh, and part of the wind will iſſue out of the lower lateral apertures of the pipe BK.

We ſhall not here examine the greater or leſs degree of perfection of the different forms of water-blowing machines which are uſed at various iron forges; ſuch as thoſe of the Catalans, and elſewhere. Theſe points may be eaſily determined from the principles here laid down, compared with thoſe eſtabliſhed in the articles *Resistance of Fluids (Encycl.)*, and Dynamics (*Supplement*).

WATERBOROUGH, a townſhip of the Diſtrict of Maine, York county, on Mouſom river, 15 miles N. W. of Wells, and 110 from Boſton. It was incorporated in 1787, and contains 905 inhabitants.—*Morſe.*

WATERBURY, a townſhip of Vermont, in Chittenden county, ſeparated from Duxbury on the ſouth-weſt by Onion river. It contains 93 inhabitants.—*ib.*

Waterbury, the north-weſternmoſt townſhip of New-Haven county, Connecticut, called by the Indians *Matteluck*. It was ſettled in 1671, and is divided into the pariſhes of Northbury, Salem, and South-Britain.—*ib.*

WATEREE, a branch of Santee river, South Carolina.—*ib.*

WATERFORD, a plantation in Cumberland county, Diſtrict of Maine, ſouth-eaſt of Orangeton, or Greenland.—*ib.*

Waterford, a new townſhip in York county, Diſtrict of Maine, incorporated February, 1797, formerly a part of Waterborough.—*ib.*

Waterford, a townſhip of New Jerſey, in Glouceſter county.—*ib.*

Waterford, a neat village of New York, in the townſhip of Half Moon.—*ib.*

WATERLAND, an iſland in the South Pacific Ocean, ſo named by Le Maire. S. lat. 14 46, weſt long. 144 10.—*ib.*

WATERQUECHIE, or *Quechy*, a ſmall river of Vermont, which empties into Connecticut river in Hartland.—*ib.*

WATERTOWN, a very pleaſant town in Middleſex county, Maſſachuſetts, 7 miles weſt by north-weſt of Boſton. Charles river is navigable for boats to this town, 7 miles from its mouth in Boſton harbour. The townſhip contains 1091 inhabitants, and was incorporated in 1630. That celebrated apoſtle of the Indians, the Rev. Mr Eliot, relates that in the year 1670, a ſtrange phenomenon appeared in a great pond at Watertown, where the fiſh all died; and as many as could, thruſt themſelves on ſhore, and there died. It was eſtimated that not leſs than 20 cart-loads lay dead at once round the pond. An eel was found alive in the ſandy border of the pond, and upon being caſt again into its natural element, it wriggled out again, as faſt as it could, and died on the ſhore. The cattle, accuſtomed to the water, refuſed to drink it for 3 days, after which they drank as uſual. When the fiſh began to come aſhore, before they died, many were taken both by Engliſh and Indians and eaten without any injury.—*ib.*

Watertown, a townſhip in Litchfield county, Connecticut. It is about 26 miles N. N. W. of New-Haven.—*ib.*

WATER VLIET, an extenſive townſhip of New-York, Albany county, on the weſt ſide of Hudſon's river, and includes the village of Hamilton, and the iſlands in the river neareſt the weſt ſide. It is bounded weſt by the manor of Renſſelaerwyck, and contained, in 1790, 7,419 inhabitants, including 707 ſlaves. In 1796, there were 600 of the inhabitants qualified electors.—*ib.*

WATLAND *Iſland*, one of the Bahama Iſlands in the Weſt-Indies. The S. point is in lat. 24 N. and long. 74 weſt.—*ib.*

WATSON, *Fort*, in S. Carolina, was ſituated on the N. E. bank of Santee river, about half way between the mouth of the Congaree and Nelſon's Fort, on the bend of the river oppoſite the Eutaw Springs. Its garriſon of 114 men being beſieged by Gen. Greene, ſurrendered in April, 1781. He then marched with his main force againſt Camden higher up the river.—*ib.*

WAUKEAGUE, a village in the townſhip of Sullivan, in the Diſtrict of Maine, 9 miles from Deſert Iſland.—*ib.*

WAWASINK, a village in New-York, on Rondout Kill, a branch of Wallkill, 7 miles weſt of New Paltz, and 12 ſouth-weſt of Eſopus.—*ib.*

WAWIACHTANOS, and *Twightwees*, two Indian tribes, reſiding chiefly between Sciota and Wabaſh rivers.—*ib.*

WAYNE, a new county in the N. W. Territory, laid out in the fall of 1796, including the ſettlements of Detroit and Michillimakkinak.—*ib.*

Wayne, a county of Newbern diſtrict, N. Carolina; bounded N. by Edgcombe, and S. by Glaſgow. It contains 6,133 inhabitants, incluſive of 1,537 ſlaves.—*ib.*

Wayne, a townſhip of Pennſylvania, ſituated in Mifflin county.—*ib.*

Wayne, *Fort*, in the N. W. Territory, is ſituated at the head of the Miami of the Lake, near the Old Miami Villages, at the confluence of St Joſeph's and St Mary's rivers. It is a ſquare fort with baſtions at each angle, with a ditch and parapet, and could contain 500 men, but has only 300 with 16 pieces of cannon. It is 150 miles north by weſt of Cincinnati, and 200 weſt by ſouth of Fort Defiance. The Indians ceded to the United States a tract of land 6 miles ſquare, where this fort ſtands, at the late treaty of peace at Greenville.—*ib.*

WAYNESBOROUGH, a poſt-town of N. Carolina, 24 miles from Kingſton, 50 S. E. from Raleigh, and 498 from Philadelphia.—*ib.*

Waynesborough, a poſt-town in Burk county, Georgia, 30 miles ſouth of Auguſta, 25 north-eaſt of Louiſville. No river of conſequence paſſes near this town; yet being the place where both the ſuperior and inferior courts are held, it is in a proſperous condition.—*ib.*

WEARE, a townſhip of New-Hampſhire, ſituated in Hillſborough county, 18 miles ſouth-weſterly of Concord, 60 weſt of Portſmouth, and 70 north-weſt of Boſton. It was incorporated in 1764, and contains 1924 inhabitants.—*ib.*

WEATHERSFIELD, a townſhip of Vermont, Windſor county, on the weſt ſide of Connecticut river, between Windſor on the north, and Springfield on the ſouth. Aſcutney Mountain lies partly in this townſhip, and in that of Windſor. It is a flouriſhing town, and contains 1097 inhabitants.—*ib.*

Weathersfield, a poſt-town of Connecticut, pleaſantly ſituated in Hartford county, on the weſt ſide of Connecticut river, 4 miles S. of Hartford, 11 N. of Middleton, 36 N. by E. of New-Haven, and 218 N. E. of Philadelphia. This town was ſettled in 1635 or 1636, by emigrants from Dorcheſter in Maſſachuſetts, and has a fertile and luxuriant ſoil. It conſiſts of between 200 and 300 houſes, and has a very elegant brick meeting-houſe for Congregationaliſts. The inhabitants are generally wealthy farmers; and beſides the common productions of the country, raiſe great quantities of onions, which are exported to different parts of the United States, and to the Weſt-Indies.—*ib.*

WEATHERFORD's *Place*, *Charles*, an Indian houſe and plantation of that name, on the eaſtern ſide of Alabama river, above M'Gillivray's ſiſter's place, and a good way below the junction of Tallapooſee and Cooſa rivers.—*ib.*

WEAUCTENEAU *Towns*, Indian villages on Wabaſh river, deſtroyed by Generals Scott and Wilkinſon in 1791.—*ib.*

WEAUS, or *Weeas*, an Indian tribe whoſe towns lie on the head waters of Wabaſh river. At the treaty of Greenville they ceded a tract of land, 6 miles ſquare, to the United States.—*ib.*

WEAVER's *Lake*, in the State of New-York, is 3 miles north-weſt of Lake Otſego. It is 2 miles long and 1½ broad.—*ib.*

WEAVING (ſee *Encycl.*) is an operation, which, by means of a well known inſtrument called the *weaving-loom*, has hitherto been performed by bodily labour. That labour is pretty ſevere; and Mr Robert Millar, an ingenious calico-printer in the county of Dumbarton, Scotland, wiſhing to leſſen it, invented, ſome years ago, a weaving-loom, which may be wrought by water, ſteam, horſes, or any other power. For his invention he received a patent, dated June 26th 1796; and though truth compels us to ſay, that we do not think it likely to emulate the ſpinning machine of Arkwright, it is ſufficiently ingenious to deſerve notice in a Work of this kind. The following is his own deſcription of his patent weaving-loom:

Fig. 1. (Plate L.) repreſents a ſide view of the loom, AA, BB, CC, DD, being the frame. *a* is an axis (which we ſhall call the ſpindle) acroſs the frame. On this axis is a ſheeve *b*, two inches thick, having a groove round it, two inches deep, and half an inch wide. The bottom of this groove is circular, except in one part *c*, where it is filled up to the top; a lever *d* reſts on the bottom of this groove, and is lifted up by it when the elevation *c* comes round to the ſituation repreſented in the figure. By this motion, the lever *d* acts on the ratchet-wheel *e* by the catch *f*, and draws it forward one tooth, each revolution of the ſheeve. This ratchet wheel is in an iron frame *gg*, which alſo pro-

perly carries the two catches *t* and *u*, which are connected with it at *v*. The catch *u* holds the ratchet-wheel in its poſition, while the lever *d* and the catch *t*, are moved by the groove *c* in the ſheeve. On the arbor of the ratchet is a ſmall pinion *h*, working in the wheel *f*; this wheel is fixed on the end of the roller *e* of fig. 3. On the ſide of the ſheeve *b* is fixed a wiper *k*, which lifts the treadle *l*. This treadle turns on its joints in the ſheeve E, which is fixed to the ſide of the frame A and D; it is kept preſſing on the bottom of the groove in the ſheeve by a ſpring *m*, fixed to the frame ſide A, and having a ſlender rod *n* from its extremity, joining it with the treadle at *l*. From the point of the treadle there goes a belt *o*, which paſſes over the pulley *p*, which is ſeen edgewiſe in this figure, and is joined to the top of the fly pin *q*, of fig. 2. At the end of the frame A is the ſhort poſt F; on this reſts the yarn beam *j*, having a ſheeve *r*, over which paſſes a cord, having a weight *s* ſuſpended to it. The other end of this cord is faſtened to the ſpring *v*; the weight cauſes the yarn-beam to ſtretch the web from the ratchet wheel *e*, with its catch *u*; and the ſpring *v* allows the rope to ſlide on the ſheeve as the ratchet is drawn round during the working.

Fig. 2. is a front view of the loom. *a a* is the ſpindle which carries the ſheeve *b*, and the wipers *d* and *d*, which move the treadles *w*, *w*, of fig. 1. Theſe uſe the treadles of the headles, with which they are connected by cords from the ſhafts of the headles *s*, *s*. From the upper ſhaft there go two leathern belts *f*, *f*, to the roller *y*, furniſhed each with a buckle, for tightening them at pleaſure. The two wipers *c*, *c*, on the ſhaft *a*, which ſerve for taking back the lay, have the two treadles *x*, *x*, in fig. 3. with a belt from each paſſing over the roller *h* 2 of fig. 1. and fixed to the ſword of the lay. From the ſwords of the lay forward is fixed a belt to each end of the roller *i*; from this roller there goes a cord to the ſpring *j*, which ſerves for taking forward the lay which is hinged on the rocking tree *t*. The ſtar-wheel *b* of fig. 3. and the ſheeve *b* of fig. 1. are fixed to the oppoſite ends of the ſpindle *a* without the frame; and both the wheel and ſheeve have a wiper *k* fixed to them for moving the treadles. In order to drive the ſhuttle, the belts *o*, *o*, go from the points of the treadles, over the pulleys *p*, *p*, to the top of the fly-pin *q*: This turns on a pin joint in a rail *r*, which goes acroſs the loom. From its lower end there go two ſmall cords to the ſhuttle drivers *g*, *g*, which ſlide on the iron rods *n*, *n*. A long iron rod *v* goes acroſs the lay, and is hung on two centres at the ends. In this rod *v* are fixed two ſmall crooked wires *w*, *w*, which are more diſtinctly marked in the little figure *w* above, which repreſents a ſection of the lay. The dot at the lower end of the wire *w*, in this figure, is the ſection of the rod *v*. The ſhuttle paſſes between theſe wires and the lay every ſhot, and lifts them up, cauſing the rod *v* to turn round a little. But if the ſhuttle ſhould not paſs theſe wires, nor lift them, it would be drawn home by the lay, and deſtroy the web. To prevent this, there is fixed on one end of the rod *v* a ſtout crooked wire *z*, having a broad or flat head, which naturally reſts on a plate of iron, marked and fixed to the back of the lay. This plate has a ſlit in its middle about an inch deep. In this ſlit reſts the rod *a* 2 of fig. 3. on which is a ſhort ſtud, which is caught by the wire *z* when the wire *w* is not lifted back by the paſſing ſhuttle. This will ſtop the lay from coming home, and will ſet off the loom.

Fig. 3. is another ſide-view of the loom oppoſite to fig. 1. On the ſpindle *a* is the ſtar-wheel *b*, on the outſide of the loom-frame, on the arms of which wheel is fixed the wiper *k*, as the ſimilar wiper is fixed to the ſheeves on the other end of the ſpindle. The wipers which drive the ſhuttles are fixed on oppoſite ſquares of the ſpindle, and work alternately. Below the ſtar-wheel is a pinion *c*, which is on a round ſpindle, turned by the water-wheel, by means of a wheel on this ſpindle. In a wheel on this ſpindle are two ſtuds, on which the pinion *c* ſlides off and on as the loom is ſet off and on by the lever *d*. At the farther end of this lever is the weight *s*, hanging by a cord which paſſes over a pulley *t*, fixed at the outer end of the ſpring-catch on which the lever *d* reſts; and thus the loom is drawn in at the upper end of the lever *d*. But when the ſhuttle does not lift the wire *z*, it catches on the ſtud on the rod *a z*, which is connected with the ſpring-catch, and the lever *d* flies off with the weight *s*, and the loom ſtops working. On the head of the poſt F is the yarn-beam. The rollers *e* and *f* are cylinders, preſſed together by a ſcrew-lever, and take away the cloth between them at a proper rate. In the roller *f* is a groove for a band for driving the roller *g*, on which the cloth winds itſelf as it is wrought. Wherever ſprings are mentioned to be uſed in the above deſcription, weights may be uſed in their ſtead, and to the ſame effect, and more eſpecially upon the treadle of fig. 1. for driving the ſhuttle.

WEBHAMET *River*, in the Diſtrict of Maine, is the principal entrance by water to the town of Wells, in York county. It has a barred harbour.—*Morſe.*

WECHQUETANK, a Moravian ſettlement made by the United Brethren, in Pennſylvania, behind the Blue Mountains. In 1760, the Bethlehem congregation purchaſed 1400 acres of land for the Chriſtian Indians. In 1763, it was deſtroyed by white ſavages, who inhabited near Lancaſter; they likewiſe murdered many of the peaceable Indians ſettled here. It was finally deſtroyed by the Americans during the late war. It lies about 30 miles north-weſt by weſt of Bethlehem.—*ib.*

WEIGHTS and Measures, in commerce, are ſo various, not only in different countries, but even in different provinces of the ſame country, and this variation is the ſource of ſo much inconveniency in trade, that writers on political and commercial economy have propoſed various methods for fixing an univerſal and immoveable ſtandard of weights and meaſures for all ages and nations. Sir James Stewart Denham's ſpeculations on this ſubject have been noticed in his life publiſhed in this *Supplement*; Mr Whitehurſt's ingenious contrivance for eſtabliſhing a ſtandard of weights and meaſures has been mentioned under the title Measure (*Encycl.*); and the new table of weights and meaſures, which the French republicans wiſh to impoſe upon all Europe, is given (*Encycl.*) under the title Revolution, nº 183.

As theſe meaſures occur frequently, even in Engliſh tranſlations of French books of value, we ſhall here give ſuch an account of them as may enable the reader to reduce them with eaſe to the Engliſh ſtandards. They

They are of five kinds; *meaſures of length, of capacity, of weight, of ſuperficies for land, and of wood for fuel.* For every kind, there are many meaſures of different ſizes, one of which has been taken as the baſis of all the reſt, and its name aſſumed as the root of their names. Thus METRE is called the principal meaſure of length; LITRE, of capacity; GRAMME, of weight; ARE, of ſuperficies of land; and STERE, of wood for fuel. Theſe words being the radical terms of the names of other meaſures of length, capacity, &c. a relation is hereby preſerved between the names.

The meaſures of length above the *metre*, are ten times, a hundred times, a thouſand times, ten thouſand times, greater than the metre. The meaſures of length below the metre, are ten times, a hundred times, a thouſand times, leſs. To form the names of theſe meaſures, other words which indicate the relations of *ten times*, a *hundred times*, greater; and of *ten times*, a *hundred times*, leſs, &c. are placed before the word *metre*. The ſame annexes have been uſed to form the names of meaſures, greater or leſs, than the *litre*, the *gramme*, &c. It is neceſſary, therefore, to ſtate in this place the Engliſh equivalents of only the *metre*, the *litre*, the *gramme*, the *are*, and the *ſtere*.

The METRE = 3.28084 feet Engliſh.

The LITRE = 61.0243 cubic inches, or $1\frac{101}{141}$ pint ale meaſure.

The GRAMME, or cubic *centi-metre* of water, at the freezing point, = $\frac{1}{454}$ lb. averd. or $\frac{1}{28}$ of an ounce, or $\frac{16}{25}$ of a dram nearly.

The ARE = $1076\frac{2}{5}$ ſquare feet, or $119\frac{3}{5}$ ſquare yards, or $\frac{1}{40}$ of an acre nearly.

The STERE, or cubic metre = 35.31467 cubic feet.

The moſt part of the Engliſh, not chooſing to adopt the weights and meaſures preſcribed to them by the French Convention and the National Inſtitute, Sir George Shuckburgh Evelyn, Bart. turned his attention to this ſubject, and publiſhed, in the Philoſophical Tranſactions for 1798, an account of ſome endeavours to aſcertain a ſtandard of weights and meaſures. The principles upon which he proceeded are the ſame with Mr Whitehurſt's; but he has carried his experiments much farther than his predeceſſor, and ſeems to have conducted them with greater accuracy. His memoir is hardly ſuſceptible of abridgment; and our limits do not permit us to inſert it entire. This is indeed unneceſſary, if it be true, as another ingenious gentleman alleges*, that we are in the actual poſſeſſion, and the conſtant uſe, of a ſtandard both for weight and meaſure, as invariable as that now uſed in France. This ſtandard he finds in the foot meaſure, and in the avoirdupoſe, or, as he thinks it ought to be called, the *decade* ounce weight.

The decade ounce weight of pure rain, or diſtilled water, at 60° of heat, is generally allowed to be equal in bulk to the one thouſandth part of the cubic foot. Were 44 3511 parts out of 10000, or about $\frac{1}{23}$th part added to the preſent Wincheſter buſhel, that buſhel would then contain exactly 10 cubic feet or 10000 oz. of diſtilled water, at 60° of heat.

Our author then gives comparative tables between this ſyſtem and that which is now eſtabliſhed in France. Taking the metre at 3 French feet, and 11.296 lines †, and the French foot to be to the Engliſh as 1 : 1.065752004 ‡, one French foot will be equal to 10 65752004 Engliſh decades, or tenths of an Engliſh foot: hence he calculates the following

COMPARATIVE TABLES, Engliſh with French.

LONG MEASURE.

Long decade.	Metre.	Metre.	Long decades.
1 =	0.03047983 ferè	1 =	32 808583358, &c. or inches 39 3703.

SQUARE MEASURE.

Square decades.	Ares,	Ares.	Square decades.
1 =	0 000092902 ferè	1 =	107640.3142, or ſqr. inch. 155002.052448

CUBE MEASURE.

Cube decades.	Litres.	Litre.	Cube decades.
1 =	0 02831637 ferè	1 =	35.3152622, &c. or cub. inch. 61.0247727

WEIGHTS.

Avoird. or decade oz.	Grammes.	Gramme.	Decade oz.
1 =	28.31637 ferè	1 =	0.03531526, &c. or grains, 15.45042625

$$\left.\begin{array}{c}\text{Long,}\\ \text{Square,}\\ \text{or}\\ \text{Cube,}\end{array}\right\}\text{decades are reduced to}\left\{\begin{array}{c}\text{Long}\\ \text{Square,}\\ \text{or}\\ \text{Cube,}\end{array}\right\}\begin{array}{c}\text{English}\\ \text{inches by}\\ \text{multiply-}\\ \text{ing by}\end{array}\left\{\begin{array}{c}1.2\\ 1.44\\ 1.728\end{array}\right.$$

and decade ounces are reduced to grains.

$$\text{containing}\left\{\begin{array}{c}7000,\\ \text{or}\\ 5760,\end{array}\right\}\text{to the lb.}\left\{\begin{array}{c}\text{Avoird.}\\ \\ \text{Troy,}\end{array}\right\}\text{by}$$

multiplying the ounce by 437.5 = the number of grains in an avoirdupoiſe ounce.

Our author, who ſeems to have paid much attention to weights and meaſures, obſerves, that a ſtandard meaſure for the purpoſes of trade, in particular, as well as for others, that would uniformly give an accurate reſult, and could be eaſily made, examined, and aſcertained, by common mechanics, which neither our preſent liquid nor dry meaſures evidently can, would ſurely be an acquiſition of great value. Such an one, he preſumes, would be the following: A ſquare pyramid, whoſe perpendicular height is exactly thrice the length of the ſide of the baſe: for ſuch an one, and every ſection of it, made by a plane parallel to its baſe, would, in the firſt inſtance, poſſeſs, and, in every ſubdiviſion, retain theſe remarkable properties.

1ſt, Similar comparative dimenſions to thoſe above given, for the original pyramid, *i. e.* every ſmaller pyramid, formed by the above-mentioned parallel ſection, would have its perpendicular height thrice the length of the ſide of its baſe; and,

2dly, The length of the ſide of each baſe will always indicate, or equal the cube root of the ſolid content of the pyramid; *e. g.* If the length of the ſide of the baſe be 3, the ſolid content will be the cube of 3, *viz.* 3 × 3 × 3 = 27.

We do not perceive very clearly the great value of this ſtandard; but Mr Goodwyn ſays, that he has been many years in the habit of uſing a pyramid meaſure to examine corn; and is perfectly convinced that ſuch a one will indicate a far more accurate reſult than can ariſe

* H. Goodwin Eſq; in *Nicholſon's Journal*, vol. iv. p. 103, &c.

† *Journal de Phyſ.* vol. v. p. 460.

‡ *Phil. Tranſ.* 1768, p. 326. and *Connoiſſance des Temps*, 1795.

WEAVING LOOM, PLATE L.

Fig. 1.

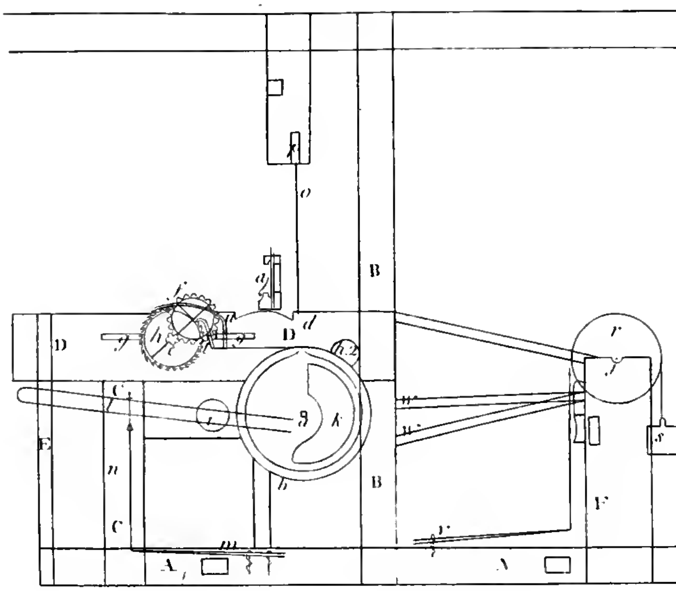
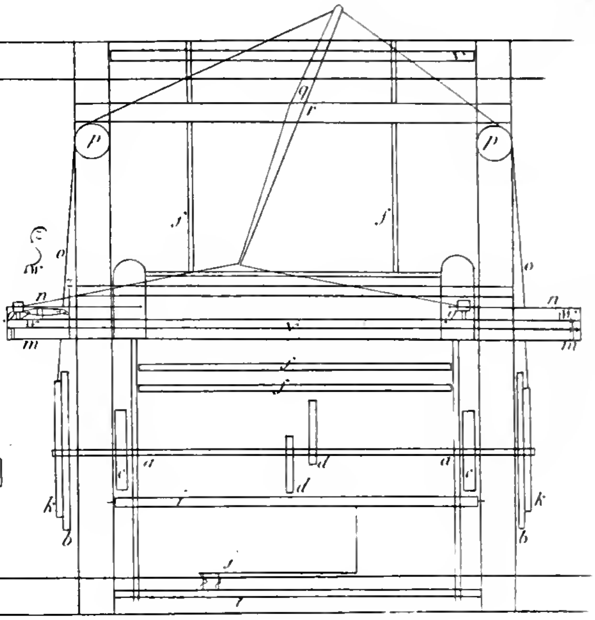
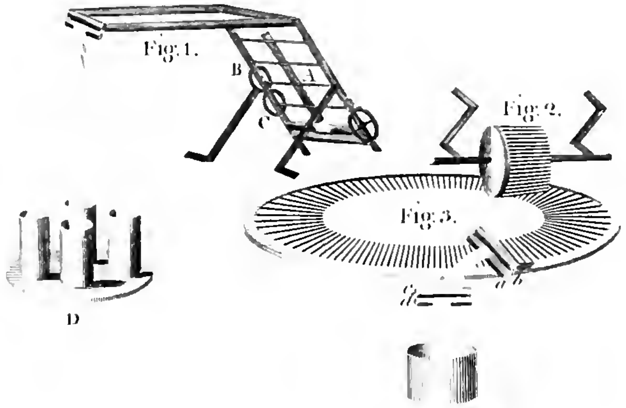
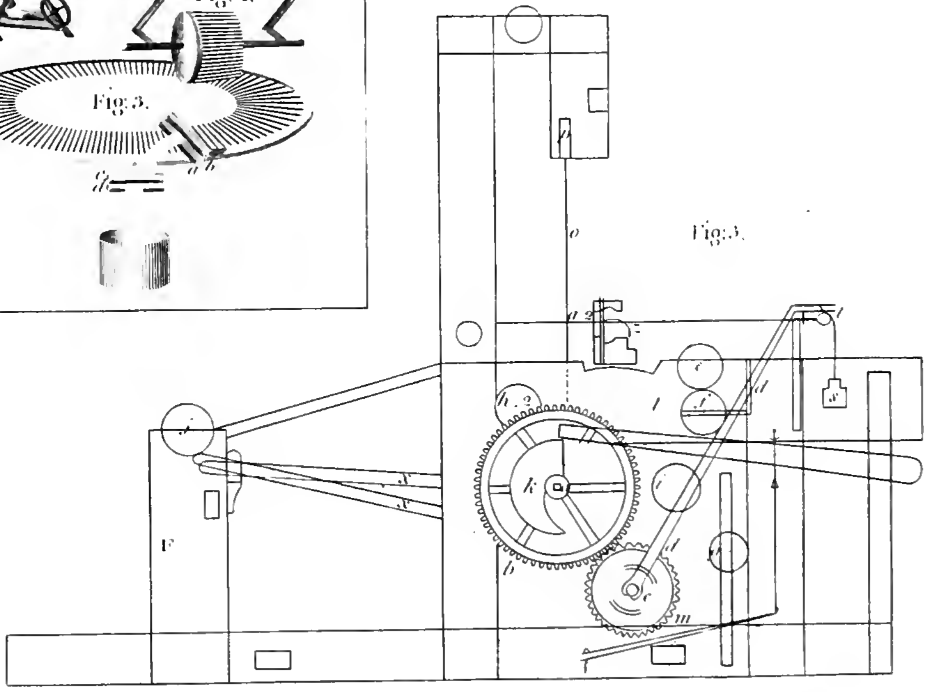


Fig. 2.



WOOL-COMBING





ariſe from the manner in which corn is meaſured by the buſhel. This we are bound to believe ; for it is abſurd to oppoſe theories to a fact aſcertained by experience.

WEISENBERG, a townſhip of Pennſylvania, in Northampton county.—*Morſe*.

WELCH *Mountains*, are ſituated in Cheſter county, Pennſylvania. Beſides other ſtreams, Brandywine Creek riſes here.—*ib*.

Welch *Tract*, a ſmall territory of Pennſylvania, ſo named becauſe firſt ſettled by Welchmen. There are a number of ſmall towns in it, as Haverford-Weſt, Merioneth, &c. It is pretty thickly inhabited by an induſtrious, hardy and thriving people.—*ib*.

WELCOME, *Sir Thomas Roes*, or *Ne Ultra*, a bay or ſtrait in that part of Hudſon's Bay which runs up to the N. round from Cape Southampton, opening between lat. 62 and 63 N. On the weſt or north ſhore is a fair head land called the Hope by Captain Middleton, in lat. 66 30 N.—*ib*.

WELLFLEET, a townſhip of Maſſachuſetts, in Barnſtable county, ſituated on the peninſula called Cape Cod ; S. E. from Boſton, diſtant by land 105 miles, by water 60, and from Plymouth light-houſe 8 leagues. The harbour is large, indented within with creeks, where veſſels of 70 or 80 tons may lie ſafe in what is called the Deep Hole. The land is barren, and its timber is ſmall pitch-pine and oak. Before it was incorporated in 1763, it was called the *North Precinct of Eaſtham*, and was originally included in the Indian *Skeekeet* and *Pamet*. In 1790, it contained 1117 inhabitants. Since the memory of people now living, there have been in this ſmall town 30 pair of twins, beſides two births that produced three each. The method of killing gulls in the gull-houſe, is no doubt an Indian invention, and alſo that of killing birds and fowl upon the beach in dark nights. The gull-houſe is built with crotches fixed in the ground on the beach, and covered with poles, the ſides being covered with ſtakes and ſea weed, and the poles on the top covered with lean whale. The man being placed within, is not diſcovered by the fowls, and while they are contending for and eating the fiſh, he draws them in one by one between the poles, until he has collected 40 or 50. This number has often been taken in a morning. The method of killing ſmall birds and fowl that perch on the beach, is by making a light ; the preſent mode is with hogs lard in a frying-pan ; but the Indians are ſuppoſed to have uſed a pine torch. Birds, in a dark night, will flock to the light, and may be killed with a walking-cane. It muſt be curious to a countryman who lives at a diſtance from the ſea, to be acquainted with the method of killing black-fiſh. Their ſize is from 4 to 5 tons weight, when full grown. When they come within the harbours, boats ſurround them, and they are as eaſily driven on ſhore, as cattle or ſheep are driven on the land. The tide leaves them, and they are eaſily killed. They are a fiſh of the whale kind, and will average a barrel of oil each : 400 have been ſeen at one time on the ſhore. Of late years theſe fiſh rarely come into the harbours.—*ib*.

WELLS, a ſmall, but rapid river of Vermont, which, after a ſhort S. E. courſe, empties into Connecticut river, below the Narrows, and in the N. E. corner of Newbury. Its mouth is 40 yards wide.—*ib*.

Wells, a townſhip of Vermont, Rutland county, between Pawlet and Poultney, and contains 622 inhabitants. Lake St Auſtin lies in this townſhip, and is 3 miles long, and 1 broad.—*ib*.

Wells, a poſt-town of the Diſtrict of Maine, in York county, ſituated on the bay of its name, about half way between Biddeford and York, and 88 miles N. by E. of Boſton, and 441 from Philadelphia. This townſhip is about 10 miles long, and 7 broad ; was incorporated in 1653, and contains 3,070 inhabitants. It is bounded S. E. by that part of the ſea called Wells Bay, and N. E. by Kennebunk river, which ſeparates it from Arundel. The ſmall river Negunket, perhaps formerly Oguntiquit, has no navigation, nor mills of any value, but noticed, about 150 years ago, as the boundary between York and Wells. The tide through Piſcataqua bay urges itſelf into the marſhes at Wells, a few miles E. of Negunket, and forms a harbour for ſmall veſſels. Further E. in this townſhip the ſmall river Mouſom is found coming from ponds of that name about 20 miles from the ſea. Several mills are upon the river, and the inhabitants are opening a harbour by means of a canal. Webhamet river is the principal entrance to this town by water.—*ib*.

Wells *Bay*, in the townſhip above mentioned, lies between Capes Porpoiſe and Neddock. The courſe from the latter to Wells Bar, is N. by E. 4 leagues.—*ib*.

Well's *Falls*, in Delaware river, lie 13 miles N. W. of Trenton, in New-Jerſey.—*ib*.

WENDELL, a townſhip of Maſſachuſetts, in Hampſhire county, 80 miles N. W. of Boſton. It was incorporated in 1781, and contains 519 inhabitants.—*ib*.

Wendell, a townſhip of New Hampſhire, Cheſhire county, about 15 miles N. E. of Charleſtown, containing 267 inhabitants. It was called Saville, before its incorporation in 1781.—*ib*.

WENHAM, a townſhip of Maſſachuſetts, Eſſex county, between Ipſwich and Beverly ; 26 miles N. E. by N. of Boſton. It was incorporated in 1643, and contains 502 inhabitants. Here is a large pond, well ſtored with fiſh, from which, and its vicinity to Salem, it was, with whimſical piety, called *Enon*, by the firſt ſettlers.—*ib*.

WENMAN, one of the Gallipago Iſlands, on the coaſt of Peru, ſituated W. of Cape Franciſco.—*ib*.

WENTWORTH, a townſhip of New Hampſhire, Grafton county, containing 241 inhabitants. It was incorporated in 1766, and is S. E. of Oxford, adjoining.—*ib*.

WESEL, a village of New-Jerſey, Eſſex county, on Paſaic river, 2 miles north-weſtward of Acquakenunk, and 5 weſtward of Hakkenſack.—*ib*.

WEST, or *Wantaſtiquek*, a river of Vermont, has its main ſource in Bromley, about 3 miles S. E. from the head of Otter Creek. After receiving 7 or 8 ſmaller ſtreams, and running about 37 miles, it falls into Connecticut river at Brattleborough. It is the largeſt of the ſtreams on the eaſt ſide of the Green Mountains ; and at its mouth is about 15 rods wide, and 10 or 12 feet deep. A number of figures, or inſcriptions, are yet to be ſeen upon the rocks at the mouth of this river, ſeeming to allude to the affairs of war among the Indians ; but their rudeneſs and awkwardneſs denote that the formers of them were at a great remove from the knowledge of any alphabet.—*ib*.

WEST RIVER *Mountain*, in New Hampſhire, in the townſhip of Cheſterfield, lies oppoſite to the mouth of Weſt river; and from this part of Connecticut river to Piſcataqua Harbour on the eaſt is 90 miles, the broadeſt part of the State. Here are viſible appearances of volcanic eruptions. About the year 1730, the garriſon of Fort Dummer, 4 miles diſtant, was alarmed with frequent exploſions of fire and ſmoke, emitted by the mountain. Similar appearances have been obſerved ſince.—*ib.*

WEST *Bay*, a large bay of Lake Superior, at its weſternmoſt extremity, having the 12 iſles at its mouth. It receives St Louis river from the weſt.—*ib.*

WEST BETHLEHEM, a townſhip of Waſhington county, Pennſylvania.—*ib.*

WESTBOROUGH, a townſhip of Maſſachuſetts, Worceſter county, 34 miles weſt-ſouth-weſt of Boſton, and 13 eaſt of Worceſter, was incorporated in 1717. Among other ſingular occurrences in the Indian wars, the ſtrange fortune of Silas and Timothy Rice is worthy of notice. They were ſons of Mr Edmond Rice, one of the firſt ſettlers in this town, and carried off by the Indians on Auguſt 8, 1704, the one 9 the other 7 years of age. They loſt their mother tongue, had Indian wives, and children by them, and lived at *Cagnawaga*. Silas was named *Tookanowras*, and Timothy, *Oughtſorongoughton*. Timothy recommended himſelf ſo much to the Indians by his penetration, courage, ſtrength, and warlike ſpirit, that he arrived to be the third of the ſix chiefs of the *Cagnawagas*. In 1740 he came down to ſee his friends. He viewed the houſe where Mr Rice dwelt, and the place from whence he with the other children were captivated, of both which he retained a clear remembrance; as he did likewiſe of ſeveral elderly perſons who were then living, though he had forgot the Engliſh language. He returned to Canada, and, it is ſaid, he was the chief who made the ſpeech to Gen. Gage, in behalf of the Cagnawagas, after the reduction of Montreal. Theſe men were alive in 1790.—*ib.*

WEST *Camp*, a thriving village of New York, containing about 60 houſes, in Columbia county, on the eaſt ſide of Hudſon's river, 7 miles above Red Hook, and 13 north of New York city.—*ib.*

WEST-CHESTER, a county of New York; bounded north by Dutcheſs county, ſouth by Long-Iſland Sound, weſt by Hudſon's river, and eaſt by the State of Connecticut. It includes Captain's Iſlands and all the iſlands in the ſound, to the eaſt of Frogs Neck, and to the northward of the main channel. In 1790, it contained 24,003 inhabitants, including 1419 ſlaves. In 1796, there were, in its 21 townſhips, 3,243 of the inhabitants qualified electors.—*ib.*

WEST-CHESTER, the chief townſhip of the above county; lying partly on the Sound, about 15 miles eaſterly of New York city. It was much impoveriſhed in the late war, and contains 1203 inhabitants; of whom 164 are electors, and 242 ſlaves.—*ib.*

WEST CHESTER, the chief town of Cheſter county, Pennſylvania, containing about 50 houſes, a court-houſe, ſtone gaol, and a Roman Catholic church. It is about 25 miles weſt of Philadelphia.—*ib.*

WESTERLY, a poſt-town on the ſea coaſt of Waſhington county, Rhode-Iſland, and ſeparated from Stonington in Connecticut by Paucatuck river, 36 miles weſt by ſouth of Newport, and 256 from Philadelphia. The inhabitants carry on a briſk coaſting trade, and are extenſively engaged in the fiſheries. The townſhip contains 2,298 inhabitants, of whom 10 are ſlaves.—*ib.*

WESTERN, a townſhip of Maſſachuſetts, ſituated in the ſouth-weſt corner of Worceſter county, 18 miles eaſt by north of Springfield, 29 in the ſame direction from Worceſter, and 73 ſouth-weſt by ſouth of Boſton.—*ib.*

WESTERN, *Fort*, in the Diſtrict of Maine, was erected in 1752, on the eaſt bank of the ſmall fall which terminates the navigation of Kennebeck river. It is 18 miles from Taconnet Fall. It is in the townſhip of Harwington, Lincoln county. A company was incorporated in February 1796, to build a bridge over the river at this place.—*ib.*

WESTERN *Precinct*, in Somerſet county, New-Jerſey, contains 1,875 inhabitants, including 317 ſlaves.—*ib.*

WESTFIELD, a townſhip of Vermont, Orleans county, ſouth of Jay.—*ib.*

WESTFIELD, a pleaſant poſt-town of Maſſachuſetts, Hampſhire county, on the river of this name, in a curious vale, 10 miles weſt of Springfield, 34 eaſt of Stockbridge, 52 ſouth-weſt of Worceſter, 105 weſt-ſouth-weſt of Boſton, and 260 from Philadelphia. It contains a Congregational church, an academy, and about 50 or 60 compact houſes. The townſhip was incorporated in 1669, and contains 2,204 inhabitants.—*ib.*

WESTFIELD, a ſmall river of Maſſachuſetts, which riſes in Berkſhire county, and runs nearly a ſouth-eaſt courſe through Middlefield, Weſtfield, and Weſt-Springfield, where it empties into the Connecticut, by a mouth about 30 yards wide.—*ib.*

WESTFIELD, a townſhip of New York, Waſhington county, bounded ſoutherly by Kingſbury, and northerly by Whitehall. It contains 2,103 inhabitants, of whom 186 are electors, and 9 ſlaves. It lies near Lake George.—*ib.*

WESTFIELD, in Richmond county, New York, is bounded northerly by the Freſh Kill, eaſterly by Southfield, and weſterly by the Sound. It contains 1151 inhabitants, of whom 131 are electors, and 276 ſlaves.—*ib.*

WESTFIELD, a ſmall town in Eſſex county, New Jerſey, containing a Preſbyterian church, and about 40 compact houſes. It is about 7 or 8 miles W. of Elizabeth-Town.—*ib.*

WESTFORD, a townſhip of Vermont, in Chittenden county, N. E. of Colcheſter, adjoining, and contains 63 inhabitants.—*ib.*

WESTFORD, a townſhip of Maſſachuſetts, ſituated in Middleſex county, 28 miles N. W. of Boſton, and contains 1229 inhabitants. In the year 1792, an academy was eſtabliſhed here.—*ib.*

WEST-GREENWICH, a townſhip in Kent county, Rhode-Iſland, containing 2,054 inhabitants, including 10 ſlaves.—*ib.*

WESTHAM, a ſmall town of Virginia, Henrico county, on the N. bank of James's river, 6 miles N. W. by W. of Richmond. Here Benedict Arnold deſtroyed one of the fineſt founderies for cannon in America, and a large quantity of ſtores and cannon, in January, 1781.—*ib.*

WESTHAMPTON, a townſhip of Maſſachuſetts, Hampſhire county, 7 miles weſterly of Northampton, and 109 S. W. by W. of Boſton. It contains 683 inhabitants,

bitants, and lies on the W. ſide of Connecticut river. —*ib.*

WEST *Harbour*, on the S. coaſt of the iſland of Jamaica, is to the N. of Portland Point. There is good anchorage, but expoſed to S. and S. E. winds.—*ib.*

WEST-HAVEN, a pariſh of the townſhip of New-Haven, in Connecticut, pleaſantly ſituated on the Harbour and Sound, 3 miles W. S. W. of the city.—*ib.*

WESTMINSTER, a townſhip of Maſſachuſetts, ſituated in Worceſter county, was granted to thoſe who did ſervice in the Narraganſet war, or their heirs, in 1728, and was then ſtyled *Narraganſet, No.* 2. It was incorporated by its preſent name in 1759; and contains 20,000 acres of land, well watered. It is ſituated on the height of land between the rivers Merrimack and Connecticut, having ſtreams ariſing in the town, and running into both. It is about 55 miles from Boſton to the north of weſt, and about 22 miles north from Worceſter, and contains 177 dwelling-houſes, and 1176 inhabitants.—*ib.*

WESTMINSTER, a conſiderable townſhip of Vermont, in Windham county, on Connecticut river, oppoſite Walpole in New Hampſhire. It contains 1601 inhabitants. Sexton's river enters the Connecticut in the S. E. corner of the townſhip. Here is a poſt-office 18 miles north of Brattleborough, 18 north-weſt of Keen, in New Hampſhire, 59 north of Northampton in Maſſachuſetts, and 329 north-eaſt of Philadelphia.—*ib.*

WESTMINSTER, the eaſternmoſt town of Frederick county, Maryland, about 18 miles E. N. E. of Woodſborough, 26 north-weſt of Baltimore, and 47 N. by E. of the city of Waſhington.—*ib.*

WESTMORE, the weſternmoſt townſhip of Eſſex county, Vermont. Willoughby Lake lies in this townſhip.—*ib.*

WESTMORELAND, a county of Virginia, bounded north and eaſt by Patowmack river, which divides it from Maryland, ſouth-eaſt by Northumberland, ſouth-weſt by Richmond, and weſt by King George. It contains 7722 inhabitants, of whom 4425 are ſlaves. This county has the honour of having given birth to George Waſhington, firſt Preſident of the United States. The court-houſe in this county is on the ſouth bank of Patowmack river, 10 miles N. by E. of Richmond, 16 north-weſt of Kinſale, and 289 ſouth-weſt by ſouth of Philadelphia. Here is a poſt-office.—*ib.*

WESTMORELAND, a county of Pennſylvania, bounded north by Lycoming, and ſouth by Fayette county, and abounds with iron ore and coal. It contains 11 townſhips and 16,018 inhabitants, including 128 ſlaves. Chief town, Greenſburg.—*ib.*

WESTMORELAND, a conſiderable townſhip of New Hampſhire, Cheſhire county, on the eaſtern bank of Connecticut river, between Cheſterfield and Walpole, 110 miles from Portſmouth. It was incorporated in 1752, and contains 2,018 inhabitants.—*ib.*

WESTMORELAND, a townſhip of New-York, in Herkemer county, taken from Whiteſtown, and incorporated in 1792. In 1796, it contained 840 inhabitants, of whom 137 were electors. The centre of the town is 6 miles ſouth of Fort Schuyler, and 36 north weſt of Cooperſtown.—*ib.*

WESTMORELAND, a tract of land in Pennſylvania, bounded eaſt by Delaware river, weſt by a line drawn due north and ſouth 15 miles weſt of Wyoming on Suſquehannah river, and between the parallels of 41 and 40 degrees of north lat. was claimed by the State of Connecticut, as within the limits of their original charter, and in 1754 was purchaſed of the Six Nations of Indians by the Suſquehannah and Delaware companies, and afterwards ſettled by a conſiderable colony, under the juriſdiction of Connecticut. This tract was called *Weſtmoreland*, and annexed to the county of Litchfield in Connecticut. The Pennſylvanians diſputed the claim of Connecticut to theſe lands, and in the progreſs of this buſineſs there was much warm contention and ſome bloodſhed. This unhappy diſpute has ſince been adjuſted.—*ib.*

WESTON, a townſhip of Maſſachuſetts, in Middleſex county, 15 miles weſt of Boſton. It was incorporated in 1712, and contains 1,010 inhabitants. —*ib.*

WESTON, a townſhip of Connecticut, Fairfield county, north of Fairfield, adjoining —*ib.*

WEST-POINT, a ſtrong fortreſs erected during the revolution, on the W. bank of Hudſon's river, in the ſtate of New York, 6 miles above Anthony's Noſe, 7 below Fiſh Kill, 22 S. of Poughkeepſie, and about 60 N. of New York city. It is ſituated in the midſt of the high lands, and is ſtrongly fortified by nature as well as art. The principal fort is ſituated on a point of land, formed by a ſudden bend in the river, and commands it, for a conſiderable diſtance, above and below. Fort Putnam is ſituated a little further back, on an eminence which overlooks the other fort, and commands a greater extent of the river. There are a number of houſes and barracks on the point near the forts. On the oppoſite ſide of the river, are the ruins of Old Fort Conſtitution, with ſome barracks going to decay. A number of continental troops are ſtationed here to guard the arſenal and ſtores of the United States, which are kept at this place. This fortreſs is called the Gibraltar of America, as by reaſon of the rocky ridges, riſing one behind another, it is incapable of being inveſted by leſs than 20,000 men. The fate of America ſeemed to hover over this place. It was taken by the Britiſh, and afterwards retaken by ſtorm, in a very gallant manner, by Gen. Wayne. Benedict Arnold, to whom the important charge of this fort was committed, deſigned to have ſurrendered it up to the Britiſh; but Providenee diſappointed the treaſonable deſign, by the moſt ſimple means. Major Andre, a moſt accompliſhed and gallant officer, was taken, tried, and executed as a ſpy, and Arnold eſcaped. Thus the Britiſh exchanged one of their beſt officers, for one of the worſt men in the American army.—*ib.*

WESTPORT, a flouriſhing townſhip of Maſſachuſetts, Briſtol county, 70 miles ſoutherly of Boſton. It was incorporated in 1787, and contains 2,466 inhabitants.—*ib.*

WESTRINGIA, a new genus of plants deſcribed by J. E. Smith, M. D. preſident of the Linnæan Society of London. It was firſt diſcovered in New Holland by Dr Solander, who called it *Cunila Fruticoſa*, though it is totally different from the CUNILA (ſee that article, *Encycl.*), and more reſembles roſemary, from which, however, it is likewiſe different. Its peculiar character is: *Calyx ſemiquinquefidus, pentagonus; corolla reſupinata, limbo quadrifido, lobo longiore erecto, bipartito: Stamina diſtantia, duo breviora (inferiora) abortiva.* Dr

Smith aſſigns it rather to the *didynamia-angioſpermia*, placing it immediately after the *Teucrium*, than to the *diandria* claſs of plants.

WEST-SPRINGFIELD, a townſhip of Maſſachuſetts, Hampſhire county, on the W. ſide of Connecticut river, oppoſite Springfield, about 28 miles N. of Hartford, and 100 W. S. W. of Boſton. In the compact part are about 40 dwelling-houſes, and a Congregational church. The townſhip contains 3 pariſhes, and 2,367 inhabitants.—*Morſe.*

WEST-STOCKBRIDGE, a townſhip of Maſſachuſetts, in Berkſhire county, adjoining Stockbridge on the weſt, and has the New York line on the north-weſt, and lies 150 miles from Boſton. William's river, and its ſtreams water the townſhip, and accommodate 3 iron-works, a fulling-mill, a griſt-mill, and 2 ſaw-mills.—*ib.*

WEST-TOWN, a townſhip in Cheſter county, Pennſylvania.—*ib.*

WEYBRIDGE, a townſhip of Vermont, in Addiſon county, ſeparated from New-Haven on the N. and E. by Otter Creek. It contains 175 inhabitants. Snake Mountain lies nearly on the line between this townſhip and that of Addiſon on the weſt.—*ib.*

WEYMOUTH, the *Weſſaguſcus*, or *Waſſaguſſet*, of the Indians, a townſhip of Maſſachuſetts, Norfolk county, incorporated in 1635. It lies 14 miles S. E. of Boſton, and employs ſome ſmall veſſels in the mackarel fiſhery. Fore river on the N. W. and Back river on the S. E. include near one half of the townſhip. The cheeſe made here is reckoned among the beſt brought to Boſton market. It is ſaid to be one of the oldeſt towns in the ſtate; Mr Weſton, an Engliſh merchant, having made a temporary ſettlement here in the ſummer 1622. It contains 232 houſes, and 1469 inhabitants.—*ib.*

WHALE COVE *Iſland*, in the northern part of N. America, is the moſt northerly of two iſlands lying to the S. of Brook Cobham, or Marble Iſland, which is in lat. 63 N. Lovegrove, the other iſland, has a fair opening to the weſt of it.—*ib.*

WHALE FISH *Iſland*, in the river Eſſequibo, on the coaſt of S. America, is above the Seven Brothers, or Seven Iſlands, and below the Three Brothers.—*ib.*

WHALE *Iſland*, at the mouth of M'Kenzie's river, in the North Sea or Frozen Ocean, on the north coaſt of the north-weſtern part of North America. N. lat. 69 14.—*ib.*

WHAPPING'S *Creek*, a ſmall creek which empties through the eaſt bank of Hudſon's river, in the townſhip of Fiſh Kill, 8 miles ſouth of Poughkeepſie, and 72 north of New York city. Here are two mills, at which conſiderable buſineſs is performed.—*ib.*

WHARTON, a townſhip of Fayette county, Pennſylvania.—*ib.*

WHATELY, a townſhip of Maſſachuſetts, in Hampſhire county, 10 miles north of Northampton, and 105 miles from Boſton. It was incorporated in 1771, and contains 736 inhabitants.—*ib.*

WHEAT (ſee TRITICUM, *Encycl.*) has for ſome years paſt been at ſo very high a price, that every hint for increaſing its quantity or improving its quality is intitled to notice. In the Leiceſter Journal for the 6th of December 1799, there is an ingenious paper on the ſubject of tranſplanting wheat, as a means of providing againſt the expected ſcarcity of that neceſſary of life. It is recommended "to ſow, in dry land, at the uſual ſeaſon, as much corn as may be deemed neceſſary to plant in the ſpring any number of acres which may be occupied with that article in the following year. When the ſoil is prepared, a furrow is to be made with a very ſmall plough and one horſe, in the centre of the ridge or land, returning back in the ſame track (this time only of every ridge); then turn towards the left hand, and plough another furrow, about eight or nine inches from the firſt furrow, turning always to the left hand, till the whole ridge is finiſhed; it will then be formed into trenches, in parallel lines of about eight or nine inches aſunder, and imitate what gardeners term drawing of drills. In theſe furrows the plants are to be laid." Mr John Ainſworth of Glen, the experienced author of this communication, ſays he has practiſed this method with the moſt complete ſucceſs.

It has been likewiſe practiſed, on a ſmall ſcale, with equal ſucceſs, but we know not in what county. About the end of Auguſt 1783, that gentleman threw a ſmall quantity of wheat, which near two years before had been ſteeped and limed (ſee WHEAT, *Encycl.*) into an unmanured corner of his garden. In the beginning of February following he had a piece of ground (alſo unmanured) dug in an open part of his orchard, and he tranſplanted it on beds of ſix rows wide, at nine inches aſunder every way. It tillered, and ſpread over the ground ſo completely, as to prevent even a weed growing among it. It produced admirable corn, and at the rate of near four quarters per acre.

From accurate calculations which he then made, he found that an acre, ſuppoſing the ſeed to be very good, and the plants ſet at the diſtance above menttioned, would require only *half a peck* of ſeed.

Beſides the ſaving of the ſeed, there are two other material advantages which attend ſuch a method; one is, that ſome ſuitable crop may be on the ground all the winter for uſe; and the other is, that ploughing the ground ſo late as February, will effectually bury and deſtroy thoſe weeds which were beginning to vegetate; and before others can ſpring up, the corn plants have taken to the ground, and ſo ſpread over it that the weeds cannot riſe, by which means there is a very clean crop, and all the cuſtomary expenſe for weeding is ſaved.

This author ſeems to think that wheat will thrive as well, and produce as full a crop, when ſown in the ſpring, as if it had been committed to the ground in the preceding autumn. In the ſouthern counties of England we doubt not but it may; but the caſe is otherwiſe in Scotland, where the ſpring is not ſo early, and where from the narrowneſs of the iſland, the froſt is ſeldom ſo ſevere. We agree, however, with Dr Pike, in thinking it a pity that the way of ſetting wheat (as done in Norfolk and Suffolk) is not every where more general. The proceſs is indeed tedious and troubleſome; and we have often wondered that, among the numberleſs machines lately contrived to leſſen manual labour, none has been invented for dibbling wheat expeditiouſly and accurately. We are therefore pleaſed to learn, that Dr Pike himſelf has turned his attention to the ſubject, and hopes in the courſe of this year (1800) to preſent the public with a *method of ſetting wheat at* PERFECTLY EXACT *diſtances through a whole field, and as* EXPEDITIOUSLY *as the common broadcaſt ſowing, which can therefore be applied to farms of any magnitude;*

nitude; and when a peck of ſeed is found to be ſufficient for an acre (and in ſome land much leſs), the ſaving on a large farm muſt be immenſe. We truſt to the liberality of his profeſſion, that he will not take out a patent for his invention.

Though we have elſewhere given the uſual recipes for preventing ſmut in wheat, it would be improper to conclude this article without mentioning the very ſimple one which Mr Wagſtaffe of Norwich has uniformly found attended with complete ſucceſs. This conſiſts in nothing more than immerſing the ſeed in pure water, and repeatedly ſcouring it therein, juſt before it is ſown or dibbled in the ſoil. Whether well, ſpring, or river water be uſed, is indifferent; but repeated ſtirring and change of water is eſſential to remove the particles of infection that may have imperceptibly adhered to the ſeeds thus purified. The ſubſequent crop will be perfect in itſelf, and its ſeeds, he ſays, ſucceſſively ſo likewiſe, if there are no adjacent fields from whence this contamination may be wafted. He recommends the ſame waſhing, and for the ſame reaſon, of barley and oats before they be ſown.

WHEELING, or *Wheelin*, a poſt-town of Virginia, ſituated at the mouth of a creek on the eaſt bank of Ohio river, 10 miles above Grave Creek, 18 ſouth-weſt of Weſt Liberty, and 61 ſouth-weſt of Pittſburg. Not far from this place, a wall has been diſcovered ſome feet under the earth, very regularly built, apparently the work of art. It is 363 miles from Philadelphia.—*Morſe.*

WHEELOCK, a townſhip of Vermont, in Caledonia county, about 20 miles north-weſt of Littleton, and contains 33 inhabitants.—*ib.*

WHETSTONE *Fort* is on the north ſide of Patapſco river, and weſt ſide of the mouth of Baltimore Harbour, in Maryland. It is oppoſite Goſſuch Point, 2½ miles eaſterly from the Baltimore Company's iron-works, at the mouth of Gwinns Falls.—*ib.*

WHIPPANY, a village of New Jerſey, Morris county, on a branch of Paſſaick river, nearly 5 miles N. E. of Morriſtown.—*ib.*

WHIRL, or *Suck*, in Tenneſſee river, lies in about lat. 35 N.—*ib.*

WHITE, a river or torrent iſſuing from the mountain of ſulphur in the iſland of Guadaloupe, in the Weſt-Indies. It is thus named as often aſſuming a white colour from the aſhes and ſulphur covering it. It empties into the river St Louis.—*ib.*

White, a river of Louiſiana, which joins Arkanſas river, a water of the Miſſiſſippi, about 10 miles above the fort, which Mr Hutchins reckons 550 computed miles from New-Orleans, and 660 from the ſea. It has been navigated above 200 miles in flat-bottomed boats.—*ib.*

White, a ſmall river of the N. W. Territory, which purſues a north-weſt, and, near its mouth, a weſterly courſe, and enters Wabaſh river, 12 miles below the mouth of Chickaſaw river.—*ib.*

White, a river of Vermont, which falls into Connecticut river about 5 miles below Dartmouth college, between Norwich and Hartford. It is from 100 to 150 yards wide, ſome diſtance from its mouth. Its ſource is in a ſpring, which by means of Onion river, communicates with Lake Champlain. It derives its name from the whiteneſs of its water.—*ib.*

White *Cape*, or *Blanco*, on the weſt coaſt of New Mexico, is 20 leagues to the north-weſt of Herradura. This cape, in lat. 10 N. bears with the iſland Canoe, at north-weſt by weſt and S. E. by E. and with St Luke Iſland at N. E. by N. and ſouth-weſt by ſouth, being about 9 leagues from each.—*ib.*

White *Deer*, a townſhip of Pennſylvania, ſituated on Suſquehannah river.—*ib.*

WHITEFIELD, a townſhip of Pennſylvania, in Weſtmoreland county.—*ib.*

WHITE *Ground*, a place in the Creek country, 10 miles from Little Tallaſſee.—*ib.*

WHITEHALL, a townſhip of Pennſylvania, in Northampton county.—*ib.*

Whitehall, a townſhip of New York, Waſhington county, bounded ſoutherly by the S. bounds of the tract formerly called Skeenſborough, and northerly by the N. bounds of the county. In 1790, it contained 805 inhabitants. In 1796, 150 of the inhabitants were electors.—*ib.*

WHITE MARSH, a townſhip of Pennſylvania, Montgomery county.—*ib.*

WHITEPAINE, a townſhip of Pennſylvania, Montgomery county.—*ib.*

WHITE PLAINS, a townſhip of New York, Weſt-Cheſter county, bounded eaſterly by Mamaroneck river, and weſterly by Bronx river. It contains 505 inhabitants, of whom 76 are electors, and 49 ſlaves. It is remarkable for a battle fought here between the American and Britiſh forces, on the 28th of October, 1776. It is 15 miles E. by N. of Kingſbridge, 30 N. E. by N. of New York, and 125 from Philadelphia.—*ib.*

WHITE *Point*, in the iſland of Jamaica, lies eaſtward of White Horſe Cliffs, about 7 leagues E. of Port Royal.—*ib.*

WHITE'S *Bay*, on the coaſt of Newfoundland. N. lat. 50 17, W. long. 56 15.—*ib.*

WHITESTOWN, in Herkemer county, New York, on the ſouth ſide of Mohawk river, 4 miles weſt of Old Fort Schuyler, and 100 weſt of Albany. The compact part of this new and flouriſhing town lies on one beautiful ſtreet, about a mile in length, ornamented with trees. The houſes are generally furniſhed with water, conducted by pipes laid under ground, from the neighbouring hills. At preſent the court-houſe, meeting-houſe, and ſchool-houſe, are combined in one building; but it is contemplated ſhortly to erect ſeparate and handſome edifices for theſe ſeveral purpoſes. The ſoil of this town is remarkably good. Nine acres of wheat in one field, yielded, on an average, 41 buſhels of wheat, of 60 lb. each, an acre. This is no uncommon crop. This town and its neighbourhood has been ſettled with remarkable rapidity. All that diſtrict comprehended between the Oneida Reſervation, and the German Flats, and which is now divided into the townſhips of Whiteſtown, Paris, and Weſtmoreland, was known, a few years ſince, by the name of *Whiteſtown*, and no longer ago than 1785, contained two families only, thoſe of Hugh White, and Moſes Foot, eſquires. In 1796, there were within the ſame limits, 6 pariſhes, with as many ſettled miniſters, 3 full regiments of militia, 1 corps of light-horſe, all in uniform. In the whole, 7359 inhabitants, of whom 1190 were qualified electors.—*ib.*

WHITING, a townſhip of Vermont, in Addiſon county, ſeparated from Leiceſter on the E. by Otter Creek, and has part of Orwell on the W. It contains 250 inhabitants.—*ib.*

WHITTINGHAM, a townſhip of Vermont, in the ſouth-weſt corner of Windham county, containing 442 inhabitants.—*ib.*

WHITSUN *Iſland*, in the South Pacific Ocean, is about 4 miles long, and 3 broad; and ſo ſurrounded by breakers that a boat cannot land. S. lat. 19 26, W. long. 137 56. Variation of the needle in 1767, 6° E.—*ib.*

WIANDOTS, or *Wyandots*, an Indian tribe inhabiting near Fort St Joſeph, and Detroit, in the N. W. Territory. Warriors, 200.—*ib.*

WIAPOCO, or *Little Wia*, is an outlet or arm of the river Oroonoko, on the weſt ſide. It has many branches, which are all navigable.—*ib.*

WICKFORD, a ſmall trading village in the townſhip of North Kingſtown, Rhode-Iſland, and on the W. ſide of Narraganſet-Bay; 24 miles S. of Providence, and 9 or 10 N. W. of Newport.—*ib.*

WIESPINCAN, a river of Louiſiana, which empties into the Miſſiſſippi, 22 miles above the Soutoux village.—*ib.*

WICOMICO, a ſmall river of Maryland, which riſes in Suſſex county, Delaware, and empties into Fiſhing-Bay, on the eaſt ſhore of Cheſapeak Bay.—*ib.*

WIGHCOMICO, a ſhort navigable river of Maryland, which is formed by Piles and Allen's Freſh, and, running ſouthward, empties into the Patowmac, about 35 miles from its mouth. Cob Neck forms the north limit of its mouth.—*ib.*

WILBRAHAM, a townſhip of Maſſachuſetts, in Hampſhire county, 10 miles E. of Springfield, 30 N. E. of Hartford in Connecticut, and 89 S. W. of Boſton. It was incorporated in 1763; contains 2 pariſhes, and 1555 inhabitants.—*ib.*

WILKES, a county of the upper diſtrict of Georgia, ſeparated from S. Carolina, on the eaſtward, by Savannah river, and contains 31,500 inhabitants, including 7,268 ſlaves. Tobacco is the chief produce of this county, of which it exported about 3000 hhds. in 1788. It is well watered, and is famous for a medicinal ſpring, near its chief town, Waſhington.—*ib.*

WILKES, a county of Morgan diſtrict, in the N. W. corner of N. Carolina. It contains 8,143 inhabitants, including 549 ſlaves.—*ib.*

WILKES, a poſt-town and chief of the above county, 33 miles from Rockford, 45 from Morgantown, and 611 from Philadelphia.—*ib.*

WILKIE (William, D. D.), the author of an heroic poem, entitled the *Epigoniad*, was born in the pariſh of Dalmeny, in the county of Weſt-Lothian, on the 5th of October 1721. He was deſcended of an ancient family in that county, though his father rented only a ſmall farm, and was poor and unfortunate through life. He was able, however, to give his ſon a liberal education; and that ſon, it is ſaid, diſcovered ſo early a propenſity to the ſtudy of poetry, that he began to write verſes in his tenth year.

As this wonderful prematurity of genius was never heard of during Wilkie's life, it will probably be conſidered as a ſtory fabricated to raiſe the Scottiſh poet to the ſame eminence with Pope, whoſe verſification he is allowed to have imitated with ſucceſs. We have no doubt but that Wilkie wrote in early life the deſcription of a ſtorm, which is publiſhed in the 9th volume of the Statiſtical Account of Scotland; but that he wrote it in his tenth year is not proved, and is highly improbable. The poem diſplays a notion—a confuſed notion indeed—of the laws of electricity, which a boy in his tenth year, and at a period when electricity was little underſtood, could not have acquired.

Having learned the rudiments of the Latin tongue at the pariſh-ſchool of Dalmeny, young Wilkie was, at the age of thirteen, ſent to the univerſity of Edinburgh, where he was ſoon diſtinguiſhed by his originality of thought, and by his rapid progreſs in erudition and ſcience. Among his fellow ſtudents he was moſt cloſely aſſociated with Dr Robertſon the hiſtorian, Mr John Home the poet, Dr M'Ghie (A), who afterwards obtained the friendſhip of Johnſon, and became a member of the Ivy-lane Club; and a Mr Cleghorn, who promiſed to be an ornament to the univerſity, in which he was afterwards a profeſſor, but died before he had time to realize the fond hopes of his friends. During the courſe of his education, Wilkie became acquainted with the celebrated David Hume and Dr Ferguſon, and at a later period with Dr Adam Smith, the far-famed author of "The Wealth of Nations." Of all thoſe men he regarded Dr Ferguſon with the greateſt affection, and Dr Smith with the greateſt admiration. This laſt writer he conſidered as equal to Robertſon and Hume in erudition, and vaſtly their ſuperior in originality and invention; and this opinion he cheriſhed to the day of his death.

Before he had completed his education, his father died, leaving him no other inheritance than the ſtock and unexpired leaſe of his farm, and the care of his three ſiſters. Wilkie, therefore, turned much of his attention to agriculture, in which he became eminent, not merely as a theoriſt, but as a practical farmer. He had too much ſcience to be the ſlave of ancient prejudice, and too much judgment to be hurried into hazardous experiments by the charms of untried ſpeculation. One of his ſiſters being married to a ſkilful, though unlettered farmer, he availed himſelf of his brother's experience; and upon the facts and maxims derived from him built a ſyſtem of practical farming, which fully anſwered his own expectation, and obtained the applauſe of all his neighbours.

He ſtill proſecuted his ſtudies in the univerſity, and without ceaſing to be a farmer became a preacher in the church of Scotland. For ſome years this made no alteration in the mode of his living. He preached occaſionally for the miniſters of his neighbourhood; cultivated

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(A) According to Sir John Hawkins, this man bore arms on the ſide of government at the battle of Falkirk 1745. After which, taking a degree in phyſic, he went to London in hopes of employment through the intereſt of his countrymen, and perhaps in return for his loyalty. He was a learned, ingenious, and modeſt man; but ſo little ſucceſsful in his profeſſion, that he died of a broken heart, and was buried by a contribution of his friends.

vated his farm; read the claſſics; and, enamoured of the ſimple ſublimity of Homer, project an epic poem on the Homeric model. The ſubject of his intended poem he drew from the fourth book of the *Iliad*, where Sthenelus gives Agamemnon a ſhort account of the ſacking of Thebes; and as that city was taken by the ſons of thoſe who had fallen before it, Wilkie gave to his poem the quaint title of *Epigoniad*, from the Greek word επιγονοι, which ſignifies *deſcendants*. It is not our buſineſs to write a criticiſm upon this poem. The ſubject was ill-choſen; for the learned reader has enough of the heroic ages in the immortal poems of Homer and Virgil, and in thoſe ages the unlearned reader can feel no intereſt. The Epigoniad, therefore, though compoſed in ſmooth and elegant verſe, with due attention to ancient manners, and conſtructed on the moſt regular plan, has fallen into neglect, from which no critic or biographer will ever reſcue it.

In the year 1753, Mr Wilkie was ordained miniſter of Ratho, in conſequence of a preſentation from the Earl of Lauderdale, who knew his worth and admired his genius. Without neglecting his favourite amuſements of huſbandry, or the ſtudy of the belles lettres, he diſcharged with fidelity the duties of a Chriſtian paſtor, was famed for his original and impreſſive mode of preaching, and ſoon came to be loved as well as eſteemed by his rural flock.

In the year 1757 the Epigoniad was publiſhed, the reſult of fourteen years ſtudy and application, which might ſurely have been more uſefully employed on ſome other work; and in 1759 a ſecond edition was called for, to which he added *A Dream in the manner of Spenſer*. He was, the ſame year, choſen profeſſor of natural philoſophy in the univerſity of St Andrew's; an office for which it is difficult to conceive how he could have been fitted by the ſtudy of epic poetry, and cloſe attention to the cultivation of his farm. He was, however, a man of a vigorous mind, and we never heard that he diſgraced his electors.

When he removed to St Andrew's, his whole fortune exceeded not L. 200 Sterling; a proof that his Epigoniad had not enriched him. With this ſum he purchaſed a few acres of land in the neighbourhood of the city, carried his two unmarried ſiſters with him, and continued to live in the univerſity exactly as he had lived at Ratho. In his profeſſorial career there was nothing remarkable. He patroniſed genius, eſpecially poetical genius, in the young men who attended his lectures, and by them was, of courſe, loved and eſteemed: (See Fergusson in this *Suppl.*). In the year 1768 he publiſhed a volume of fables of no great value, previous to which the univerſity conferred upon him the degree of D. D.; and he died, after a lingering illneſs, on the 10th of October 1772.

The manners of Dr Wilkie were ſingular, and in ſome reſpects diſguſting. He has been ſeverely blamed for his penurioufneſs, but, in our opinion, unjuſtly. His father had left him in debt, with nothing but the profits which he might make of a ſmall farm to diſcharge that debt, and to ſupport himſelf and three ſiſters. In him, therefore, rigid economy was, for many years, a virtue; and he knows little of human nature, who can blame a man for not breaking habits which it had been the duty, as well as the buſineſs of a great part of his life to form. Amidſt his moſt rigid and offenſive economy, he was liberal in his donations to the poor.

He had been ſeized while miniſter of Ratho, with an unformed ague, of which he never got entirely rid. For this complaint he thought an extraordinary perſpiration neceſſary, and generally ſlept, in winter, under twenty-four blankets. He had an utter averſion from clean linen, and has been known to bargain, when he ſtaid a night from home, not only for the proper quantity of blankets to his bed, but alſo for ſheets, which had been uſed by ſome other perſon, and rendered ſufficiently dirty to pleaſe his feeling. It will eaſily be conceived that ſuch a man was, to the laſt degree, ſlovenly in his dreſs.

Suſpicions have been thrown out by his lateſt, and we believe his only, biographer, that Dr Wilkie's belief of the Chriſtian religion was neither orthodox nor ſteady. Not having had the pleaſure of his acquaintance, we cannot poſitively ſay that theſe ſuſpicions are groundleſs; but the writer of this article has converſed much about the author of the Epigoniad with a clergyman who knew him well, and who would have been glad to accuſe him of infidelity, if he could have preferred ſuch an accuſation with truth. He was a very abſent man, apt to forget what he was about even when diſcharging the moſt ſolemn parts of his clerical duty, and uſed to ſay of himſelf that he never could conduct a ſacrament. From this abſence of mind, and thoſe confeſſions of it, may have ariſen the ſuſpicion that he was not a firm believer; but no ſuch ſuſpicion was ever thrown out to this writer by the clergyman already referred to.

He had one very extraordinary defect in a poet: He could not read aloud the ſmootheſt verſes, ſo as to preſerve either the meaſure or the ſenſe of them. Of this Dr Anderſon has produced very compete proof in his life of Wilkie, prefixed to his poetical works in the Edinburgh edition of the Britiſh Poets. With all his defects, however, and all his foibles, he was unqueſtionably a genius, and, we are inclined to believe, a good man.

WILKSBARRE, or *Wilkſburg*, a poſt-town of Pennſylvania, and chief town of Luzerne county, ſituated on the ſouth-eaſt ſide of the eaſt branch of the Suſquehannah. It contains a court-houſe, gaol, and about 45 houſes. It is 67 miles N. E. of Bethlehem, about the ſame diſtance above Sunbury, and 118 N. by N. W. of Philadelphia.—*Morse.*

WILLIAM, *Fort*, (now called the *Caſtle*) was erected on Caſtle Iſland in Boſton harbour, in the reign of king William, by Col. Roemer, a famous engineer. When the Britiſh troops evacuated Boſton, in March, 1776, the fortifications were blown up, but were ſoon after repaired. The buildings are the governor's houſe, a magazine, gaol, barracks, and work-ſhops. On this iſland, which contains about 18 acres of land, diſtant 3 miles from the town of Boſton, there are a number of convicts, who are ſentenced to confinement here for different periods, according to their crimes, and employed in the manufacture of nails and ſhoes, and guarded by a company of between 60 and 70 ſoldiers. The fort, which commands the entrance into the harbour, has 50 pieces of cannon mounted, and 44 others lie diſmounted.—*ib.*

WILLIAMS, a town in Northampton county, Pennſylvania.—*ib.*

WILLIAM'S *Sound, Prince*, on the north-weſt coaſt of N. America. Its E. point is in lat. 60 19 N. and long. 146 53 weſt, and Cape Elizabeth which is its weſt point, and the E. point of Cook's river, is in lat. 59 10, and long. 152 15 —*ib.*

WILLIAMSBOROUGH, a poſt-town of N. Carolina, and capital of Granville county, pleaſantly ſituated on a creek which falls into the Roanoke. It carries on a briſk trade with the back counties, and contains between 30 and 40 houſes, a court-houſe, gaol, and flouriſhing academy. It is 17 miles from Warrenton, 48 north-eaſt of Hillſborough, 56 weſt-north-weſt of Halifax, and 407 from Philadelphia.—*ib.*

WILLIAMSBURG, a county of Virginia, between York and James' rivers, and was joined in the enumeration of inhabitants, in 1790, with York county. Theſe together contain 5,233 inhabitants.—*ib.*

WILLIAMSBURGH, a townſhip of Maſſachuſetts, Hampſhire county, on the weſt ſide of Connecticut river, having Hatfield on the E. It contains a handſome Congregational church, 159 houſes, and 1,049 inhabitants. In the year 1760, this townſhip was a wilderneſs. It lies 7 miles from Connecticut river, 8 north-weſt from Northampton, and 108 weſt of Boſton.—*ib.*

WILLIAMSBURG, a poſt-town of New-York, Ontario county, ſituated on the E. ſide of Geneſſee river, near where Canaſeragn creek empties into that river; 30 miles S. W. of Canandaigua, 40 N. W. of Bath, 98 N. W. of Athens or Tioga Point, and 288 N. W. of Philadelphia.—*ib.*

WILLIAMBURG, called alſo *Joneſtown*, a town of Pennſylvania, Dauphine county, at the junction of Little Swatara with Swatara river. It has a German Lutheran and Calviniſt church, and about 40 dwelling-houſes. It is 23 miles N. E. by E. of Harriſburg, and 89 north-weſt of Philadelphia.—Alſo, the name of a townſhip in Luzerne county.—*ib.*

WILLIAMSBURG, a village of Maryland, in Talbot county, 5 miles N. E. of Eaſton, and 4 N. W. of King's-Town.—*ib.*

WILLIAMSBURG, a poſt-town of Virginia, lies 60 miles eaſtward of Richmond, ſituated between two creeks, one falling into James, the other into York river. The diſtance of each landing-place is about a mile from the town. During the regal government it was propoſed to unite theſe creeks by a canal paſſing through the centre of the town; but the removal of the ſeat of government rendered it no longer an object of importance. It contains about 200 houſes, and has about 1,400 inhabitants. It is regularly laid out in parallel ſtreets, with a pleaſant ſquare in the centre of about 10 acres, through which runs the principal ſtreet eaſt and weſt, about a mile in length, and more than 100 feet wide. At the ends of this ſtreet are two public buildings, the college and capitol. Beſides theſe, there is an Epiſcopal church, a priſon, a court-houſe, a magazine, now occupied as a market, and a hoſpital for lunatics, calculated to accommodate between 20 and 30 patients, in ſeparate rooms or cells. The houſe is neatly kept, and the patients well attended; but convaleſcents have not ſufficient room for free air and exerciſe without making their eſcape. Not far from the ſquare ſtood the governor's houſe, or palace, as it was called. This was burnt during the war, while it was occupied as an American hoſpital. The houſe of the preſident of the college, occupied alſo as an hoſpital by the French army, ſhared the ſame fate. This has ſince been rebuilt at the expenſe of the French government. In the capitol is a large marble ſtatue, of Narbone Berkley, Lord Botetourt, a man diſtinguiſhed for his love of piety, literature, and good government, and formerly governor of Virginia. It was erected at the expenſe of the State, ſome time ſince the year 1771. The capitol is little better than in ruins, and this elegant ſtatue is expoſed to the rudeneſs of negroes and boys, and is ſhamefully defaced. A late act of the aſſembly authoriſes the pulling down one half of this building, to defray the charge of keeping the other half in repair. The college of William and Mary fixed here, was founded in the time of king William and queen Mary, who granted to it 20,000 acres of land, and a penny a pound duty on certain tobaccoes exported from Virginia and Maryland, which had been levied by the ſtatute of 25 Car. 2. The aſſembly alſo gave it, by temporary laws, a duty on liquors imported, and ſkins and furs exported. From theſe reſources it received upwards of 3,000l. The buildings are of brick, ſufficient for an indifferent accommodation of perhaps 100 ſtudents. By its charter, it was to be under the government of 20 viſitors, who were to be its legiſlators, and to have a preſident and ſix profeſſors, who were incorporated. It was allowed a repreſentative in the general aſſembly. Under this charter, a profeſſorſhip of the Greek and Latin languages, a profeſſorſhip of mathematics, one of moral philoſophy, and two of divinity, were eſtabliſhed. To theſe, were annexed, for a ſixth profeſſorſhip, a conſiderable donation by a Mr Boyle of England, for the inſtruction of the Indians, and their converſion to Chriſtianity. This was called the profeſſorſhip of Brafferton, from an eſtate of that name in England, purchaſed with the monies given. A court of admiralty ſits here whenever a controverſy ariſes. It is 12 miles E. of York-Town, 60 E. of Richmond, 48 N. W. of Norfolk, and 338 S. S. W. of Philadelphia.

Leaſt heat here,	6°	0'
Mean heat,	60	8
Greateſt heat,	98	0

N. lat. 37 16, weſt long. 76 48.—*ib.*

WILLIAMSPORT, a poſt-town of Maryland, Waſhington county, on the N. ſide of Patowmack river, at the mouth of Conegocheague Creek, 8 miles S. of the Pennſylvania line, 6 ſouth-weſt of Hagerſtown, 37 N. by E. of Wincheſter, in Virginia, 28 ſouth by weſt of Chamberſburg, in Pennſylvania, and 155 W. by S. of Philadelphia.—*ib.*

WILLIAMSON, a townſhip of New-York, Ontario county. In 1796, there were 142 of its inhabitants electors.—*ib.*

WILLIAMSTOWN, a townſhip of Vermont, Orange county, on the height of land between Connecticut river and Lake Champlain, about 45 miles from the former, and 50 from the latter. It is bounded eaſtward by Waſhington, and weſtward by Northfield, and contains 146 inhabitants. Stephen's Branch, a ſtream which runs N. to Onion river, riſes in this townſhip.—*ib.*

WILLIAMSTOWN, a mountainous townſhip of Maſſachuſetts, in the north-weſt corner of the State, and in Berkſhire county, containing 1769 inhabitants. It is well watered by Hooſack and Green rivers, the former of which is here 8 rods wide. On theſe ſtreams are four griſt-mills, three ſaw-mills, and a fulling-mill. The main county road paſſes through it. Colonel Ephraim Williams laid the foundation of an academy ſeveral years ſince, and endowed it by a handſome donation of lands. In 1790, partly by lottery, and partly by the liberal donation of gentlemen in the town, a brick edifice was erected, 82 feet by 42, and four ſtories high, containing 24 rooms for ſtudents, a large ſchool-room, a dining-hall, and a room for public ſpeaking. In 1793, this academy was erected into a college, by an act of the legiſlature, by the name of *Williams College*, in honour to its liberal founder. The languages and ſciences uſually taught in the American colleges are taught here. Board, tuition and other expenſes of education are very low; and from its ſituation and other circumſtances, it is likely, in a ſhort time, to become an inſtitution of great utility and importance. The firſt public commencement was held at this college in September, 1795. In 1796, the legiſlature granted two townſhips of land to Williams College. There were, in 1796, 101 ſtudents in the four claſſes in this college, beſides 30 pupils in the academy connected with the college. A company was incorporated the year abovementioned, to bring water in pipes into the town ſtreet. It is 28 miles north of Lenox, and 150 north-weſterly of Boſton.—*ib.*

Williamstown, a poſt-town and the capital of Martin county, N. Carolina, is ſituated on Roanoke river, and contains but few houſes, beſides the court-houſe and gaol. It is 25 miles from Blountſville, 24 from Plymouth, 55 from Halifax, and 444 from Philadelphia. —*ib.*

WILLIMANTIC, a ſmall river of Connecticut, which runs a ſouth-eaſt courſe, and uniting with Natchaug river, forms the Shetucket at Windham.—*ib.*

WILLINGBOROUGH, a townſhip of New-Jerſey, ſituated in Burlington county, on Delaware river, about 14 miles from Philadelphia. It has generally a thin ſoil, but conſiderable quantities of fruits and vegetables are raiſed here for the Philadelphia market.—*ib.*

WILLINGTON, a townſhip of Connecticut, in Tolland county, 6 miles eaſt of Tolland, and 35 north-eaſterly of Hartford, and was ſettled in 1719. The lands are rough and hilly. The earthquake on ſabbath evening, Oct. 29, 1727, was ſeverely felt in this town.—*ib.*

WILLIS, a townſhip in Cheſter county, Pennſylvania.—*ib.*

Willis *Creek*, in Maryland, falls into the Patowmack from the north at Fort Cumberland.—*ib.*

Willis *Iſland*, in the S. Atlantic Ocean, is near the north-weſt end of South Georgia, and has Bird Iſland to the north of it. S. lat. 54, weſt long. 38 30.—*ib.*

WILLISTON, a townſhip of Vermont, in Chittenden county, joins Burlington on the N. W. It contains 471 inhabitants.—*ib.*

WILLOUGHBY *Bay*, near the ſouth-eaſt part of the iſland of Antigua, in the Weſt-Indies. It is well fortified. Bridgetown lies on its north-eaſtern ſide, in St Philips pariſh, and is defended by Fort William. —*ib.*

Willoughby *Lake*, in Vermont, in the townſhip of Weſtmore. It is about 6 miles long and one broad, and ſends a ſtream which runs northward and empties into Lake Memphremagog, in the townſhip of Salem. This lake furniſhes fiſh reſembling baſs, of an excellent flavour, weighing from 10 to 30 pounds. People travel 20 miles to this lake, to procure a winter's ſtock of this fiſh.—*ib.*

WILLS *Cove*, on the north-eaſt ſide of the iſthmus of the iſland of St Kitts, in the Weſt Indies, to the eaſtward ſoutherly from North Friar and Little Friar Bays. —*ib.*

Wills *Creek*, or *Caicuctuck*, a branch of Patowmack river, is 30 or 40 yards wide at its mouth, where Fort Cumberland ſtood. It affords no navigation as yet, and runs a ſhort courſe ſoutherly. It is 281 miles N. W. of Williamſburg, 171 from Frederickſburg, and 173 E. by N. of Alexandria.—*ib.*

Wills-Town, an Indian village on the N. E. bank of Muſkingum river, 45 miles from its mouth, and 117 ſouth-weſterly from Pittſburg, by the Indian path through the Indian town.—*ib.*

WILMANTON, in the State of New-York, ſtands on Wallkill, between Newburg and New-Brunſwick. —*ib.*

WILMINGTON, one of the eaſtern maritime diſtricts of N. Carolina; bounded north-eaſt by Newbern diſtrict, ſouth-eaſt by the Altantic Ocean; ſouth-weſt by S. Carolina; and north-weſt by Fayette. It comprehends the counties of Brunſwick, New-Hanover, Onſlow, Duplin, and Bladen. It contains 26,035 inhabitants; of whom 10,056 are ſlaves.—*ib.*

Wilmington, a port of entry and poſt town of N. Carolina, capital of the above diſtrict, is ſituated on the eaſt ſide of the eaſtern branch of Cape Fear or Clarendon river; 34 miles from the ſea, and 100 ſouthward of Newbern. The courſe of the river, as it paſſes by the town, is nearly from north to ſouth, and the breadth 150 yards. Oppoſite the town are two iſlands extending with the courſe of the river, and dividing it into three channels: they afford the fineſt rice fields in N. Carolina. The town is regularly built, and contains about 250 houſes, a handſome Epiſcopal church, a court-houſe, and gaol. Having ſuffered much by two fires, one-fourth of the town, which has been rebuilt, is of brick. Its markets are well ſupplied with fiſh, and all manner of proviſions. A conſiderable trade is carried on to the Weſt-India Iſlands and the adjacent States. The exports for one year, ending the 30th of September 1794, amounted to 133,534 dollars. Thoſe of all the other ports of the State, amounted only to 177,598 dollars. It is 90 miles ſouth-eaſt of Fayetteville, 192 ſouth-ſouth-weſt of Edenton, 198 north-eaſt of Charleſton, S. Carolina, and 600 ſouth-ſouth-weſt of Philadelphia. N. lat. 34 11, W. long. 78 15.—*ib.*

Wilmington, a townſhip of Vermont, in Windham county, containing 645 inhabitants, who are chiefly wealthy farmers. It lies on Deerfield river, on the E. ſide of the Green Mountain, on the high-road from Bennington to Brattleborough, about 20 miles from each. Conſiderable quantities of maple ſugar are made in it; ſome farmers make 1000 or 1400 pounds a ſeaſon. The *Hay-ſtack*, in the north-weſt corner of this townſhip, is among the higheſt of the range of the Green Mountains. It has a pond near the top of it, about half a mile in length, round which deer and mooſe are found. —*ib.*

Wilmington, a townſhip of Maſſachuſetts, in Middleſex county, 16 miles from Boſton. It was incorporated in 1730, and contains 710 inhabitants. Hops, in great quantities are raiſed in this town.—*ib.*

WILMINGTON, a port of entry and poſt-town of the State of Delaware, and the moſt conſiderable town in the State. It ſtands in Newcaſtle county, on the north ſide of Chriſtiana Creek, between Chriſtiana and Brandywine creeks, which at this place are about a mile diſtant from each other, but uniting below the town, they join the Delaware in one ſtream, 400 yards wide at the mouth. The ſcite of the principal part of the town is on the ſouth weſt ſide of a hill, which riſes 109 feet above the tide, 2 miles from Delaware river, and 28 ſouth-weſt from Philadelphia. On the north-eaſt ſide of the ſame hill, on the Brandywine, there are 13 mills for grain, and about 40 neat dwelling-houſes, which form a beautiful appendage to the town. The Chriſtiana admits veſſels of 14 feet draught of water to the town; and thoſe of 6 feet draught 8 miles further, where the navigation ends; and the Brandywine admits thoſe of 7 feet draught to the mills. The town is regularly laid out in ſquares ſimilar to Philadelphia, and contains upwards of 600 houſes, moſtly of brick, and 3,000 inhabitants. It has 6 places of public worſhip, viz. 2 for Preſbyterians, 1 for Swediſh Epiſcopalians, 1 for Friends, 1 for Baptiſts, and 1 for Methodiſts. Here are two market-houſes, a poor-houſe, which ſtands on the weſt ſide of the town, and is 120 feet by 40, built of ſtone, and 3 ſtories high, for the reception of the paupers of Newcaſtle county. There is another ſtone building which was uſed as an academy, and was ſupported for ſome time with conſiderable reputation, but by a defect in the conſtitution of the ſeminary, or ſome other cauſe, it has, of late, been entirely neglected as a place of tuition. There are, however, nearly 300 children in the different ſchools in town. About the year 1736, the firſt houſes were built at this place; and the town was incorporated a few years afterwards. Its officers are two burgeſſes, 6 aſſiſtants, and two conſtables, all of whom are annually choſen. N. lat. 39 43 18, W. long. 75 32.—*ib.*

WILMOT, a townſhip of Nova-Scotia, Annapolis county, ſettled from Ireland and New-England.—*ib.*

WILSONVILLE, a town of Pennſylvania, newly laid out on the Walenpapeck, at its junction with the Lexawacſein, 120 miles north of Philadelphia. Here are already erected 14 houſes, a ſaw and griſt mill, and a large building for manufacturing ſail-cloth. The creek here falls upwards of 300 feet, ſome ſay 500, in the ſpace of a mile; for 17 miles above the falls the creek has a gentle current.—*ib.*

WILTON, a village of Charleſton diſtrict, S. Carolina; ſituated on the E. ſide of Ediſto river, 27 miles S. W. of Charleſton.—*ib.*

WILTON, a townſhip of New-Hampſhire, Hillſborough county, S. W. of Amherſt, adjoining, about 70 miles weſterly of Portſmouth. It was incorporated in 1762, and contains 1105 inhabitants.—*ib.*

WIMACOMACK, a village of New-York, in Suffolk county, Long-Iſland; 6 miles weſt by ſouth of Smithtown, and N. E. of Huntingdon, and 44 E. by N. of New-York city.—*ib.*

WINCHENDON, a poſt-town of Maſſachuſetts, in Worceſter county, 7 miles N. of Gardner, 35 north-weſterly of Worceſter, 60 north-weſt by weſt of Boſton, and 370 north-eaſt of Philadelphia. This townſhip was formerly called *Ipſwich Canada*, until it was incorporated in 1764. It is on Miller's river, and contains 950 inhabitants. This place was viſited by a dreadful tornado, on the 21ſt of October, 1795, which did conſiderable damage.—*ib.*

WINCHESTER, a townſhip of Connecticut, in Litchfield county, about 12 or 15 miles N. of Litchfield.—*ib.*

WINCHESTER, a townſhip of New-Hampſhire, in Cheſhire county, eaſt of Hinſdale and Fort Dummer, adjoining. It is 110 miles from Portſmouth, and contains 1209 inhabitants.—*ib.*

WINCHESTER, the chief town of Clarke county, Kentucky.—*ib.*

WINCHESTER, or *Fredericktown*, a poſt-town of Virginia, and the capital of Frederick county. It is ſituated near the head of Opeckon Creek, which empties into Patowmack river; about 36 miles from the celebrated paſſage of the Patowmack through the Blue Ridge. It is a handſome flouriſhing town, ſtanding upon low and broken ground, and has a number of reſpectable buildings; among which are a court-houſe, gaol, a Preſbyterian, an Epiſcopalian, a Methodiſt, and a new Roman Catholic church. The dwelling houſes are about 350 in number, ſeveral of which are built of ſtone. It is a corporation, and contains nearly 2,000 inhabitants. It was formerly fortified; but the works are now in ruins. It is 50 miles eaſt by ſouth of Romney, 100 north-eaſt by north of Staunton, 110 weſt-north-weſt of Alexandria, 180 north-weſt of Richmond, and 192 from Philadelphia. N. latitude 39 17 30, W. longitude 78 39.—*ib.*

WIND *Gap*, a paſs in the Blue Mountains in Pennſylvania; about 9 miles S. W. of Penn's Fort. Although 100 feet higher than the preſent bed of the Delaware, it is thought to have been formerly part of the bed of that river. The Wind Gap is a mile broad, and the ſtones on it ſuch as ſeem to have been waſhed for ages by water running over them.—*ib.*

WINDHAM, a county in the ſouth-eaſt corner of Vermont; having the State of Maſſachuſetts ſouth and Connecticut river eaſt, which divides it from New-Hampſhire. It contains 22 townſhips, and 17,693 inhabitants. Chief towns, Newfane and Putney.—*ib.*

WINDHAM, a county in the N. E. corner of Connecticut, having the State of Maſſachuſetts N. and the State of Rhode Iſland E. It contains 13 townſhips, and 28,921 inhabitants, including 184 ſlaves. Chief town, Windham.—*ib.*

WINDHAM, the capital of the above county, and a poſt-town, is ſituated on Shetucket river, 12 miles N. by W. of Norwich, and 31 E. of Hartford. It contains between 60 and 70 compact houſes, a court houſe, gaol, an academy, and a Congregational church. It is 253 miles from Philadelphia. The river Willimantick from the N. W. and Natchaug from the N. meet in the north-weſterly part of the townſhip, and form the Shetucket, a pleaſant river, affording plenty of fiſh, particularly ſalmon, at ſome ſeaſons of the year. The townſhip was ſettled from Norwich, in 1686, and was incorporated in 1702.—*ib.*

WINDHAM, a townſhip of New-Hampſhire, Rockingham county, is about 25 miles ſouth-weſt of Exeter, and 40 from Portſmouth. It contains 663 inhabitants.—*ib.*

Windham, a townſhip of the Diſtrict of Maine, Cumberland county, 134 miles north of Boſton. It was incorporated in 1762, and contains 938 inhabitants. —*ib.*

WINDSOR, a townſhip of Nova-Scotia, in Hants county, near the river St Croix, which empties into the Avon. The rivers Kenetcoot and Cocmiguen (ſo called by the Indians) run through this townſhip and empty into the Avon. On theſe rivers are flouriſhing ſettlements and fertile land. Lime-ſtone and plaſter of Paris are found here. The late Potawock (ſo called by the Indians) lies between the head of St Margaret's Bay and the main road from Halifax to Windſor; the great lake of Shubenaccadie lies on the eaſt ſide of this road, about 7 miles from it, and 21 from Halifax.—*ib.*

Windsor, a county of Vermont, bounded N. by Orange, S. by Windham, E. by Connecticut river, and W. by Rutland and part of Addiſon county. It contains 22 townſhips, and 15,748 inhabitants.—*ib.*

Windsor, a poſt-town of Vermont, and capital of the above county, is ſituated on the weſt bank of Connecticut river, 18 miles N. by W. of Charleſtown, in New-Hampſhire, 45 E. by S. of Rutland, 80 N. E. of Bennington, and 255 from Philadelphia. The townſhip contains 1452 inhabitants. This, with Rutland, is alternately the ſeat of the State Legiſlature.—*ib.*

Windsor, a hilly townſhip of Maſſachuſetts, in Berkſhire county, 20 miles N. N. W. of Lenox, and 136 W. by N of Boſton. The county road to Northampton paſſes through it, alſo the road from Pittsfield to Deerfield. It gives riſe to Houſatonick and Weſtfield rivers, on which are 4 ſaw-mills and 2 corn-mills. It was incorporated in 1771, and contains 916 inhabitants. In the Gore, adjoining Adams and Windſor, are 425 inhabitants.—*ib.*

Windsor, a conſiderable and very pleaſant town of Hartford county, Connecticut, on the weſt ſide of Connecticut river, about 7 miles northerly of Hartford. Here Windſor Ferry river, formed by the junction of Farmington and Poquabock rivers, empties into the Connecticut from the weſt. Windſor Ferry river divides the townſhip into the upper and lower pariſhes. —*ib.*

Windsor, a townſhip of New-Jerſey, Middleſex county, containing 2,838 inhabitants, including 190 ſlaves. —*ib.*

Windsor, a townſhip of Pennſylvania, York county. —*ib.*

Windsor, a poſt-town and the capital of Bertie county, N. Carolina; ſituated on Cuſhai river, and contains, beſides a few houſes, a court-houſe and gaol. It is 23 miles W. by S. of Edenton, 18 from Plymouth, 97 from Halifax, and 481 from Philadelphia.—*ib.*

WINDWARD *Paſſage*, a name given to a courſe from the S. E. part of the iſland of Jamaica, in the Weſt-Indies, and extending for 160 leagues to the N. ſide of Crooked Iſland in the Bahamas. Ships have often ſailed through this channel from the north part of it to the iſland of Cuba, or the Gulf of Mexico, notwithſtanding the common opinion, on account of the current, which is againſt it; that they keep the Bahama ſhore on board, and that they meet the wind in ſummer for the moſt part of the channel eaſterly, which with a counter current on ſhore puſhes them eaſily through it. —*ib.*

Windward *Point*, near the eaſtern extremity of the iſland of St Chriſtopher's, is the eaſt point of Sandy-Hill Bay; about 2 miles to the W. N. W. of St Anthony's Hill Point.—*ib.*

WINEE, or *Black River*, in S. Carolina, riſes in Camden diſtrict, and running ſouth-eaſterly through Cheraws into Georgetown diſtrict, unites with Pedee river, about 3 miles above Georgetown.—*ib.*

WINES (ſee that article, *Encycl.* and *Vegetable Substances*, *Suppl.*) are ſo often adulterated with minerals prejudicial to the health, that various methods have been deviſed for detecting the adulteration. The property which liver of ſulphur (alkaline ſulphures) and hepatic air (ſulphurated hydrogen) poſſeſs of precipitating lead in a black form, has been long ago made public; and this property has been employed to determine the quality of wines by means of the *liquor probatorius Wirtembergenſis*, or Wirtemberg proving liquor. But in trying wines ſuppoſed to have been adulterated, this proof does more hurt than ſervice, becauſe it precipitates iron of the ſame colour as the pernicious lead. Many wine-merchants, therefore, of the greateſt reſpectability, rendered by theſe means ſuſpected, have been ruined.

The following is recommended by M. Hanhemann as a better teſt of ſound wines than the proving liquor of Wirtemberg. Mix equal parts of oyſter ſhells and crude ſulphur in a fine powder, and put the mixture into a crucible. Heat it in a wind furnace, and increaſe the fire ſuddenly, ſo as to bring the crucible to a white heat, for the ſpace of 15 minutes. Pulveriſe the maſs when it is cool, and preſerve it in a bottle cloſely ſtopped.

To prepare the liquor, put 120 grains of this powder, and 120 grains of cream of tartar (acidulous tartarite of potaſh), into a ſtrong bottle; fill the bottle with common water, which boil for an hour, and then let it cool; cloſe the bottle immediately, and ſhake it for ſome time: after it has remained at reſt to ſettle, decant the pure liquor, and pour it into ſmall phials capable of holding about an ounce each, firſt putting into each of them 20 drops of muriatic acid. They muſt be ſtopped very cloſely with a piece of wax, in which there is a ſmall mixture of turpentine.

One part of this liquor, mixed with three parts of ſuſpected wine, will diſcover, by a very ſenſible black precipitate, the leaſt traces of lead, copper, &c. but will produce no effect upon iron, if it contains any of that metal. When the precipitate has fallen down, it may ſtill be diſcovered whether the wine contains iron, by ſaturating the decanted liquor with a little ſalt of tartar (tartareous acidulum of potaſh), by which the liquor will immediately become black. Pure wines remain clear and bright after this liquor has been added to them.

WINHALL, a townſhip of Vermont, in Bennington county, about 25 or 30 miles N. E. of Bennington. It contains 155 inhabitants.—*Morſe.*

WINNIPISEOGEE, a lake in New-Hampſhire, and the largeſt collection of water in the State. It is 22 miles in length from S. E. to N. W. and of very unequal breadth, but no where more than 8 miles. Some very long necks of land project into it; and it contains ſeveral iſlands, large and ſmall, and on which rattle-ſnakes are common. It abounds with fiſh from

6 to 20 pounds weight. The mountains which ſurround it, give riſe to many ſtreams which flow into it; and between it and the mountains, are ſeveral leſſer ponds, which communicate with it. Contiguous to this lake are the townſhips of Moultonborough on the N. W. Tuftonborough and Wolfborough on the N. E. Meredith and Gilmantown on the S. W. and a tract of land, called the Gore, on the S. E. From the S. E. extremity of this lake, called Merry Meeting Bay, to the north-weſt part called Senter Harbour, there is good navigation in the ſummer, and generally a good road in the winter; the lake is frozen about 3 months in the year, and many ſleighs and teams, from the circumjacent towns, croſs it on the ice. Winnipiſeogee river conveys the waters of the lake into Pemigewaſſet river, through its eaſtern bank at New-Cheſter.—*ib.*

WINLAND, a country accidentally diſcovered by Biron or Biorn, a Norman, in 1001; ſuppoſed to be a part of the iſland of Newfoundland. It was again viſited, and an intercourſe opened between it and Greenland. In 1221, Eric, biſhop of Greenland, went to Winland to recover and convert his countrymen, who had degenerated into ſavages. This prelate never returned to Greenland; nor was any thing more heard of Winland for ſeveral centuries.—*ib.*

WINLOCK, or *Wenlock*, a townſhip of Vermont, in Eſſex county, weſt of Minehead.—*ib.*

WINNEBAGO, a lake of the N. W. Territory; weſt of Michigan Lake, and ſouth-weſt of Bay Puan, into which it ſends its waters. It is about 15 miles long from eaſt to weſt, and 6 wide. It receives a large ſtream from the ſouth-weſt called Crocodile river. Fox river enters it from the weſt, and by it, through Ouiſconſing river, has communication with Miſſiſſippi river, interrupted by a portage of only 3 miles. The centre of the lake lies in lat. about 43 30 N. and long. 88 10 W.—*ib.*

WINNEBAGOES, an Indian nation inhabiting round the lake of the ſame name, who can furniſh 2 or 300 warriors. Their town ſtands on an iſland at the E. end of the lake, of about 50 acres extent, and diſtant from Bay Puan 35 miles, according to the courſe of the river. The town contains about 50 houſes, which are ſtrongly built with palliſades. The land adjacent to the lake is very fertile, abounding ſpontaneouſly with grapes, plums, and other fruit. The people raiſe a great quantity of Indian corn, beans, pumpkins, ſquaſhes, melons, and tobacco. The lake abounds with fiſh, and in the autumn or fall, with geeſe, ducks, and teal; and are very fat and well flavored by feeding on wild rice, which grows plentifully in theſe parts. Mr Carver thinks from the reſult of his inquiries of the origin, language, and cuſtoms of this people, that they originally reſided in ſome of the provinces of Mexico, and migrated to this country about a century ago. Their language is different from any other yet diſcovered; and they converſe with other nations in the Chippeway tongue.—*ib.*

WINNIPEG, or *Winnepeek*, a lake in Upper Canada, north-weſt of Lake Superior. It lies between 50 30 and 54 32 N. lat. and between 95 50 and 99 30 W. long. It is 217 miles long, including Baſkeſcoggan or Play-Green Lake, its northern arm; and is 100 miles broad from the Canadian Houſe on the E. ſide to Sable river on the weſt ſide. It receives the waters of a number of ſmall lakes in every direction, and exhibits a number of ſmall iſles. The lands on its banks are ſaid, by Carver and other travellers, to be very fertile, producing vaſt quantities of wild rice, and the ſugar-tree in great plenty. The climate is conſiderably more temperate here than it is upon the Atlantic coaſt, 10° farther ſouthward.—*ib.*

WINNIPEG, *Little*, a lake which lies weſt of the former, and has communication with Lake Minitoba, on the S. which laſt ſends the waters of both into Winnipeg Lake, in an E. N. E. courſe. It is 80 miles long and 15 broad. Fort Dauphin is ſeated on a lake contiguous, on the weſt, whoſe waters empty into this lake. Dauphin Fort lies in lat. 51 46 N. and long. 100 54 W.—*ib.*

WINNIPEG *River*, runs north-weſt into the lake of its name. It is the outlet of the waters of a vaſt chain of lakes; the chief of which are La Plue and Lake of the Woods. The lat. of the Proviſion Store, at the bottom of the river, is 50 33 12 N.—*ib.*

WINNSBOROUGH, a poſt-town, and the capital of Fairfield county, S. Carolina; ſituated on a branch of Wateree Creek, which empties into the river of that name. Here are about 25 houſes, a handſome court-houſe, a gaol, and a college called Mount Zion college, which is ſupported by a reſpectable ſociety of gentlemen, and has been long incorporated. The inſtitution flouriſhes, and bids fair for uſefulneſs. It is 30 miles north-north-weſt of Columbia, 130 from Charleſton, and 708 from Philadelphia.—*ib.*

WINSLOW, a poſt-town of the Diſtrict of Maine, Lincoln county, ſituated on Kennebeck river; 18 miles north of Harrington. Fort Halifax was built at this place in 1754, on the point of land at the confluence of Sebaſticook and Kennebeck rivers. This town is 88 miles N. by E. of Portland, 211 in a like direction from Boſton, and 559 from Philadelphia. It was incorporated in 1771, and contained, in 1790, 779 inhabitants, and in 1797, about 1500.—*ib.*

WINTERHAM, a place in Amelia county, Virginia. Black lead is found here; but no works for its manufacture are eſtabliſhed: thoſe who want it go and procure it for themſelves.—*ib.*

WINTHROP, a poſt-town of the Diſtrict of Maine, Lincoln county, between Androſcoggin and Kennebeck rivers, about 10 miles from each; 5 miles eaſterly of Monmouth; 10 weſt by ſouth of Hallowell, now Harrington court-houſe, 57 north of Portland, 185 from Boſton, and 529 from Philadelphia. The townſhip in which it ſtands, was incorporated in 1771, and contains 1240 inhabitants.—*ib.*

WINTHROP'S *Bay*, on the north coaſt of the iſland of Antigua. Maiden Iſland, a ſmall iſle ſouth ſouth-weſt of Long Iſland is due eaſt of the ſouth-eaſt point of this bay.—*ib.*

WINTON, a county of Orangeburg diſtrict, S. Carolina.—*ib.*

WINTON, a poſt-town of North-Carolina, and capital of Hartford county, on the S. E. ſide of Chowan river, a few miles below the place where Meherrin and Nottaway join their waters. It has a court-houſe and gaol, and a few compact houſes. It is 12 miles from Murfreeſborough, 15 from the Bridge on Bennet's Creek, 130 S. S. E. of Peterſburg, in Virginia, and 434 from Philadelphia.—*ib.*

WINYAW *Bay*, on the coaſt of South-Carolina, communicates with the ocean 12 miles below George-town.—*ib.*

WISCASSET, a port of entry and poſt-town of the Diſtrict of Maine, Lincoln county, on the weſt ſide of Sheepſcut river, 10 miles S. E. of New-Milford on the E. ſide of Kennebeck river, 13 north-weſt of Bath, 56 north-weſt of Portland, 178 N. E. by N. of Boſton, 525 from Philadelphia, and 1513 from Sunbury in Georgia. It is a part of the townſhip of Pownalborough, and is very flouriſhing. It contains a congregational church, and about 120 houſes. Its navigation is greater in proportion to its ſize and number of inhabitants than any part of Maſſachuſetts. A gazette is publiſhed here, and the county courts are held in it. Wiſcaſſet Point is 3 leagues from Croſs river. The exports for one year, ending the 30th of Sept. 1794, amounted to 23,329 dollars.—*ib.*

WITCHARN *Bay*, is within the great ſound in the Bermudas Iſlands, in the Weſt-Indies; ſituated at the E. part of the bottom or S. part of the Sound, having two ſmall iſlands at the mouth of it.—*ib.*

WOAHOO, one of the Sandwich Iſles, in the North Pacific Ocean, 7 leagues north-weſt of Morotoi Iſland. It is high land, and contains 60,000 inhabitants; and has good anchoring ground, in lat. 21 43 N. and long. 157 51 W.—*ib.*

WOAPANACHKY, the name of the Delaware nation, in their language.—*ib.*

WOAPO, one of the Ingraham Iſlands, leſs in ſize than Chriſtiana. The body of it lies in lat. 9 27 S. It bears north-weſt by weſt, about 20 leagues from Reſolution Bay. It was called *Adams*, by Capt. Ingraham; and a ſmall iſland to the ſouthward of it he called *Lincoln*. Capt. Roberts afterwards diſcovered them and named them from his ſhip and ſchooner; the larger *Jefferſon*, and the leſſer *Reſolution*.—*ib.*

WOBURN, a townſhip of Maſſachuſetts, in Middleſex county, 10 miles north of Boſton. It was incorporated in 1642 by the name of *Wooborne*, and was till then known by the name of *Charleſtown Village*. It contains 1727 inhabitants.—*ib.*

WOLCOTT, a townſhip of Vermont, in Orleans county, ſouth of Craftſbury, containing 32 inhabitants. La Moille river runs N. weſtward through it.—*ib.*

WOLF, a ſmall boatable river of Tenneſſee, which runs weſterly into Miſſiſſippi river, about 19 miles ſouth of Hatchy river, and 55 from Reelfoot. It is 50 yards wide ſeveral miles from its mouth, which is very near the ſouth-weſt corner of the State, in lat. 35.—*ib.*

WOLFBOROUGH, a townſhip of New-Hampſhire, Strafford county, on the E. ſide of Winnipiſiogee Lake, and contains 447 inhabitants. It contains ſome fine farms, and particularly that which formerly belonged to Gov. Wentworth.—*ib.*

WOLVES *Iſlands* lie near Campo Bello Iſland, on the eaſternmoſt coaſt of the Diſtrict of Maine. Between theſe the ſoundings are from 50 to 100 fathoms. N. lat. 44 48, W. long. 66 40. From Grand Mannan Iſland to Wolves Iſlands the courſe is N. E. by N. 3 leagues.—*ib.*

WOMELDORF, a poſt-town of Pennſylvania, in Berks county, ſituated on the weſt ſide of a ſmall ſtream which falls into Tulpehocken Creek. It contains about 40 houſes, and a German Lutheran and Calviniſt church. It is 68 miles north-weſt of Philadelphia.—*ib.*

WOODBRIDGE, a poſt-town of New-Jerſey, Middleſex county, on the great road from New-York to Philadelphia, on a ſtream which falls into Arthur Kull, above Amboy. It is about 3 miles N. by W. of Amboy, 10 ſouth-weſterly of Elizabeth-Town, and 70 N. E. of Philadelphia. The townſhip contains 3550 inhabitants, including 256 ſlaves.—*ib.*

Woodbridge, a townſhip of Connecticut, New-Haven county, about 7 miles north-weſt of New-Haven city.—*ib.*

WOODBURY, a townſhip of Vermont, in Caledonia county, 15 or 20 miles weſt-north-weſt of Barnet.—*ib.*

Woodbury, a poſt-town of New-Jerſey, and capital of Glouceſter county, ſituated near a ſmall ſtream, which empties into the Delaware below Red Bank. It contains about 80 houſes, a handſome brick court-houſe, a Quaker meeting-houſe, and an academy. Several of the houſes are neat and handſome. It is 9 miles ſouth of Philadelphia, and 11 north-eaſt of Swedeſburg. Alſo, the name of a townſhip of Pennſylvania, in Huntingdon county.—*ib.*

Woodbury, a townſhip of Connecticut, in Litchfield county, 8 miles ſouth of Litchfield. It was ſettled in 1672.—*ib.*

WOOD *Creek*, a ſluggiſh ſtream which riſes in the high lands, a little eaſt of Fort Edward, on Hudſon's river; and after running 25 miles, fails into the head of Lake Champlaine at Skeneſborough. It has a fall at its mouth, otherwiſe it is navigable for batteaux for 20 miles up to Fort Anne.—*ib.*

Wood *Creek* runs weſtward, and empties into Lake Oneida.—*ib.*

WOOD-cuts are engravings on wood, commonly on box, which, in many caſes, are uſed with advantage inſtead of copper-plates. The art of cutting or engraving on wood is undoubtedly of high antiquity; for Chineſe printing is a ſpecimen of it. (See China, n° 127. *Encycl.*) Even in Europe, if credit be due to Papillon, this art was practiſed at a period conſiderably remote; for he mentions eight engravings on wood, entitled, " A repreſentation of the warlike actions of the great and magnanimous Macedonian king, the bold and valiant Alexander; dedicated, preſented, and humbly offered, to the moſt holy father, Pope Honorius IV. by us Alexander Alberic Cunio Chevalier, and Iſabella Cunio, &c." This anecdote, if true, carries the art of cutting in wood back to 1284 or 1285; for Honorius occupied the papal throne only during theſe two years. Even this is not the remoteſt period to which ſome have carried the art in Europe; for the uſe of ſeals or ſignets being of very high antiquity, they imagine that the invention of wood-cuts muſt be coeval with them. The ſuppoſition is certainly plauſible, but it is not ſupported by proof. The earlieſt impreſſion of a wooden-cut, of which we have any certain account, is that of St Chriſtopher carrying an infant Jeſus through the ſea, in which a hermit is ſeen holding up a lantern to ſhew him the way; and a peaſant, with a ſack on his back, climbing a hill, is exhibited in the back ground. The date of this impreſſion is 1423.

In the year 1430 was printed at Haarlem, " The

hiſtory

hiſtory of St John the evangeliſt and his revelation, repreſented in 48 figures in wood, by Lowrent Janſon Cotter;" and, in 1448, Jorg Schappſ of Augſburg cut in wood the hiſtory of the Apocalypſe, and what was called *The poor man's bible.* (See ENGRAVING, *Encycl.* page 668.)

A folio chronicle, publiſhed 1493 by Schedal, was adorned with a vaſt number of wood-cuts by William Plydenwurff and Michael Wolgemut, whoſe engravings were greatly ſuperior to any thing of the kind which had appeared before them. Wolgemut was the preceptor of Albert Durer, whoſe admirable performances in this department of art are juſtly held in the higheſt eſteem even at the preſent day.

About this period it became the practice of almoſt all the German engravers on copper to engrave likewiſe on wood; and many of their wood-cuts ſurpaſs in beauty the impreſſions of their copper-plates. Such are the wood-cuts of Albert Aldtorfer, Hiſbel Pen, Virgil Soles, Lucas van Cranach, and Lucas van Lyden, the friend and imitator of Albert Durer, with ſeveral others.

It appears that the Germans carried this art to a great degree of perfection. Hans or John Holbien, who flouriſhed in 1500, engraved the *Dance of Death*, in a ſeries of wooden-cuts, which, for the freedom and delicacy of execution, has hardly been equalled, and never ſurpaſſed.

Italy, France, and Holland, have produced many capital artiſts of this kind. Joan. Tornæſium printed a bible at Lyden, in 1554 (a copy of which we have ſeen), with wooden-cuts of excellent workmanſhip. Chriſtopher Jegher of Antwerp, from his eminence in the art, was employed by Rubens to work under his inſpection, and he executed ſeveral pieces which are held in much eſtimation; the character of theſe is boldneſs and ſpirit.

The next attempt at improvement in this art was by Hugo da Carpi, to whom is attributed the invention of the *chiaro ſcuro*. Carpi was an Italian, and of the 16th century; but the Germans claim the invention alſo, and produce in evidence ſeveral engravings by Mair, a diſciple of Martin Schoen, of date 1499. His mode of performing this was very ſimple. He firſt engraved the ſubject upon copper, and finiſhed it as much as the artiſts of his time uſually did. He then prepared a block of wood, upon which he cut out the extreme lights, and then impreſſed it upon the print; by which means a faint tint was added to all the reſt of the piece, excepting only in thoſe parts where the lights were meant to predominate, which appear on the ſpecimens extant to be whitened with white paint. The drawings for this ſpecies of engraving were made on tinted paper with a pen, and the lights were drawn upon the paper with white paint.

There is, however, a material difference between the *chiaro ſcuros* of the old German maſters and thoſe of the Italians. Mair and Cranach engraved the outlines and deep ſhadows upon copper The impreſſion taken in this ſtate was tinted over by means of a ſingle block of wood, with thoſe parts hollowed out which were deſigned to be left white upon the print. On the contrary, the mode of engraving by Hugo da Carpi was, to cut the outline on one block of wood, the dark ſhadows upon a ſecond, and the light ſhadows, or half tint, upon a third. The firſt being impreſſed upon the paper, the outlines only appeared: this block being taken away, the ſecond was put in its place, and being alſo impreſſed on the paper, the dark ſhadows were added to the outlines; and the third block being put in the ſame place upon the removal of the ſecond, and alſo impreſſed upon the paper, made the dim tints, when the print was completed. In ſome inſtances, the number of blocks were increaſed, but the operation was ſtill the ſame, the print receiving an impreſſion from every block.

In 1698, John Baptiſt Michel Papillon practiſed engraving on wood with much ſucceſs, particularly in ornamental foliage and flowers, ſhells, &c. In the opinion, however, of ſome of the moſt eminent artiſts, his performances are ſtiff and cramped. From that period the art of engraving on wood gradually degenerated, and may be ſaid to have been wholly loſt, when it was lately re-invented by Mr Bewick of Newcaſtle.

This eminent artiſt was apprentice to Mr Bielby, an engraver on metal of the very loweſt order, who was ſeldom employed in any thing more difficult than the cutting of the face of a clock. Application having been made to this man for a wood-cut or two of the moſt trifling deſcription, the job was given to Thomas Bewick; by whom it was executed in ſuch a manner, that Mr Bielby, who was accuſtomed to employ his apprentices in ſuch work, adviſed him to proſecute engraving in that line. The advice was followed; and young Bewick inventing tools, even making them with his own hands, and ſawing the wood on which he was to work into the requiſite thickneſs, proceeded to improve upon his own diſcoveries, without aſſiſtance or inſtruction of any kind. When his apprenticeſhip expired, he went to London, where the obſcure wood-engravers of the time wiſhed to avail themſelves of his abilities, while they were determined to give him no inſight into their art. He remained ſome years in London; and during that time, if we miſtake not, received from the *Society for the Encouragement of Arts, &c.* a premium of conſiderable value for the beſt engraving in wood. Returning to Newcaſtle, he entered into copartnerſhip with his old maſter; and eſtabliſhed his reputation as an artiſt by the publication of his admirable Hiſtory of Quadrupeds. This was followed by his Hiſtory of Birds, of which only one volume has yet (1800) appeared.

John Bewick, brother to Thomas, learned the art of him, and practiſed it for ſeveral years in London with great applauſe. His abilities, however, though reſpectable, were not, by the beſt judges, deemed ſo brilliant as his brother's; and owing to bad health, and the nature of his connection with the bookſellers and others, he ſeems not to have advanced the art beyond the ſtage at which he received it. He died, three or four years ago, at Newcaſtle.

Mr Neſbit, who executed the admirable Hudibras publiſhed by Vernor and Hood (A), and Mr Ander-

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(A) The deſigns were by Thornton; and the cuts from them have been compared to Holbein's far-famed Dance of Death.

ſon, whoſe beautiful cuts adorn the poem entitled *Grove Hill*, were the next, and hitherto have been the laſt of Thomas Bewick's pupils, who have appeared before the public as artiſts. By theſe gentlemen we are authorized to ſay, that the method practiſed by the ancient engravers on wood, whoſe works are ſtill admired, muſt have been different from that of Bewick and his pupils. What that method was ſeems to be altogether unknown. Papillon, who writes the beſt hiſtory extant of the art, gueſſes indeed in what manner the old engravers proceeded ſo as to give to their works the ſpirit and freedom for which they are famed; but that his gueſſes are erroneous ſeems evident from the ſtiffneſs of his own works. The principal characteriſtic in the mechanical department of the productions of the ancient maſters is the croſſing of the black lines, which Papillon has attempted with the greateſt awkwardneſs, though it ſeems to have been accompliſhed by them with ſo much eaſe, that they introduced it at random, even where it could add nothing to the beauty of the piece. In Bewick's method of working, this croſs hatching is ſo difficult and unnatural, that it may be conſidered as impracticable (B).

The engravers of Bewick's ſchool work on the end of the wood which is cut acroſs the trunk of the tree, in pieces of the proper thickneſs. As wood-cuts are generally employed in the printer's preſs amidſt a form of types, this thickneſs muſt be regulated by the height of the types with which they are to be uſed. The tools employed are nearly the ſame with thoſe uſed in copperplate engraving, being only a little more deep, or lozenge, as engravers call it. They muſt have points of various degrees of fineneſs for the different purpoſes to which they are applied, ſome of them being ſo much rounded off at the bottom as to approach to the nature of a goodge, whilſt others are in fact little chiſſels of various ſizes. Theſe chiſſels and goodges, to which every artiſt gives the ſhape which he deems moſt convenient, are held in the hand in a manner ſomewhat different from the tool of the engraver on copper, it being neceſſary to have the power of lifting the chips upwards with eaſe. To attempt a deſcription of this in writing would be in vain; but it is eaſily acquired, we are told, by practice.

The pupils of the ſchool of Bewick conſider it as quite improper to ſpeak of his invention as a revival of the ancient art. Some old prints, it is true, have the appearance of being executed in the ſame way with his; but others have certainly been done by a method very different. It is therefore not fair to appreciate the preſent art by what has been done, but by what may be done; and that remains yet to be ſhewn. The art is in its infancy; and thoſe who are diſpoſed to compare it with the art of engraving on copper, ought to look back to the period when copperplate engraving was of as recent invention as Bewick's method of engraving on wood. Marc Antonio, who engraved under the direction of the great painter Raphael, thought it no mean proof of his proficiency in his art, that he was able to imitate on copper plates the wood cuts of Albert Durer; and Papillon is highly indignant that there ſhould have been perſons ſo very blind as to miſtake the copies for the originals. If copper has its advantages over wood in point of delicacy and minuteneſs, wood has, in its turn, advantages not inferior in regard to ſtrength and richneſs. Thoſe prints which were executed under the auſpices of Titian and Rubens, will always remain a monument of the ſpirit and vigour natural to wood-engraving; and if there be not found in them all the attention to *chiaro ſcuro*, which the preſent age demands, it muſt not be attributed either to defect in the art, or to want of abilities in the artiſts, but to the taſte of the times when *chiaro ſcuro* was little underſtood. It remains for ſome enterpriſing artiſt to ſhew that the vigour of the ancient art may be attained by the preſent one, and at the ſame time to add to that vigour thoſe gradations of ſhade which are ſo much admired in good copperplates. As there ſeems to be a more perfect, or at leaſt a more pleaſant black produced by wood than by copperplate printing, and certainly a more perfect white (C), who will ſay that any intermediate ſhade whatever may not be produced by wood-cuts? To attempt this on a ſmall ſcale would indeed be vain, becauſe the ſlighteſt variation, produced by a little more or leſs ink, or a harder preſſure in printing, bears ſuch a proportion to a very ſhort line, as muſt neceſſarily render the attempt abortive.

Wood-engraving, therefore, muſt always appear to diſadvantage while it is confined to ſmall ſubjects, and will never reach its ſtation *as a fine art*, till thoſe who are engaged in its cultivation improve upon the diſcoveries of one another, and apply to ſubjects to which it is properly adapted. As an *economical art* for illuſtrating mechanics and other ſubjects of ſcience, it is too little employed even in its preſent ſtate.

The works of Bewick and his pupils which have hitherto been publiſhed, are not numerous. Beſides his quadrupeds and birds, the Hudibras by Neſbit, and the Grove Hill by Anderſon, which have been already noticed, we are acquainted with none but the following:—Goldſmith's *Traveller* and *Deſerted Village* with elegant plates, all by Thomas Bewick, except one or two which were executed by John; Somerville's *Chace* by the ſame artiſts, executed in a ſtyle of elegance which perhaps has never been ſurpaſſed; a View of St Nicholas's Church, Newcaſtle, 15 inches long, by Mr Neſbit, who received for it a ſilver medal from the Society for the Encouragement of Arts, and an honorary letter from the Society of Antiquaries.

WOODFORD, a county of Kentucky, on Ohio river, between Kentucky and Licking rivers. Chief town, Verſailles.—*Morſe.*

Woodford, a townſhip of Vermont, eaſt of Bennington, adjoining. It contains 60 inhabitants.—*ib.*

WOOD *Iſland*, on the ſea-coaſt of the Diſtrict of Maine, 5 leagues north-eaſt of Cape Porpoiſe, and ſouth-weſt by ſouth 4 leagues of Richman's Iſland.—*ib.*

WOODS, *Lake of the*, the moſt northern in the United

(B) Mr Neſbit has indeed introduced ſomething of it into two or three of his pieces, merely to ſhew that he *could* do it; but ſo great was the labour, and ſo little the advantage of this improvement, if ſuch it can be called, that probably it will not be attempted again.

(C) The parts of the print intended to be white are not even touched by the wood-block.

United States, is ſo called from the large quantities of wood growing on its banks; ſuch as oak, pine, fir, ſpruce, &c. This lake lies nearly eaſt of the ſouth end of Winnipeg Lake, and is ſuppoſed to be the ſource or conductor of one branch of Bourbon river. Its length from eaſt to weſt is ſaid to be about 70 miles; and in ſome places it is 40 miles wide. Other accounts ſay it is 36 leagues in length. The Killiſtinoe Indians encamp on its borders to fiſh and hunt. This lake is the communication between the lakes Winnipeg, Bourbon, and Lake Superior.—*ib.*

WOODSTOCK, one of the principal towns of Windſor county, Vermont. It has a court-houſe and about 50 dwelling-houſes. It lies north-weſt of Windſor, adjoining, and contains 1665 inhabitants. Waterquechie river paſſes through the centre of the town, on the banks of which ſtand the meeting-houſe and court-houſe.—*ib.*

Woodstock, a townſhip of New-York, in Ulſter county, bounded eaſterly by Kingſton, Hurley and Marbletown, and weſterly by Delaware river. It contains 1025 inhabitants, including 15 ſlaves. In 1796, according to the State cenſus, 160 of the inhabitants were qualified electors.—*ib.*

Woodstock, a ſmall town of N. Carolina, on the E. ſide of Pamplico river.—*ib.*

Woodstock, a poſt-town of Virginia, ſeat of juſtice and capital in Shenandoah county. It contains between 60 and 70 houſes, a court-houſe and gaol. The inhabitants are moſtly Germans and their deſcendants. It is 12 miles from Straſburg, 40 from Rockingham court-houſe, and 222 from Philadelphia.—*ib.*

Woodstock, a conſiderable and pleaſant townſhip of good land, in the N. E. corner of Connecticut, Windham county, divided into 3 pariſhes. This townſhip, which is 7 miles ſquare, was granted by the general court of Maſſachuſetts, 7th Nov. 1783, and was ſettled by 39 families from Roxbury in 1688. This town remained under the juriſdiction of Maſſachuſetts till about the year 1760, ſince which time it has been conſidered as belonging to Connecticut. It is 66 miles S. W. of Boſton, 45 N. E. of Hartford, 22 S. W. of Worceſter, 33 N. W. of Providence, and about the ſame diſtance N. of Norwich.—*ib.*

WOODSTOWN, a poſt-town of New-Jerſey, Salem county, and contains about 40 or 50 houſes. It is 12 miles N. by E. of Salem, 31 north by weſt of Bridgetown, and 26 S. S. W. of Philadelphia.—*ib.*

WOODY *Point*, one of the limits of Hope Bay, on the north-weſt coaſt of North-America, as Breaker's is the other. It is in about lat. 50 N. and long. 128 weſt.—*ib.*

WOOL-combing, a well known operation, which, when performed by the hand, is laborious, tedious, and expenſive. The expenſe of it through all England has been calculated at no leſs a ſum than L 800.000; and to leſſen this expenſe, the Rev. Edmund Cartwright of Doncaſter in Yorkſhire bethought himſelf ſome years ago, of carding wool by machinery. After repeated attempts and improvements, for which he took out three patents, he found that wool can be combed in perfection by machinery, of which he gives the following deſcription:

Plate L. Fig. 1. Is the crank laſher. A is a tube through which the material, being formed into a ſliver, and ſlightly twiſted, is drawn forward by the delivering rollers. B, a wheel faſt upon the croſs-bar of the crank. C, a wheel, on the oppoſite end of whoſe axis is a pinion working in a wheel upon the axis of one of the delivering rollers.

Note, When two or more ſlivers are required, the cans or baſkets, in which they are contained, are placed upon a table under the laſher (as repreſented at D), which by having a ſlow motion, twiſts them together as they go up.

Fig. 2. Is the circular clearing comb, for giving work in the head, carried in a frame by two cranks. Fig. 3. The comb-table, having the teeth pointing towards the centre, moved by cogs upon the rim, and carried round upon trucks, like the head of a windmill. *a*, *b*, the drawing rollers. *c*, *d*, callender, or conducting rollers.

Note, Underneath the table is another pair of rollers, for drawing out the backings.

In the above ſpecification, we have omitted the frame in which the machine ſtands, the wheels, ſhafts, &c. Had theſe been introduced, the drawing would have been crowded and confuſed; beſides, as matters of information, they would have been unneceſſary, every mechanic, when he knows the principles of a machine, being competent to apply the movements to it.

The wool, if for particular nice work, goes through three operations, otherwiſe two are ſufficient: the firſt operation opens the wool, and makes it connect together into a rough ſliver, but does not clear it. The clearing is performed by the ſecond, and, if neceſſary a third operation. A ſet of machinery, conſiſting of three machines, will require the attendance of an overlooker and ten children, and will comb a pack, or 240lb. in twelve hours. As neither fire nor oil is neceſſary for machine-combing, the ſaving of thoſe articles, even the fire alone, will, in general, pay the wages of the overlooker and children: ſo that the actual ſaving to the manufacturer is the *whole* of what the combing coſts, by the old imperfect mode of hand-combing. Machine-combed wool is better, eſpecially for machine-ſpinning, by at leaſt 12 *per cent.* being all equally mixed, and the ſlivers uniform, and of any required length.

WOOLWICH, a townſhip of Glouceſter county, New-Jerſey.—*Morſe.*

Woolwich, a townſhip of Lincoln county, Diſtrict of Maine, on the E. ſide of Kennebeck river, S. of Pownalborough, containing 797 inhabitants.—*ib.*

WOONSOKET *Falls*, on Blueſtone river, in Smithfield townſhip, Rhode-Iſland.—*ib.*

WORCESTER, a large and populous county of Maſſachuſetts. It contains 50 townſhips, 53 Congregational churches, 510,236 acres of unimproved land, and 207,430 under cultivation, and 56,807 inhabitants. It is about 50 miles in length, from north to ſouth, and about 40 in breadth; bounded ſouth almoſt equally by the States of Connecticut and Rhode-Iſland, and north by the State of New-Hampſhire. On the eaſt it is bounded chiefly by Middleſex county, and weſt by Hampſhire county.—*ib.*

Worcester, a poſt-town of Maſſachuſetts, and capital of the above county. It is the largeſt inland town of New-England, and is ſituated about 45 miles weſt of Boſton, 52 north-eaſt of Spring-field, and 299 north eaſt of Philadelphia. The public buildings in this town are two Congregational churches, a court-houſe, and a ſtrong ſtone gaol. The inhabitants, upwards of 2000 in number, have a large inland trade, and manufacture pot and pearl aſh, cotton and linen goods, beſides ſome other articles. The compact part of the town contains about 150 neat houſes, ſituated in a healthy vale, principally on one ſtreet. Printing in its various branches, is carried on very extenſively in this town by Iſaiah Thomas, Eſq. who in the year 1791, printed two editions of the Bible, the one the large royal quarto, the firſt of that kind publiſhed in America, the other a large folio, with 50 copper-plates, beſides ſeveral other books of conſequence. His printing apparatus conſiſts of 10 printing-preſſes, with types in proportion; and he is now making preparations for the printing of Bibles of various ſmaller kinds. His printing apparatus is reckoned the largeſt in America. This townſhip, part of what was called *Quinſigamond* by the Indians, was incorporated in 1684; but being depopulated by Indian hoſtilities, the firſt town-meeting was held in 1722. It is propoſed to open a canal between Providence, in Rhode-Iſland, and this town. N. lat. 42 23, W. long. 71 44.—*ib.*

Worcester, a townſhip of Pennſylvania, in Montgomery county.—*ib.*

Worcester, the ſouth-eaſternmoſt county of Maryland, having Somerſet county and Cheſapeak Bay on the weſt, Sinepuxent Bay on the eaſt, which opens to the N. Atlantic Ocean, and Accomac county, in Virginia, on the ſouth. It is well watered by Pocomoke, Aſſatigul, and St Martin's river. It contains 11,640 inhabitants, including 3836 ſlaves. Chief town, Snow-hill.—*ib.*

Worcester, a townſhip of Vermont, in the eaſternmoſt part of Chittenden county, abount 25 miles eaſt of Burlington.—*ib.*

WORTHINGTON, a poſt-town of Maſſachuſetts, in Hampſhire county, 19 miles weſt by north of Northampton, 25 eaſt by ſouth of New-Lebanon, in New-York State, 120 weſterly of Boſton, and 289 from Philadelphia. It was incorporated in 1768, and contains 1116 inhabitants.—*ib.*

WRENTHAM, the *Wollomonuppouge* of the Indians, a conſiderable townſhip of Norfolk county, Maſſachuſetts, on the poſt-road from Boſton to Providence, 27 miles ſouth-ſouth-weſt of Boſton, and 18 north-eaſt of Providence, containing 1767 inhabitants; formerly a part of Dedham, incorporated in 1661. There is a curious cavern in this town, called *Wampom's Rock*, from an Indian family of that name who lived in it for a number of years. It is about 9 feet ſquare, and 8 feet high, leſſening from the centre to about four feet. It is ſurrounded by broken rocks, and now ſerves as a ſhelter for cattle and ſheep, as do ſeveral others here, formerly inhabited by Indians.—*ib.*

WRIGHTSBOROUGH, a ſmall ſettlement or village on Little river, a branch of the Savannah, about 30 miles from Auguſta. It was ſettled by Joſeph Mattock, Eſq. one of the Friends, who named it after Sir James Wright, then governor of Georgia, who promoted its eſtabliſhment.—*ib.*

WRIGHTSTOWN, in Buck's county, Pennſylvania, 4 miles N. of Newtown, and 4 W. of Delaware river.—*ib.*

WYACONDA, a river of Louiſiana, which falls into the Miſſiſſippi 34 miles below Riviere du Moins, —*ib.*

WYALUSING, a townſhip of Pennſylvania, Luzerne county.—*ib.*

WYALUXING *Creek*, in Luzerne county, Pennſylvania, falls into the Eaſt Branch of Suſquehannah river from the north-eaſtward, and north-weſtward of Meſhoppen Creek, which is 33 miles ſouth-eaſt of Tioga Point.—*ib.*

WYMOA *Road*, in the North Pacific Ocean, a place of anchorage at Atooi Iſland, one of the Sandwich Iſlands, in lat. 21 57 north, and long. 159 47 weſt. It is at the ſouth-weſt ſide, and about 6 miles from the weſt end of the iſland. The iſland is about 10 leagues long, and 25 leagues north-weſt of Woahoo Iſland.—*ib.*

WYONDOTTS, or *Wiandats*, an Indian nation reſiding near Fort Detroit, in the neighbourhood of the Ottawas and Putawatimes, whoſe hunting grounds are about Lake Erie. The number of warriors, 20 years ago, were, Wyondotts 250, Ottawas 400, Putawatimes 150. Another tribe of the Wyondotts live near Sanduſky, among the Mohickons and Caghnawagas, who together have 300 warriors. At the treaty of Greenville, in conſequence of lands ceded to the United States, the latter agreed to pay them a ſum in hand, and in goods to the value of 1000 dollars a year forever.—*ib.*

WYNTON, the chief town of Hertford county, Edenton diſtrict, North-Carolina.—*ib.*

WYOMING, a general name formerly given to a tract of country in Pennſylvania, ſituated on Suſquehannah river, above Wilkſbarre. In the year 1778, the ſettlement which was known under this name, conſiſted of 8 townſhips, each containing 5 miles ſquare, ſettled from Connecticut, and originally under its juriſdiction, and produced great quantities of grain of all ſorts, fruit, hemp, flax, &c. inhabited by about 1000 families, who had furniſhed the continental army with near 1000 ſoldiers, beſides various ſupplies of proviſions, &c. In the month of July, all theſe flouriſhing ſettlements were reduced by the Indians and tories to a ſtate of deſolation and horror, almoſt beyond deſcription. In the vicinity of Wyoming is a bed of coal, of the open burning kind, which gives a very intenſe heat. Wyoming Falls lie about 2 miles above Wilkſbarre, and 8½ miles above Nantikoke Falls. N. lat. 41 14, W. long. 75 53. —*ib.*

WYONOKE *Creek*, in N. Carolina, lies within or about lat. 36 30 N. The charter of Carolina, in 1664, extended the bounds eaſtward as far as the north end of Currituck Inlet, upon a ſtraight line weſterly to this creek.—*ib.*

WYTHE, a county of Virginia, ſaid to be 120 miles in length, and nearly 50 in breadth; bounded north by Kanhaway, and ſouth by the ſtate of North Carolina. Its population in 1790 was included in Montgomery county. There are lead mines in this county, on the Great Kanhaway, 25 miles from the line of N. Carolina, which yield from 50 to 80lbs. pure lead from 100lbs waſhed ore, but moſt commonly 60 to 100. Two of them are worked by the public; the beſt of which is 100 yards under the hill; and although there are not more than 30 labourers generally employed, they might employ 50 or 60 to advantage. The labourers cultivate their own corn. Twenty,

twenty-five and ſometimes ſixty tons of lead have been extracted from theſe mines in a year. Chief town, Evanſham. The court-houſe is on the poſt-road from Richmond to Danville, in Kentucky, 301 miles from the former, and 323 from the latter. It is 46 miles from Montgomery court-houſe, 57 from Abingdon, and 454 from Philadelphia. A poſt-office is kept here.—*ib.*

X.

Xagua, || Xaliſco. Xarayes, || Xeres.

XAGUA, a harbour on the S. E. coaſt of the iſland of Cuba, and one of the fineſt ports in the Weſt-Indies. It lies between the Iſlands of Pines, or Pinez, and Spirito Santo.—*Morſe.*

XAINTES, Santos, or *All Saints Iſlands,* ſo named from their being diſcovered on that Holy Day, by the Spaniards, on the S. E. ſide of the iſland of Gaudaloupe, and in its juriſdiction. The moſt weſterly of theſe three iſles is called Terre de Bas, or the Low Iſland, and the moſt eaſterly Terre de Haut, or the High Iſland. The third, which lies exactly in the middle between the other two, is little other than a barren rock, and helps to form a very good harbour.—*ib.*

XALISCO, a province of New-Spain, and the moſt ſoutherly on the coaſt of Guadalajara audience. It is bounded S. and W. by the South Sea; E. by Guadalajara Proper, and Mechoacan, and divided from Chiametlan, on the N. by a narrow ſlip of land belonging to Guadalajara, extending into the ſea. It is not above 150 miles in extent either way. It has ſilver mines, and abounds with Indian wheat, but has few cattle. The oil of the *Infernal Fig-tree,* as the Spaniards call it, is brought from this province. It is ſaid to be efficacious in diſſolving tumors, expelling of wind, and all cold humours, by anointing the belly, and taking a few drops of it in a glaſs of wine, as alſo by clyſters. It is alſo ſaid to cure ulcers in the head, and deafneſs. The Indians are numerous here, and are reckoned braver and more polite than their neighbouring countrymen. The Xaliſco, an ancient city, is the capital, yet the moſt conſiderable place in it is Compoſtella.—*ib.*

XARAYES, *Laguna de los,* a large lake of Paraguay, in S. America, formed by the river Paraguay, in its courſe from north to ſouth.—*ib.*

XERES *de la Frontera,* a town in the ſouthernmoſt part of Zacatecas, a province of Guadalajara audience, in New Spain, in N. America. It is garriſoned for defending the mines againſt the hoſtile Indians.—*ib.*

Y.

Yabaque, || Yadkin. Yagarchoca, || Yago.

YABAQUE, one of the Lucayos or Bahama Iſlands, ſituated ſouth-weſt of Meguana Iſland. N. lat. 22 30.—*Morſe.*

YADKIN, a conſiderable river of N. Carolina, which riſes in the Alleghany Mountains, running E. about 60 miles, then turning to the S. S. E. paſſes the Narrows, a few miles above Rocky river; thence directing its courſe through Montgomery and Anſon counties, enters S. Carolina. It is about 400 yards broad where it paſſes Saliſbury, but it is reduced between 2 hills, about 25 miles to the ſouthward of that town, to the width of 80 or 100 feet. For 2 miles it is narrow and rapid, but the moſt narrow and moſt rapid part is not above half a mile in length. In this narrow part, ſhad are caught in the ſpring of the year, by hoop nets, in the eddies, as faſt as the ſtrongeſt men are able to throw them out. Perhaps there is not in the United States a more eligible ſituation for a large manufacturing town. Boats with 40 or 50 hogſheads paſs eaſily from theſe Rapids to Georgetown. The late war, by which N. Carolina was greatly convulſed, put a ſtop to ſeveral iron-works. At preſent there are 4 or 5 furnaces in the State that are in blaſt, and a proportionable number of forges. There is one in Guilford county, one in Surry, and one in Wilkes, all on the Yadkin. From the mouth of Rocky River to the ocean, the ſtream aſſumes the name of *Great Pedee.*—*ib.*

YAGARCHOCA, a lake of Quito, within the limits of the juriſdiction of San Miguel de Ibarra. It is famous for having been the ſepulchre of the inhabitants of Otabalo, when taken by Huayna Capac, the 12th Inca; who, inſtead of rewarding their magnanimity with clemency, was irritated at the noble reſiſtance which they made againſt his army, ordered them all to be beheaded, and their bodies to be thrown into the lake; hence its name, which ſignifies a lake of blood. —*ib.*

YAGO, *St,* or *St James,* an ancient town on the N. ſide of St Domingo Iſland, founded before 1504, and the country round is reckoned as healthy as any in the iſland. It is ſituated on the high road from La Vega to Daxavon; 10 leagues weſt by north of the former, and 28 eaſterly of the latter, and about 10 from the anchoring-place of St Yague, and nearly as far from

Port

Port de Plate. It ſtands on the northern ſide of the river Yaqui, in a ſavannah commanding the river. The town is open, and regularly laid out, and contains above 600 houſes. It is 52 leagues N. N. W. of St Domingo city, 34 weſt by north of the bottom of Samana Bay, and 22 N. W. of Cotuy. The territory of St Yago, or Jago, contains 28,000 ſouls, and is very fertile in mines. The ſand of Green and Yaqui rivers is mixed with gold. Mercury is found at the head of the latter river, and copper is alſo found in this territory. The tree, guatapana, which retains its Indian name, is found here. It bears a ſort of grain or pod, from which is extracted a very fine black dye. —*ib.*

YAGUACHE, a lieutenancy of Guayaquil juriſdiction, in South-America. It lies at the mouth of the river of the ſame name, which empties into that of Guayaquil on the ſouth ſide, and has its ſource from the ſkirts of the Cordilleras, ſouth of the river Bamba. Within its juriſdiction are 3 towns; the chief of which is that where the cuſtom-houſe is erected, and called San Jacint de Yaguache; the 2 others are Nauſa and Antonche. It produces wood, cocoa, cattle, and cotton.—*ib.*

YAMACRAW, the ancient Indian name of the ſpot where Savannah, in Georgia, is erected.—Alſo the name of a tribe of the Creek Indians.—*ib.*

YAQUE, *Port St*, vulgarly called *Old Port*, a ſmall anchoring place on the N. ſide of the iſland of S. Domingo; ſituated between Padrepin on the weſt, and Macoris Point on the eaſt.—*ib.*

YAQUI, *Grand*, or *Monte Chriſt River*, a river of the north part of the iſland of St Domingo, which runs a weſt-north-weſt courſe, and empties into the Bay of Monte Chriſt. It might be aſcended in canoes or ſmall boats, for 15 leagues, were it not for the limbs of trees which lodge in it. All its numerous branches are from the ſouthward.—*ib.*

YARDSLEY's *Ferry*, on Delaware river, is 3 miles north-weſterly of Trenton, in New-Jerſey, and 5 below M'Crankey's Ferry.—*ib.*

YARI, a town in Amazonia, South-America, at the head of a branch of Amazon river, ſouth-weſterly from Macapa.—*ib.*

YARMOUTH, a poſt-town of Maſſachuſetts, Barnſtable county, on the neck of the peninſula of Cape-Cod, 4 miles E. of Barnſtable, 12 E. by S. of Sandwich, 110 ſouth-weſt of Boſton, and 427 from Philadelphia. The townſhip extends from ſea to ſea. It was incorporated in 1639, and contains 2,678 inhabitants.—*ib.*

Yarmouth, a townſhip of Nova-Scotia, in Queen's county, ſettled by New-Englanders. It lies at the head of a ſhort bay, 8 miles ſouth-eaſt of Cape St Mary.—*ib.*

YARUQUI, a plain 4 leagues north-eaſt of the city of Quito, and 249 toiſes lower than it. Near it is a village of the ſame name. This ſpot was pitched upon as the baſe of the whole operations for meaſuring the length of an arch of the meridian, by Ulloa.—*ib.*

YAZOO *River*, in Georgia Weſtern Territory, conſiſts of 3 large branches which run a ſouthern courſe, and near its mouth theſe unite and purſue a ſouth-weſt courſe a few miles, and the confluent ſtream enters the eaſtern bank of the Miſſiſippi, by a mouth upwards of 100 yards wide; according to Mr Gauld, in lat. 32 37 N. and by Mr Purcel, in 32 28.—*ib.*

Yazoo *Cliffs*, or *Aux Cotes*, lie 7½ miles from the river Yazoo, and 39¾ miles from Louſa Chitto, or Big Black river.—*ib.*

YBAGUE, a city of New-Granada, in Terra Firma, South-America.—*ib.*

YCA, or *Valverde*, or the *Green Vale*, from a valley of the ſame name planted with vines, which is 6 leagues long, and produces plenty of wine. It is about 41 miles ſouth-eaſt of Piſco, in Peru, and is inhabited by 500 Spaniards. It is a beautiful and rich town, having a large church, 3 convents, and an hoſpital. About 6 leagues from the town is its port, called Puerto Quemada.—*ib.*

YCAQUE, or *Icaco*, the northern point of the bay of Mancenilla, in the iſland of St Domingo.—*ib.*

YLO, a port of Peru, in Los Charcos, convenient for loading and unloading, in lat. 18 S. The town of the ſame name, lies about a quarter of a league to the windward of the river, and is inhabited by Indians. Frezier calls it *Hilo*.—*ib.*

YOHOGANY, the principal branch of Monongahela river, called alſo *Youghiogeny*, and *Yoxhiogeni*, purſues a north-weſterly courſe, and paſſes through the Laurel Mountain, about 30 miles from its mouth; is, ſo far, from 300 to 150 yards wide, and the navigation much obſtructed in dry weather by rapids and ſhoals. In its paſſage through the mountain it makes very great falls, admitting no navigation for 10 miles, to the Turkey-foot. Thence to the Great Croſſing, about 20 miles, it is again navigable, except in dry ſeaſons, and at this place is 200 yards wide. The ſources of this river are divided from thoſe of the Patowmack, by the Alleghany Mountain. From the falls, where it interſects the Laurel Mountain, to Fort Cumberland, the head of the navigation to the Patowmack, is 40 miles of very mountainous road. The country on this river is uneven, but in the vallies the ſoil is extremely rich. Near to Pittſburg the country is well peopled, and there, as well as in Redſtone, all the comforts of life are in the greateſt abundance. This whole country abounds with coal, which lies almoſt on the ſurface of the ground.—*ib.*

YONKERS, a townſhip of New-York, in Weſt Cheſter county, bounded eaſterly by Bronx river, and weſterly by the county of York and Hudſon's river. It contains 1125 inhabitants, of whom 139 are electors, and 170 ſlaves.—*ib.*

Yonkers, a poſt-town of New-York, 114 miles from Philadelphia.—*ib.*

YORK, a river of Virginia, which takes its riſe near the Blue Ridge, and empties into the Cheſapeak, a little to the S. of Mobjack Bay. At York-Town it affords the beſt harbour in the State, which will admit veſſels of the largeſt ſize. The river there narrows to the width of a mile, and is contained within very high banks, cloſe under which the veſſels may ride. It has 4 fathoms water at high tide, for 20 miles above York, to the mouth of Poropotank, where the river is a mile and a half wide, and the channel only 75 fathoms, paſſing under a very high bank. At the confluence of Pamunky and Mattapony it has but 3 fathoms depth, which continues up Pamunky to Cumberland, where the width is 100 yards, and up Mattapony to within 2 miles of Frazer's Ferry, where it becomes 28½ fathoms deep, and holds that about 5 miles.—*ib.*

YORK, a river of York county, Diſtrict of Maine, which runs up 7 or 8 miles, and affords a tolerable harbour for veſſels under 200 tons. The rocks, however, render it ſomewhat difficult and hazardous for ſtrangers.—*ib.*

YORK, a maritime and populous county of the Diſtrict of Maine, bounded E. and N. E. by Cumberland, S. by the ocean, W. by New-Hampſhire, from which it is ſeparated by Salmon Fall River, and N. by Canada. It is well watered by Saco, Mouſom, and other ſtreams, and is divided into 27 townſhips, and contains 28,821 inhabitants. Chief town, York.

YORK, a poſt-town of the Diſtrict of Maine, in York county, 9 miles N. E. of Portſmouth, in New-Hampſhire, 20 S. of Wells, 48 S. by W. of Portland, 75 from Boſton, and 421 from Philadelphia. N. lat. 43 16. It is a port of entry and capital of the county. The river of its name empties into York harbour at the town. It is navigable for veſſels of 250 tons. About a mile from the ſea is a wooden bridge acroſs the river, 270 feet in length, which was erected in 1761. Before the war, 25 or 30 veſſels were employed in the Weſt-India trade, and coaſting buſineſs, but their veſſels were taken or deſtroyed, and little marine buſineſs is now done, except that a ſmall fiſhery is ſupported. This townſhip was ſettled in 1630, and called *Agamenticus*, from the hill of that name which is a noted land-mark for mariners. In 1640, Sir Ferdinand Gorges incorporated a great part of it by the name of *Georgiana*. In the year 1692, the Indians took the town by ſurpriſe, and burnt moſt of the houſes, and 150 perſons were killed or captivated. It contained, according to the cenſus of 1790, 2900 perſons. Fiſh of various kinds frequent the rivers and ſhores of the ſea contiguous. In a calm ſeaſon, in the ſummer, one may ſtand on the rocks of the ſhore, and catch them, in the ſea, with a line, or even with an angling rod, and a fathom or two of line.—*ib.*

YORK, a county of Pennſylvania, bounded E and N. E. by Suſquehannah river, which ſeparates it from Lancaſter and Dauphine counties, and S. by the State of Maryland. It contains 29 townſhips, and 37,747 inhabitants.—*ib.*

YORK, a poſt-town and capital of the above county, ſituated on the eaſt ſide of Codorus Creek, which empties into the Suſquehannah. It contains about 500 houſes, ſeveral of which are of brick. The town is regularly laid out; the public buildings are a court-houſe, a ſtone gaol, a record-office, handſomely built, an academy, a German Lutheran, a German Calviniſt, a Preſbyterian, Roman Catholic, and Moravian church, and a Quaker meeting houſe. It is 22 miles W. S. W. of Lancaſter, 51 N. W. by N. of Hartford, in Maryland, 199 N. E. of Staunton, in Virginia, and 88 W. of Philadelphia.—*ib.*

YORK, a county of S. Carolina, in Pinckney diſtrict; bounded E. by Catawba river, N. by the State of North-Carolina; S. by Cheſter county, and W. by Broad River, which divides it from Spartanburg, and is one of the moſt agreeable and healthy counties in the State, and well watered by Catawba and Broad rivers, and their tributaries. It contains 6604 inhabitants, of whom 5652 are whites, and 923 ſlaves. Here are extenſive iron-works. This county ſends three repreſentatives and one ſenator to the State Legiſlature.—*ib.*

YORK, a county of Virginia, bounded north by York river, which divides it from Glouceſter county, ſouth by Warwick; eaſt by Elizabeth City county, and weſt by that of James City. It contains 5233 inhabitants, of whom 2760 are ſlaves.—*ib.*

YORK, or *Yorktown*, a port of entry and poſt-town of Virginia, and capital of York county. It is agreeably ſituated on the ſouth ſide of York river, where the river is ſuddenly contracted to a narrow compaſs, oppoſite to Glouceſter, and a mile diſtant, where there is a fort fronting that on the York ſide, about 11 miles weſt by ſouth of Toes Point, at the mouth of the river. The banks of the river are very high, and veſſels of the greateſt burden may ride cloſe under them with the greateſt ſafety. It contains about 60 or 70 houſes, a gaol, an Epiſcopal church, and a tobacco ware-houſe. In 1790, it contained 661 inhabitants, of whom 372 were ſlaves. Its exports, in the year 1794, amounted to 71,578 dollars. It will ever be famous in the American annals for the capture of Lord Cornwallis and his army by the combined force of the United States and France, which took place on the 19th of October, 1781. It is 12 miles E. by S. of Williamſburg, 21 N. W. of Hampton, 72 E. S. E. of Richmond, and 350 S. S. W. of Philadelphia. N. lat. 37 22 30, W. long. 76 52.—*ib.*

YORK, a town of Upper Canada, ſituated on the north-weſtern ſide of Lake Ontario, and is deſigned to be the future ſeat of government of that province. The public buildings are erecting. It is 40 miles N. by W. of Niagara Fort, and 120 W. S. W. of Kingſton. N. lat. 43 57, W. long. 80 35.—*ib.*

YORK *Bay* is 9 miles long, and 4 broad, and ſpreads to the ſouthward before the city of New-York. It is formed by the confluence of Eaſt and Hudſon's rivers, and emboſoms ſeveral ſmall iſlands, of which Governor's Iſland is the principal. It communicates with the ocean through the *Narrows*, between Staten and Long Iſlands, which are ſcarcely 2 miles wide. The paſſage up to New-York, from Sandy Hook, the point of land that extends furtheſt into the ſea, is ſafe, and not above 20 miles in length. The common navigation is between the eaſt and weſt banks, in about 22 feet water. The light-houſe at Sandy-Hook is in lat. 40 30 N. and long. 74 2 W.

YORK *Fort*, on the S. W. ſhore of Hudſon's Bay, at the mouth of Port Nelſon river, is 160 miles weſterly of Severn Houſe. N. lat. 57 1 51, W. long. 92 46 40.—*ib.*

YORK *Iſle*, or *Iſlands*, lie in S. lat. 50 37, about 50 leagues from the coaſt of Patagonia, in South-America, and are inhabited. Trinity Iſle lies due eaſt of them, near the main land.—*ib.*

YORK *Ledge*, on the coaſt of the Diſtrict of Maine. From York Harbour to York Ledge, the courſe is S. E. 2 leagues.—*ib.*

YORK *Minſter*, on the S. coaſt of the iſland Terra del Fuego, is 19 leagues at E. S. E. from Gilbert Iſland. S. lat. 55 26, W. long. 70 25.—*ib.*

YORK *Road*, or *Bay*, in the Straits of Magellan, in S. America, is 10 miles from Cape-Croſs Tide. S. lat. 53 39, W. long. 73 52.—*ib.*

YORKTOWN, a townſhip of New-York, Weſt-Cheſter county, bounded weſterly by the town of Cortland, and northerly by Dutcheſs county. In 1790, it contained 1609 inhabitants, including 40 ſlaves. In 1796, according to the State cenſus, there were 210 of the inhabitants electors.—*ib.*

YUCATAN, one of the ſeven provinces of the audience of Mexico, in New Spain. The Britiſh had a right to cut logwood and carry it away, by the treaty of 1783, in the tract between Rio Honde and Balize rivers.—*ib.*

YUNA, a river of the iſland of St Domingo, which runs an E. S. E. and E. courſe, and empties into the W. end of the Bay of Samana. It riſes near Monte Chriſt river. It is navigable no farther than Cotuy, 13 leagues from its mouth.—*ib.*

Z.

ZACATECAS, a province of New-Spain, bounded by New Biſcay on the N. by Panuco on the E. Mechoacan, Guadalajara, and Chiametlan, on the S. and by part of Chiametlan and Culiacan on the W. It is well inhabited, and abounds with large villages. The mines here are reckoned the richeſt in America.—*ib.*

ZACATECAS, the capital of the above province, ſituated under the tropic of Cancer, 40 leagues N. of Guadalajara, and 80 N. W. of Mexico. Its garriſon conſiſts of about 1000 men, and there are about 800 families of ſlaves, who work in the mines and other laborious work. N. lat. 23 29, W. long. 103 20.—*ib.*

ZACATULA, a ſmall ſeaport-town of the province of Mechoacan, ſituated at the mouth of the river of the ſame name, on the coaſt of the Pacific Ocean. N. lat. 17 22, W. long. 104 58.—*ib.*

ZACHEO, or *Deſechio*, a ſmall iſland, 8 or 9 leagues to the N. E. by N. of Mona, between the iſland of St Domingo and that of Porto Rico. It is nothing more than a green mountain, 800 or 1000 yards long.—*ib.*

ZAMINY, in the language of Bengal, ſecurity.

ZAMORA, a city of Peru, in S. America, 200 miles ſouth of Quito, which is pretty large, and the houſes well built of timber and ſtone. The church and convent of Dominicans, are both elegant ſtructures. There are ſeveral gold mines in the neighbourhood of the city, but few of them are worked. S. lat. 4 10, W. long. 77 5.—*Morse.*

ZAPOTECHAS, a river of New-Spain which runs north-eaſtward into the Gulf of Mexico. A fort of the ſame name ſtands on the N. W. bank of the river, about 250 miles S. E. from the city of Mexico.—*ib.*

ZELITO, or *Ziltio*, one of the forts for the protection of the harbour of Carthagena, on the N. coaſt of S. America.—*ib.*

ZEMINDARS, the great landholders of Bengal. This is the original ſenſe of the word; but it is now more ſtrictly applicable to thoſe who have their title conſtituted or confirmed by a patent or charter from government, by which they hold their lands or Zemindaries upon certain conditions. As far as can be aſcertained from the narrations of hiſtory, it appears that, in times prior to the irruptions of the Mahomedans, the rajahs who held their reſidence at Delhy, and poſſeſſed the ſovereignty of Hindoſtan, deputed officers to collect their revenues (Kheráje), who were called in the Indian language *Choudheries*. The word *Zemindar* is Perſian, and that language can have had no currency in the countries of India, until it was introduced by the people of Perſia. When the Emperor Shehâb-ul-Dien Ghory conquered the empire of Hindoſtan (A), he left Sultan Cutub-ul-Dien to be his viceroy at Delhy, and adminiſter the government of Hindoſtan. From that time the cuſtoms and practices of the Mahomedans began gradually to be eſtabliſhed in India; their armies were ſent into the countries of the reduced Rajahs, under the command of Omrahs, in order to preſerve the conqueſt; and lands were allotted to them to defray the expenſe. From hence aroſe the ſyſtem of Jaghiredarry in Hindoſtan. But when theſe Omrah Jaghiredars had eſtabliſhed their own ſtrength, ſeveral of them rebelled againſt the imperial authority, and aſpired at the crown. Thus circumſtanced, the emperors, in order to obviate theſe miſchiefs, thought it would be more politic to commit the management of the country to the native Hindoos, who had moſt diſtinguiſhed themſelves by the readineſs and conſtancy of their obedience to the ſovereign power.

In purſuance of this plan, diſtricts were allotted to numbers of them under a reaſonable revenue (Jummah Monáſib), which they were required to pay in money to the governors of the provinces, deputed from the Emperor. And in caſe any one of the Omrahs or provincial governors ſhould ſwerve from his allegiance, the Zemindars of that country were to exert themſelves in ſuch a manner as ſhould check rebellion, and reſtore good government. For this purpoſe, grants of Zemindary were ſeverally conferred upon ſuch of the Hindoos as were obedient; deſcribing their apportionment of the country; and every perſon who had received a grant under the authority of the crown was thereby fully inveſted with the functions of Zemindar.

The functions of a Zemindar are, 1ſt, The preſervation and defence of their reſpective boundaries from traitors and inſurgents; 2dly, The tranquillity of the ſubjects, the abundance of cultivators, and increaſe of his

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(A) This event took place towards the cloſe of the 12th century. N. B. *Kheráje* ſignifies ſpecifically the tribute paid by a conquered country.

his revenue. 3dly, The puniſhment of thieves and robbers, the prevention of crimes, and the deſtruction of highwaymen. The accompliſhment of theſe objects is conſidered in the royal grant as the diſcharge of office to the ſovereign; and on that account the word *office* (Khidmut) is employed in the Dewanny Sunnud for a Zemindary.

It was a rule in the times of the ancient emperors, that when any of the Zemindars died, their effects and property were ſequeſtrated by the government. After which, in conſideration of the rights of long ſervice, which is incumbent on ſovereigns, and elevates the dignity of the employer, Sunnuds for the office of Zemindary were granted to the children of the deceaſed Zemindar; and no other perſon was accepted, becauſe the inhabitants could never feel for any ſtranger the attachment and affection which they naturally entertain for the family of their Zemindar, and would have been afflicted if any other had been put over them. For this reaſon, the emperors, conſidering it as a means of conciliating the minds of the people, graciouſly fixed and confirmed the children of the deceaſed Zemindar in the office of their fathers and grandfathers, by iſſuing new ſunnuds to transfer the poſſeſſion to them. By degrees Zemindaries became truly heritable property, which, however, could be transferred by gift or ſale from one family to another. They could likewiſe be forfeited to the ſovereign, by the Zemindar's deviating from his allegiance, neglecting to pay his tribute, or to diſcharge the duties of his ſtation.

It is univerſally known, ſays Sir Charles Rouſe Boughton, that, when the three provinces of Bengal, Bahar, and Oriſſa, were ceded to the Britiſh Eaſt-India Company, the country was diſtributed among the Zemindars and TALOOKDARS (ſee that article in this Vol.), who paid a ſtipulated revenue, by twelve inſtalments, to the ſovereign power or its delegates. They aſſembled at the capital in the beginning of every Bengal year (commencing in April), in order to complete their final payments, and make up their annual accounts; to ſettle the diſcount to be charged upon their ſeveral remittances in various coins for the purpoſe of reducing them to one ſtandard, or adjuſt their concerns with their bankers; to petition for remiſſions on account of ſtorms, drought, inundation, diſturbances, and ſuch like; to make their repreſentations of the ſtate, and occurrences of their diſtricts: after all which they entered upon the collections of the new year; of which, however, they were not permitted to begin receiving the rents from their own farmers, till they had completely cloſed the accounts of the preceding year, ſo that they might not encroach upon the new rents, to make up the deficiency of the paſt. Our author proves, we think completely, the right of the Zemindars to transfer their poſſeſſions, either by inheritance to their children, or, with the conſent of the ſovereign, to other families; and he argues ſtrenuouſly and ſucceſsfully againſt the bad policy, as well as injuſtice, of interfering with thoſe rights, as long as the Zemindars diſcharge the duties of their ſeveral ſtations.

ZINOCHSAA, the original name of a river of New-York, which runs through Onondago, the chief town of the Six Nations.—*Morse*.

ZITAR, a town of Terra Firma, S. America, near to and ſouth from the head of the Gulf of Darien.—*ib.*

ZOAR, a plantation in Berkſhire county, Maſſachuſetts, containing 78 inhabitants.—*ib.*

ZONCOLCUCAN, mountains in Guaxaca, in New-Spain, which give riſe to Papalo-apain or Alvarad river.—*ib.*

ZONESHIO, the chief town of the Seneca Indians, 2 miles N. of Seneca Lake.—*ib.*

APPENDIX.

THE importance of every invention which tends to facilitate Navigation is ſuch as to entitle it to be recorded for the benefit of mankind, particularly in Commercial Nations. In this view the accounts of the Artificial Horizon and the New Log are preſented to our readers from the Specifications of the Patents obtained by Cheſter Gould, the Inventor of the *Artificial Horizon*. He ſays, "My invention conſiſts in applying a fluid or fluids coloured, or otherwiſe, to the quadrant or ſextant, ſo as to obtain a level for the purpoſe of taking the altitudes of celeſtial and other ſubjects, on land or water, without the aſſiſtance of the natural horizon. This I perform in the manner following: that is to ſay, I make a circular tube or ring of braſs, or of other proper ſubſtance, from two to three inches in diameter, or more or leſs, as convenience may direct, in which I fit four tranſparent glaſſes, directly oppoſite to, and parallel with, each other, ſo that the ſurfaces of the fluid contained in the tube may be diſtinctly ſeen by the obſerver. The inſide of this tube, which is to contain the fluid, may be equal in area to a tube of about one-fourth part of an inch in diameter, or even more, and when in uſe ſhould be about half filled with ſome tranſparent fluid, and it ſhould be fixed to a ſmall apparatus made of braſs or other proper ſubſtance, with ſuch joints and adjuſtments as are neceſſary to bring it to its true poſition on the quadrant or ſextant.

"The artificial horizon, repreſented in the annexed drawing, I conſider to be moſt proper for general uſe.

"Fig. A, in the drawing (ſee Appendix, Plate III.), repreſents the whole inſtrument with the artificial horizon put together; *m*, repreſents the ſcrew which binds the cramp *n* to the frame of the quadrant or ſextant, ſo that the ring or tube of the artificial horizon will ſtand directly behind the fore horizon glaſs. The poſition of the tube or ring ought to be ſuch, that its plane will be parallel to the plane of the quadrant or ſextant, and ſo alſo that the centre of its glaſſes and the hole of the foreſight vane of the quadrant or ſextant, which is intended to be uſed, ſhould form a line parallel to the chord of the arch, and to the plane of the quadrant or ſextant at the ſame time. Its true poſition on the quadrant or ſextant being obtained, and the ring or tube being filled as is above deſcribed up to the centre of its glaſſes, and the quadrant or ſextant being held in a vertical poſition, the ſurface of the fluid may be brought to form a perfect level with the eye of the obſerver. This being done, the object whoſe altitude is to be taken is then reflected down to this fluid level, in the ſame manner as when altitudes are taken by a ſea horizon.

"The whole inſtrument may be varied in its form, ſcale and proportion, the tube may be filled with mercury, but I prefer a tranſparent fluid; and, in order to retard the too ſudden motion of the fluid, I make an adjuſtment in the bottom of the tube (either fixed or moveable) by which the motion of the fluid is obſtructed and regulated at pleaſure. I have in ſome inſtances uſed coloured glaſſes, but for general uſe I prefer the plain; in either caſe the ſurfaces ſhould be well ground and finely poliſhed. I have alſo uſed two tubes or rings, ſo placed, that, when the inſtrument is in uſe, the level is formed by an apparent contact of one of the ſurfaces of the fluid in each tube, but I think a ſingle tube or ring to be much preferable.

"I prefer the artificial horizon made and uſed as above deſcribed, but it may be ſo conſtructed as to be connected with a teleſcope, ſuch as is frequently applied to quadrants or ſextants, by which means the ſurfaces of the fluid, and their contact with the image of the ſun or any other body, may be more exactly determined, and this may be effected whether the inſtrument is intended to be fitted up with two rings or with one only. As the form of the teleſcope and of the artificial horizon as well as the mode of connecting them together admit of great variety, I inſtance the following examples; that is to ſay,

"The firſt example ſhall be where only one ring or tube is uſed. In this caſe I make the tube of ſuch a figure, that one pair of the glaſſes occupy the field of the teleſcope, between which glaſſes one of the ſurfaces of the fluid appears, and the other ſurface of the fluid is put ſo much out of the axis of the teleſcope, as not to obſtruct the light from the object glaſs, and by placing a horizontal wire, or by drawing a horizontal line acroſs one of the glaſſes, the inſtrument being previouſly adjuſted, and ſo held or placed, that the ſurface of the fluid in the tube between the glaſſes and the wire or line is made to correſpond. The image of the ſun or other object may be brought to touch the wire or line at the ſame time by moving the index of the quadrant or ſextant, and the altitude may be read off upon the arch as in common caſes.

"The ſecond example ſhall alſo be with one tube or ring only, and where both the ſurfaces of the fluid ſhall appear as in the field of the teleſcope. In this caſe, I cut off one half of the object glaſs of the teleſcope commonly uſed, ſuppoſing it to be divided by a line parallel to the plane of the inſtrument, and inſtead of the part taken away I place half of another object glaſs, whoſe focus is equal to one half of the focus of the original object glaſs, and I encreaſe the diſtance between the ſurfaces of the fluid to twice the focal diſtances of the original glaſs, and by placing one ſurface of the fluid in the field of the teleſcope, as in the firſt example, and the other ſurface in the axis of the teleſcope produced, the inſtrument being adjuſted, that ſurface of the fluid neceſſarily placed behind the object glaſs will appear to meet the ſurface of the fluid placed in the field of the teleſcope, and to which the image of the ſun can be made to coincide as in the firſt example.

"The laſt example ſhall be where two tubes or rings are uſed. In this caſe I place one of the rings or tubes as in the firſt example, that is to ſay: one of the ſurfaces of the fluid in the field of the teleſcope, and the other out of the axis of the teleſcope and towards the object glaſs, and I place the ſecond ring or tube with one ſurface.

face in the field of the teleſcope as near to the firſt as poſſible, and the other ſurface of the ſecond ring or tube out of the axis and towards the eye-glaſs of the teleſcope, the inſtrument being adjuſted, and held or placed, ſo that the two ſurfaces placed in the field and both brought into contact with the wire or horizontal line, the image of the ſun or other object may be made to coincide, and the altitude read as in the two preceding examples.

"Although the foregoing deſcription of the artificial horizon is agreeable to the form in which I now make it, and which in my opinion is the beſt, yet there are other forms in which it may be made ſo as to produce nearly the ſame effect, for a fluid will become level in a tube made in the form of a ſquare, parallelogram, or triangle, or any other form, but a circular tube being more eaſily made, I give it the preference; and notwithſtanding I fix the ring of the artificial horizon at the back-ſide of the fore horizon glaſs of the quadrant or ſextant, it being ſuited to the uſe of both theſe inſtruments, yet a good effect may be produced by fixing it to the other parts of theſe inſtruments, provided the ſurfaces of the fluid are diſtinctly ſeen by the obſerver, either directly or by reflection."

The new log for aſcertaining a ſhip's diſtance at ſea, for which Mr Gould has alſo obtained a patent, conſiſts of a rotator or adjuſtable fly, connected by a line or chain, with a regiſter which may be kept on board the veſſel. The fly is compoſed of four vanes or wings placed both angularly and conically, ſo as to produce a rotary motion round the centre piece adjuſted by a regulator. "This fly (ſays the inventor) on which accuracy of meaſurement by the log wholly depends, is compoſed of regular figures, ſuch as planes and ſquares, which admit of the greateſt uniformity of workmanſhip; and its eſſential parts, together with the angular poſition of the vanes, admit of ſtrict examination, by the application of inſtruments in common uſe, ſuch as the ſquare, the compaſſes, and parallel rulers, by which very trifling errors may be eaſily diſcovered, without the trouble of experience by water. The general form of this fly being conical, it is not liable to obſtructions at ſea, from ſea weeds, or other floating ſubſtances. It is alſo detached from the regiſter for purpoſes hereafter mentioned. By the conical poſition of the vanes, I mean that poſition which is cauſed by moving their broadeſt ends from the centre in a direction with their planes, while their narrow ends remain fixed; and by the angular poſition I mean, that poſition which is cauſed by ſeparating the broad ends of the vanes from the centre, (and conſequently from each other), in a direction at right angles with the former poſition, while the narrow ends remain fixed, as in Fig. 1, in the drawing hereto annexed, (ſee Plate I.); or, in other words, the conical poſition of the vanes determines the diſtance between *a* and *b*, in the ſame figure; and their angular poſition determines the diſtance between *c* and *d*, in the ſame figure. The conical poſition of the vanes being varied, increaſes or diminiſhes the rotary power or ſtrength of action of the fly, and their angular poſition being varied, increaſes or diminiſhes the number of its revolutions made in any given diſtance. The fly is conſtructed in manner following; the centre piece, or virtual axis, has at its head end an eye-hole, or other convenience for faſtening the line to it, and the other end terminating in a ſcrew, of ſufficient length to vary the adjuſtment of the fly, ſo as to anſwer ſuch purpoſes as it is intended for. It paſſes through a collar, having a ſmooth hole through its centre, ſufficient to receive the axis upon which it ſhould turn freely, and to which it is ſecured by a collet and pin. This collar muſt have the ſame number of flats or ſides as the number of vanes intended for it; and it muſt terminate conically towards its head. The regulator ſhould have the ſame number of ſides with the former, and ſhould alſo terminate conically from its baſe, anſwering to the conical form of the fly. It has a tapped hole through its centre, to fit the ſcrew on the end of the axis, on which it ſhould move uniformly the whole length of the ſcrew. The vanes are to be attached by their narrow ends to the ſides or flats of the collar, by ſcrews or otherwiſe, having in each of them a ſlit or opening, to admit the ſcrews which bind them to the regulator, as in Fig. 1, in the ſame drawing. I make a ſcale, which I graduate into ſundry parts, anſwering to the turns of the axis through the regulator; and when the fly is put together, as in Fig. 1, the ſcale reſts upon the regulator, and ſhews how far the regulator is moved either way in adjuſting the fly. After having, by the aſſiſtance of the regulator, found the true poſition of the vanes, which would give the true diſtance ſailed, I have ſometimes made the fly a fixture throughout; but I prefer the adjuſtable fly.

"The regiſter I uſe is conſtructed in manner following: that is to ſay: Fig. 2, in the aforeſaid drawing, repreſents the regiſter in one of its forms. It may be carried either in the veſſel's cabin, or be ſuſpended over the ſtern, by the ears *a* and *b*, in the ſame Fig. 2, ſo as to turn freely towards the fly at all times. Fig. 3, in the ſame drawing, repreſents the inſide movement or train of wheels with its dial. This is fixed within the cylinder Fig. 2, and turns the index on its dial. The pinion *d*, in the ſame Fig. 3, has upon its inner end eight leaves, which moves the firſt or contrate wheel *b*, which has forty-eight teeth; and by its pinion of ſix leaves it moves the ſecond wheel *c*, which has ſixty teeth. This wheel *c*, by its pinion of ſix leaves, moves the third wheel *d*, of ſixty teeth. This wheel *d*, by its pinion of ſix leaves, moves the fourth wheel *e* of ſixty teeth; and this wheel *e*, by its pinion of ſix leaves, moves the fifth wheel *f*, of ſixty teeth, which carries the index *g* on the end of its pinion. Its dial is graduated into one hundred diviſions, each of which anſwers to one mile, and is numbered 10, 20, 30, 40, 50, 60, 70, 80, 90, 100; and, by the addition of more wheels, in like manner, the regiſter will be capable of ſhewing any neceſſary diſtance whatever. An endleſs ſcrew would produce the ſame effect in giving motion to the regiſter as the pinion *d*, but I give the preference to the pinion. Fig. 4, in the ſaid drawing, repreſents the regiſter in another form. It has a ſimilar train of wheels as the former, with the addition of one more wheel of ſixty teeth, which extends the calculation of the diſtance the veſſel ſails to a thouſand miles. The form of this regiſter, by a circular diſpoſition of the wheels, is round, and is encloſed in a round caſe, which is graduated for the purpoſe of ſhewing the ſhip's lee way, as will be ſhewn hereafter. This regiſter has three dials on its face; one of which is graduated

graduated into ten parts, anſwering to tenths of miles, and is numbered 1, 2, 3, 4, 5, 6, 7, 8, 9, 10. The index on this dial moves round once every mile the veſſel ſails, each diviſion counting one-tenth of a mile. The large dial is ſimilar to the dial on Fig. 3, deſcribed above. The other of the laſt-mentioned three dials is alſo divided into ten parts, and is numbered 100, 200, 300, 400, 500, 600, 700, 800, 900, 1000. The index on this dial moves round it once every one thouſand miles, each diviſion anſwering to one hundred miles. This regiſter has an arm or cramp *a*, fixed at one of its ends to the bottom of the box, by a ſcrew or otherwiſe, ſo as to admit of the regiſter's turning freely upon it: and by the other end of this arm or cramp the regiſter is ſecured to ſome convenient part of the veſſel. On one-half of the outſide of the circumference of the box is graduated thirty-two equal diviſions, correſponding with the diviſions of the compaſs, and an index, which is joined at one of its ends to the cramp, is brought to the edge of the box, and turned up, ſo as to anſwer the purpoſe of an index. When the veſſel makes lee-way, the fly commonly falls to windward, nearly in proportion to that lee-way, and by the fly being to windward, the pinion of the regiſter is turned the ſame way, and brings a correſponding figure or point which is marked on the box to the beforementioned index, and this denotes the number of points the veſſel makes to leeward.

“ The form and portions of the regiſter may be ſo varied as to expreſs, in other denominations of ſea-meaſure, the diſtance ſailed, if found to be more convenient than the above. And the form, ſize, and proportions of the fly may be alſo varied ſo as to accommodate it to a regiſter of any calculation. So alſo may the ſhape of the vanes be varied, if their true poſition be ſtrictly attended to, for they are all capable of variation, from any given dimenſions, and the eſſential principles are ſtill retained.

“ The pinions of the regiſter I generally make of bell-metal, and the other parts of the machine of braſs. Theſe materials I give the preference to; yet other materials will anſwer, provided they are of ſuch kind as will endure the effects of friction and of ſalt water. For the better illuſtration and deſcription of the fly which I uſe, and which I prefer, I have in the annexed drawings deſcribed one of four vanes, and its correſponding parts, ſhewing the proportions they bear to each other.

“ Fig. 1, in the ſaid drawing, repreſents the centre piece or virtual axis. This is ſix inches and an half long, and about one-fifth of an inch in diameter. On one end is a ſcrew, about two inches long, and at the other is an eye hole, to faſten the line to, as in Fig. 1. And at the diſtance of about one inch and an half from the eye hole is a collet and pin, which ſecures the collar-piece to its place.

“ The collar-piece is about three-fourths of an inch long, and half an inch thick at the largeſt end, having its ſides at right angles with each other, and terminating conically at its head end. It has a hole through its centre large enough to receive the centre piece or axis, to which it is ſcrewed by the collet and pin, ſo that it may turn freely on the axis.

“ The regulator or adjuſtment is about one-fourth of an inch thick. Its largeſt ſurface is an inch and an eighth of an inch over, and being a little tapering, its ſmalleſt ſurface is left an inch over. It has a tapped hole through its centre, fitted to the ſcrew on the end of the axis, where it belongs.

“ The four vanes are all of equal ſtrength, and about a ſixteenth part of an inch thick; they reſemble in form a right-angled triangle, whoſe baſe is eight inches, and whoſe perpendicular is three inches. A piece is cut off from the acute angle, which leaves the end about half an inch wide. A piece alſo muſt be cut out from the right angle, running nearly parallel with the baſe, ſufficient to prevent the vanes croſſing the centre, and thereby counteracting each other. The piece cut from the fly I am deſcribing is about one inch and three-fourths of an inch long, and half an inch wide; and muſt be varied according to the proportions of the fly. The vanes muſt be perfectly flat, and uniformly alike.

“ I make a ſcale, on which are the Figs. 2, 4, 6: under which figures are twenty diviſions, anſwering each to one turn of the axis through the regulator or adjuſtment; and when the outer edge of the regulator or adjuſtment ſtands at the diviſion againſt Fig. 4, in the aforeſaid ſcale, the fly is ſuppoſed to be rightly regulated or adjuſted; but if, on trial, it is found otherwiſe, then, by turning the axis, the regulator or adjuſtment is moved, and the motion of the fly altered at pleaſure. Moving the regulator or adjuſtment towards Fig. 6, in the ſcale, increaſes the motion of the fly: and moving the regulator or adjuſtment towards Fig. 2, in the ſcale, diminiſhes the motion. Every turn of the axis, either way, alters the motion of the fly about three miles in an hundred. The opening in the vanes ſhould be of ſufficient length to give freedom to the ſcrews which bind the vanes to the regulator or adjuſtment when it is moved.

“ The fly being thus completed, the vanes ſtand both in a conical and angular poſition, with regard to their centre or axis, and incline the fly to turn but one way; and as their angular poſition is increaſed or diminiſhed, ſo will be the number of revolutions of the fly in ſailing any given diſtance.

“ For particular purpoſes the motion of the fly may be increaſed two, three, and even four times faſter than is uſual. This may be done either by enlarging the regulator or adjuſtment, or moving it farther towards the collar piece, ſo as to extend the broad ends of the vanes farther from the axis or centre, that is, farther aſunder; in which caſe the ſame regiſter will ſtill anſwer, if read accordingly. If the fly is conſtructed agreeably to the ſize and proportions here given, and is accurately regulated or adjuſted, ſo as to give the true diſtance ſailed, the broad ends of the oppoſite vanes will be an inch and three-eighths of an inch aſunder. And in caſe of any accident that the fly may meet with at ſea, or otherwiſe, the above diſtance, being examined by a pair of compaſſes, will be a direction to the mariner how to reſtore the fly to its former accuracy of meaſurement, the narrow ends of the vanes that are attached to the collar piece remaining fixed.

“ The line, which I prefer to a chain, ſhould be made of good materials, be well twiſted, and about the ſize of a common log line. The line connects the fly and regiſter together. Its length ſhould be in proportion to the ſize of the veſſel, that the fly may be ſo far diſtant from the ſtern of the veſſel as not to be affected by the eddy of the veſſel's wake, which is often found to extend from fifteen to twenty-five fathoms aſtern. One end of the line is faſtened to the pinion of the regiſter, which, in Figs. 2 and 4, is marked *d*, and the other end is faſtened to the head end of the fly. See Fig. 1.

“ The fly is towed perpetually after the veſſel at ſea, and its revolutions are communicated to the regiſter by the line, and theſe in exact proportion to the velocity of the veſſel through the water.

“ There ſhould be no impediment or obſtruction about the line to prevent its turning freely, or about the regiſter to prevent it from turning the pinion to which the line is faſtened in a direction with the fly, eſpecially when the veſſel's lee-way is neceſſary to be known.

“ The log, as now improved, and uſed, has the properties and advantages over my former log, hereinafter mentioned; that is to ſay:

“ The fly of the improved log has an eaſy and efficacious mode or principle of regulation, by which its motion may be altered at pleaſure, and with great uniformity and preciſion. But my former log did not poſſeſs theſe advantages in ſo perfect a degree.

“ The fly of the improved log, on which all accuracy of meaſurement depends, is, as beforementioned, compoſed of regular figures, ſuch as planes and ſquares, which admit of the greateſt uniformity and exactneſs in the workmanſhip of it; and its eſſential parts, and their true poſitions, admit of ſtrict examination by the application of inſtruments in common uſe, ſuch as the ſquare, compaſſes, and parallel-ruler: and, by the help of theſe, trifling errors may be diſcovered and corrected without the trouble of experiments by water. Theſe conveniencies my former log was quite deſtitute of. The improved log has a fly particularly adapted to very ſlow motion of the veſſel, when ſhe ſails leſs than two miles an hour, which is alſo to be uſed when the veſſel is lying to the wind in bad weather, and drifting, to give the diſtance ſhe drifts an hour, as is above deſcribed, and the ſame regiſter anſwers for this fly alſo. But my former log being heavier, was inclined to ſink in ſlow motion, and was alſo deficient in its power of action in ſlow ſailing, which could not be remedied without enlarging the machine too much for common uſe, or without increaſing the friction to a degree that would wear out the machine in a ſhort time. The improved log may have two or more flies with one regiſter, the fly being an inconſiderable part of the expenſe of the whole machine, in which caſe, if one fly is loſt, it may be eaſily replaced; but if an accident of this kind happened to my former log, the injury could not eaſily be repaired. This circumſtance renders the improved log much more convenient in practice, and its moſt expenſive part, namely the regiſter, leſs liable to be loſt, and leſs liable to accidents. It is alſo more durable, as the train of wheels or regiſter is kept clean and dry. It is alſo more certain in its performance, not being ſo liable as my former log to obſtructions at ſea, by ſea weeds, or other floating ſubſtances. The improved log is more portable and convenient for conveyance, its conſtruction is leſs expenſive, and it is more eaſily underſtood and repaired by common mechanicks.

“ When there is no obſtruction between the fly and the box, it ſhews on the box of the regiſter the number of points lee-way the veſſel makes; but this valuable acquiſition could not be derived from my former log. The regiſter of the improved log is kept on-board the veſſel, in which the diſtance ſailed can at all times be ſeen. Whereas the whole of my former log went in the water, and the regiſter of it could not be ſeen without taking it into the veſſel.”

FINIS.

DIRECTIONS FOR PLACING THE PLATES.

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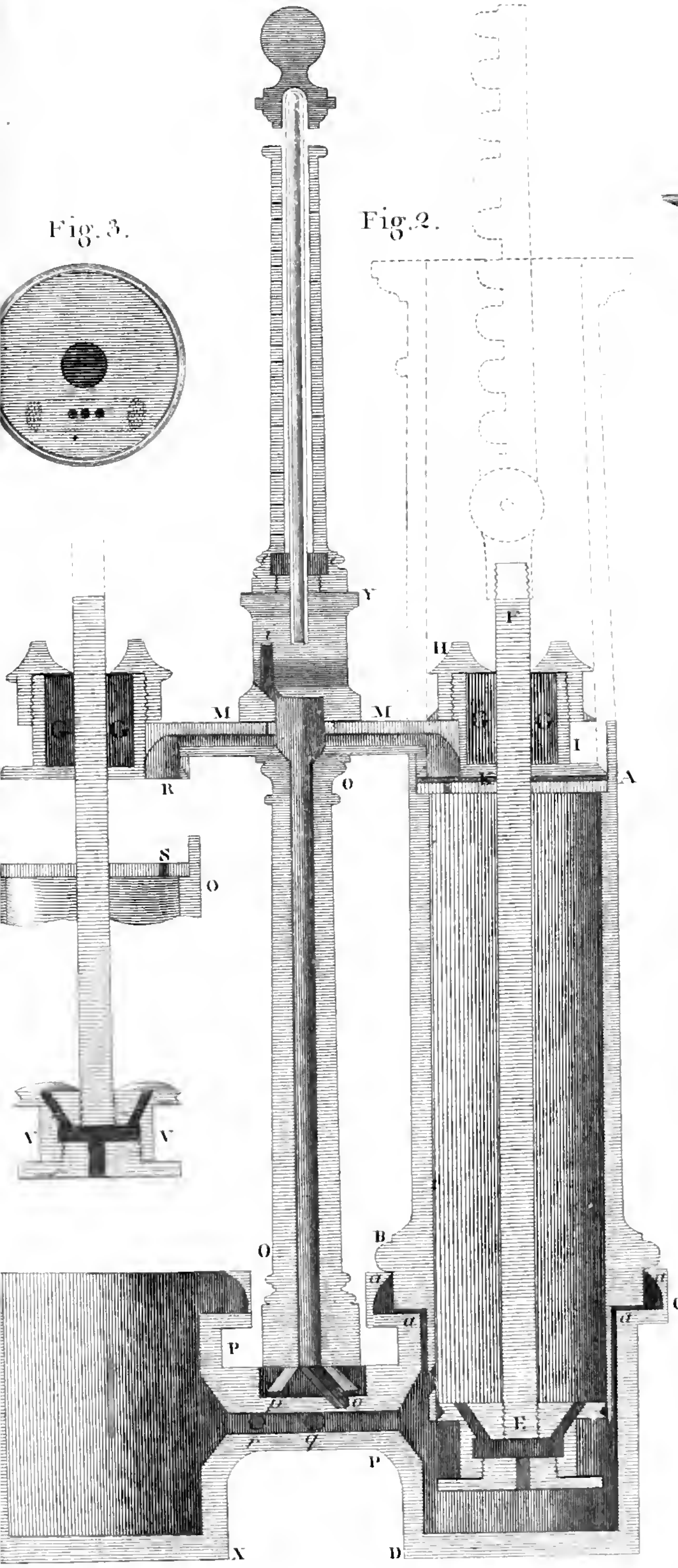


Fig. 3.

Fig. 2.

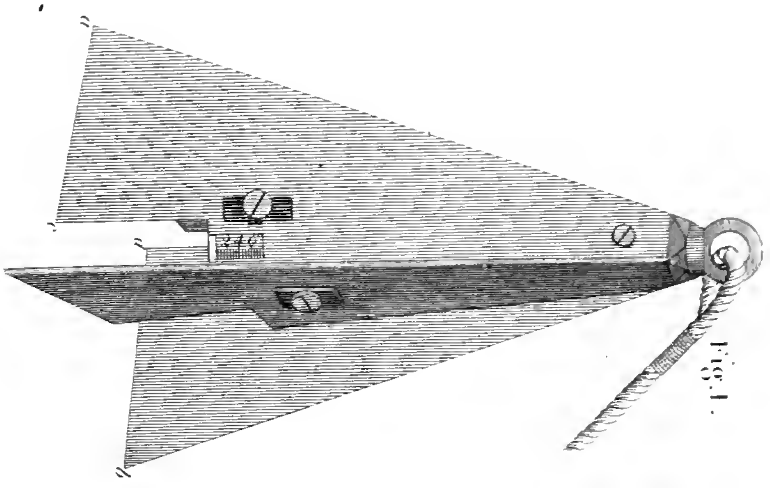


Fig. 1.

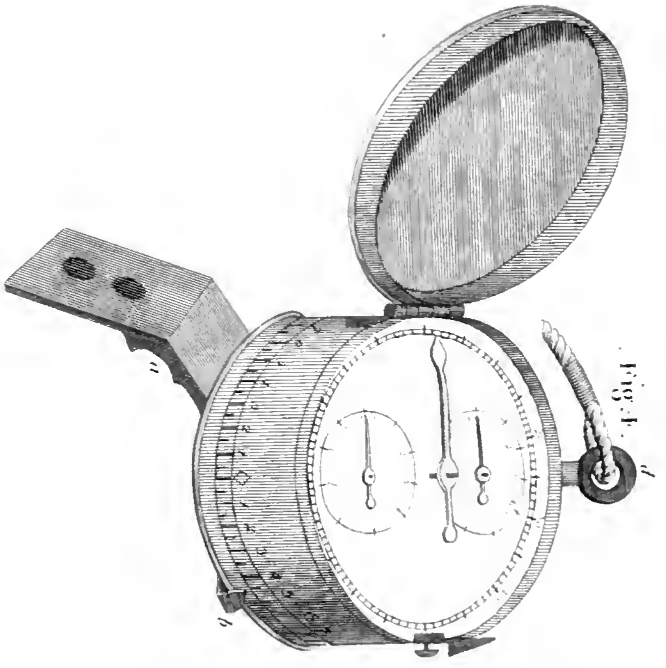
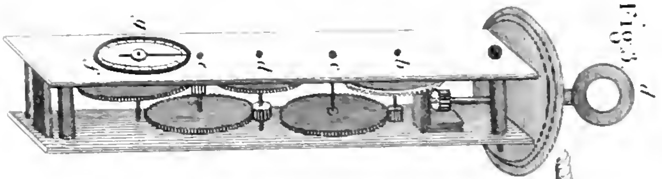


Fig. 4.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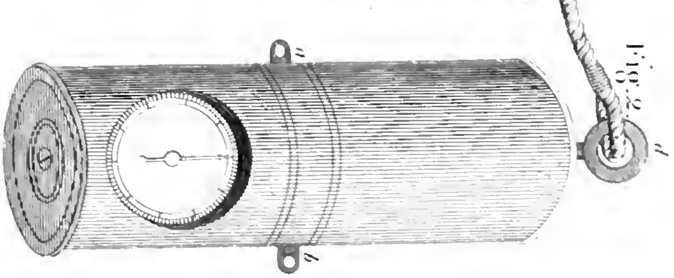
Fig. 2.

APP.x PLATE II

AIR PUMP

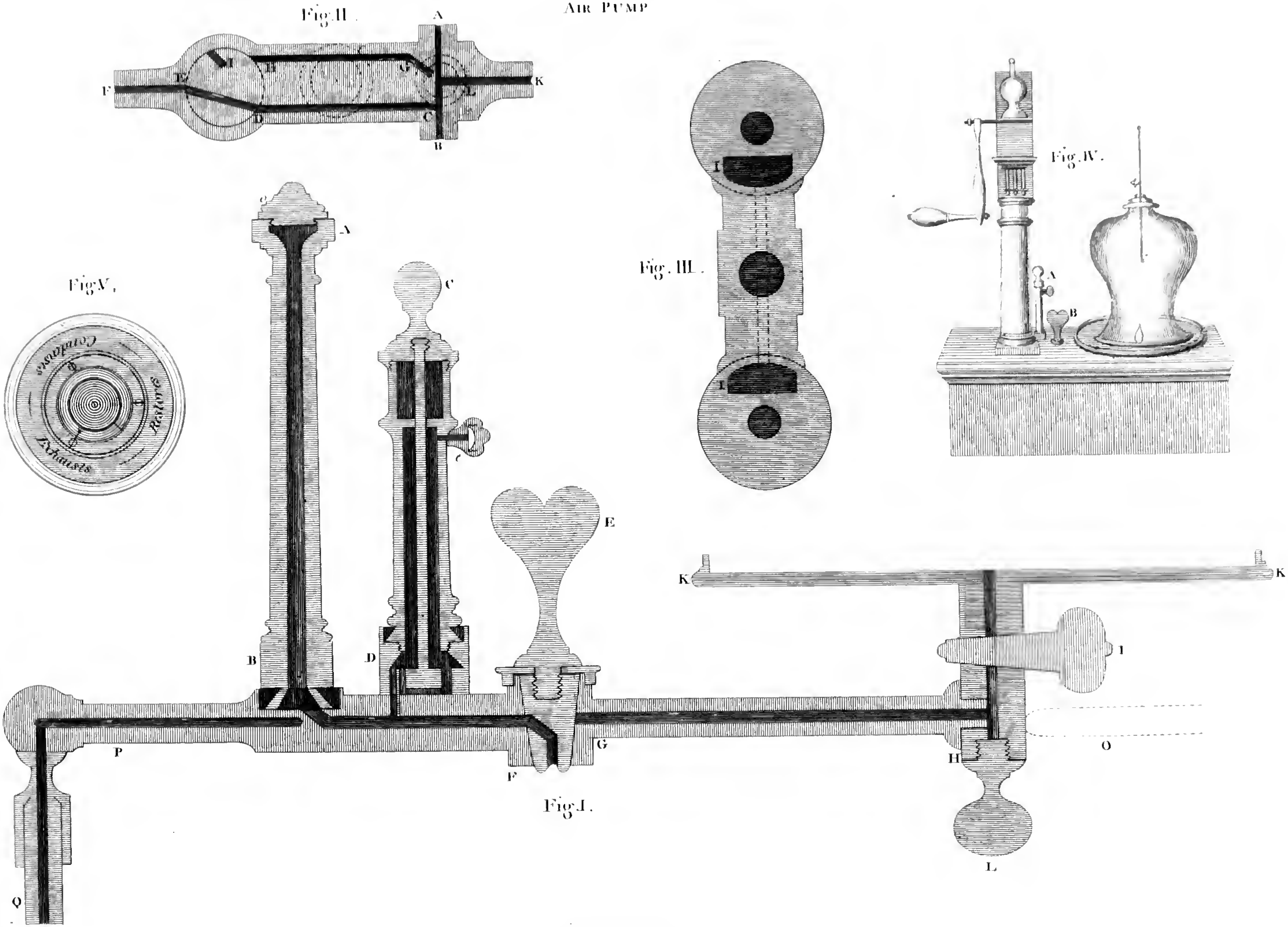
Fig. II.

Fig. III.

Fig. IV.

Fig. V.

Fig. I.

Etched [illegible]

Appx PLATE III.

Fig.1.

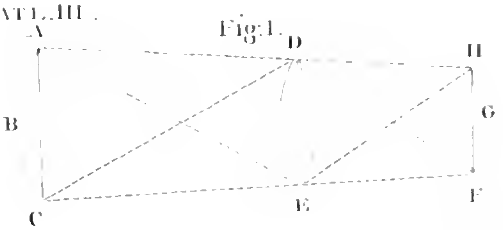

Fig.4.

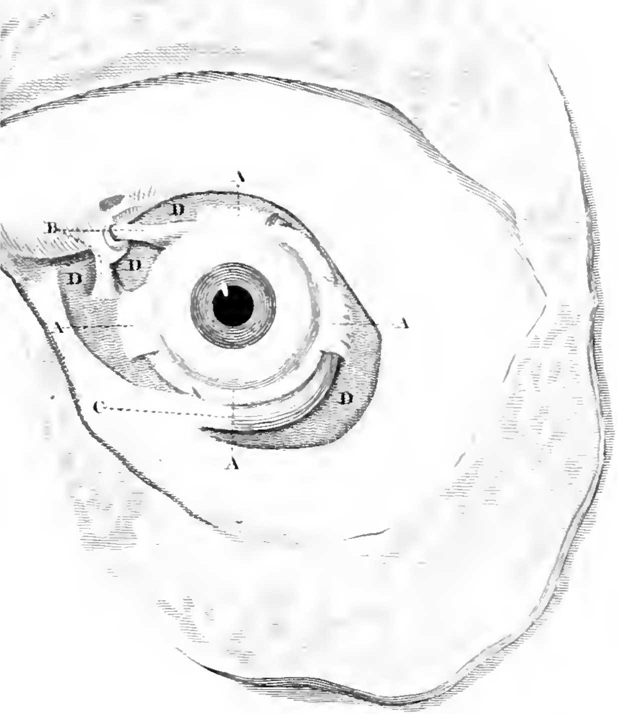

Fig.2.

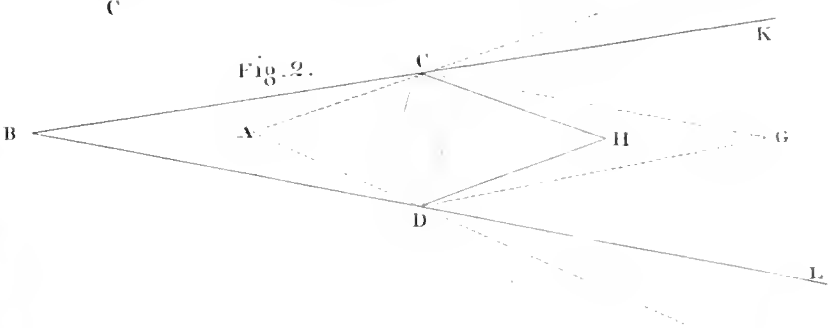

Fig.3.

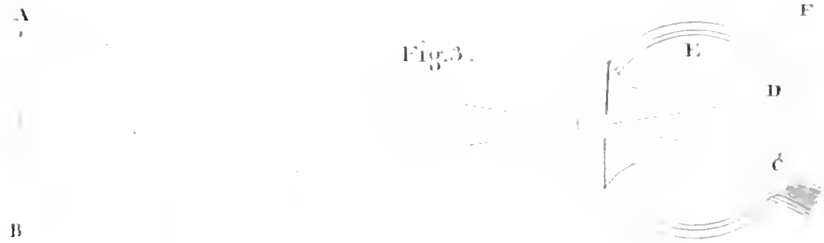

Fig.4.

Fig.5.

Fig.6.

Fig.5.

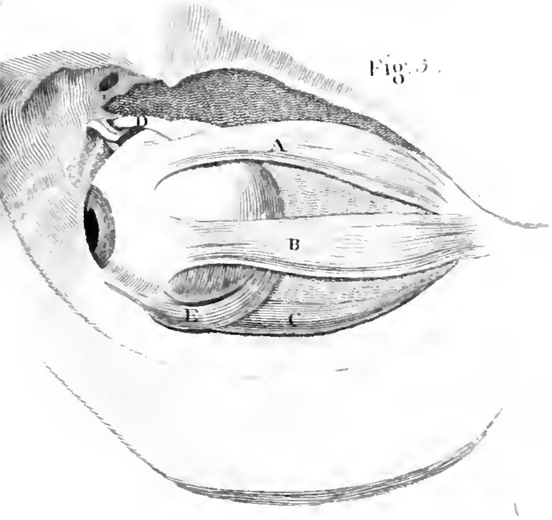

Fig.A.

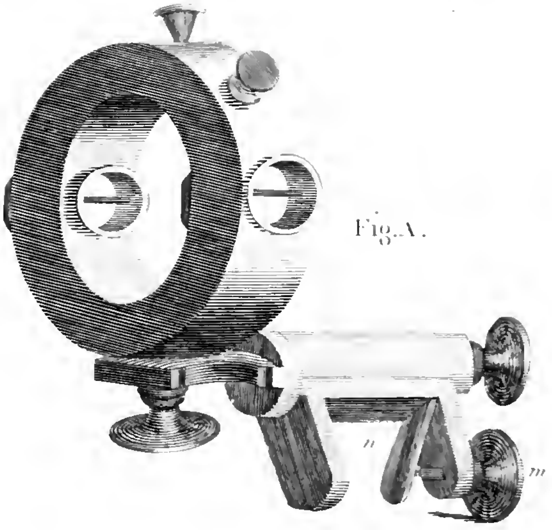

Fig.6.

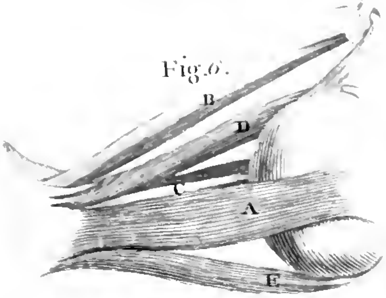

Fig.1.