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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PHI——————ZONESHIO

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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.

"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. 3 Diviſion of human knowledge.

"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.

"*Arithmetic* is derived from the form of our internal sense, and *geometry* from that of our external. 8 Origin of arithmetic and geometry.

"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. 9 Unifying power of the mind.

"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*. 10 Analytic 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. 11 Synthetic judgments.

"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*.

"The *forms* of the understanding are, *quantity*, *quality*, *relation*, *modality*. 12 Forms of the understanding.

"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*.

"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*, 13 Categories.

(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 (o). 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.

"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*. 16 Objective and subjective truths.

"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.

"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. 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. 17 Belief. 18 Proof of the existence of God, &c.

"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 supplies

(o) 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.

fupplies the place of a knowledge which is impoffible (E).

"The proofs of natural theology (fays our philofopher) taken from the order and beauty of the univerfe, &c. are proofs only in *appearance*. They refolve themfelves into a bias of our reafon to *fuppofe* an Infinite Intelligence as the author of all that is poffible; but from this bias it does not follow that there really is fuch an Author. To fay, that whatever exifts muft have a caufe, is indeed a maxim *a priori;* but it is a maxim applicable only to experience, for one knows not how to fubject to the laws of our perceptions that which is abfolutely independent of them. It is as if we were to fay, that whatever exifts in experience muft have an experience; but the world, taken as a whole, is without experience as well as its caufe. It is much better to draw the proof of the exiftence of God from morality, than to weaken it by fuch reafoning. This proof is relative. It is impoffible to *know* that God exifts; but we can comprehend how it is poffible to act morally on the *fuppofition* of the exiftence (although incomprehenfible) of an intelligent Creator—an exiftence which PRACTICAL REASON forces THEORETICAL *reafon* to adopt. This proof not only *perfuades*, 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 himfelf the idea of religion as he has that of virtue. The latter has its principle in the mind; it exifts in itfelf, and not as the means of happinefs; 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 converfe of the principle of morality is to make perfonal happinefs the bafis (F) of the will. There are compaffionate minds which feel an internal pleafure in communicating joy around them, and who thus enjoy the fatisfaction of others; but their actions, however juft, however good, have no moral merit, and may be compared to other inclinations; to that of honour (for example), which, whilft it meets with that which is juft and ufeful, is worthy of praife and encouragement, but not of any high degree of efteem. According to Kant, we ought not even to *do good*, either for the pleafure we feel in doing it, or in order to be happy, or to render others happy; for any one of thefe additions (perhaps motives) would be *empyric*, and injure the purity of our morals. A reafonable being ought to defire to be exempted from all *inclinations*, and never to do his duty but for his duty's fake.

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

If this be a correct view of the object and the refults of the critical philofophy, and the character of him from whom we received it permits us not to doubt of its being nearly correct, we confefs ourfelves unable to difcover any motive which fhould induce our countrymen, in their refearches after truth, to prefer the dark lantern of Kant to the luminous torch of Bacon. The metaphyfical reader will perceive, that, in this abftract, there is little which is new except the phrafeology; and that what is new is either unintelligible or untenable. 20 Futility of this fyftem.

21 Of which the fundamental principles are not new. The diftinction between knowledge *a priori* and knowledge *a pofteriori*, is as old as fpeculation itfelf; and the mode in which Kant illuftrates that diftinction differs not from the illuftrations of Ariftotle on the fame fubject. The Stagyrite talked of *general forms*, or *formal caufes*, in the mind, as well as the profeffor at Koenigfberg: and he or his difciples (for we quote from memory) compared them to the form of the ftatue in the rough block of marble. As that form is brought into the view of the fpectator by the chiffel of the ftatuary, fo, faid the peripatetics, are the general *forms* in the mind brought into the view of confcioufnefs by fenfation and experience.

Such was the doctrine of Ariftotle and his difciples, and fuch feems to be the doctrine of Kant and his followers; but it is either a falfe doctrine, or, if it be true, a doctrine foolifhly expreffed. A block of marble is capable of being cut into any form that the ftatuary pleafes; into the form of a man, a horfe, an ox, an afs, a fifh, or a ferpent. Not one of thefe forms therefore can be inherent in it, or effential to it, in oppofition to the reft; and a general form, including all the animals under it, is inconceivable and impoffible. In like manner, the human mind is capable of having the ideas of a circle, a triangle, a fquare, of black, white, red, of four, fweet, bitter, of the odour of a rofe, and the ftench of a dunghill, of proportion, of mufical founds, and of a thoufand other things. None of thefe ideas therefore can be effential to the mind in oppofition to the reft; and every man, who is not an abfolute ftranger to the operations of his own intellect, knows well that he cannot think of a thoufand things at once; or, to ufe the language of philofophers, have in his mind a general idea, comprehending under it a thoufand things fo difcordant as colours and founds, figures, and fmells. 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 fenfation, or experience, gives an opportunity of coming into view, he affirms what all men of reflection know to be falfe. If he means only to affirm, what feems to have been the meaning of Ariftotle, that particular fenfations give occafion

(E) We have here again taken the liberty to alter the language of our correfpondent. He makes Kant fay, "It is not this knowledge, but a *belief* of reafon, &c.;" but this is furely not the author's meaning. From the context, it is apparent that Kant means to fay, that we have not, and cannot have, what can be properly called a *knowledge* of the exiftence of God, but only fuch a belief of his exiftence as fupplies the place of this impoffible knowledge.

(F) This is a very abfurd phrafe. We fuppofe Kant's meaning to be, that the principles of him whofe actions and volitions are influenced by the profpect of perfonal happinefs, are the reverfe 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 *four* contrary to *ſweet*, nor an *inch* contrary to an *ell*. Nothing is the negation of ſubſtance, and black the negation of white; four 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 unqeſtionably learns the import of the terms of numeration, as be 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.

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, it by experience be 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. 23 With its conſequences.

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.

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.* nº 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? 24 Groundleſs or falſe aſſertions

When

(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*.

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.

25 Bad logic.

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.

* Dr Willich.

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 atheiſt 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. I.). It may not, however, be altogether uſeleſs to point out

to

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.

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." 28 His morality is extravagant.

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. Phoſphorus.

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.

* *Philosophical Magazine*, vol. ii.

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.

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 $2\frac{1}{10}$ 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 $2\frac{2}{10}$ 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, Photometer. 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

		Squares of the Diftances 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 thefe experiments, it may be obferved, that were the refiftance of the air to light, or the diminution of the light from the imperfect tranfparency of air, fenfible within the limits of the inconfiderable diftances at which the candles were placed from the photometer, in that cafe the diftance of the two equal lights united ought to be, to the diftance of one of them fingle, in a ratio lefs than that of the fquare root of 2 to the fquare root of 1. For if the intenfity of a light emitted by a luminous body, *in a fpace void of all refiftance*, be diminifhed in the proportion of the fquares of the diftances, it muft of neceffity be diminifhed in a ftill higher ratio when the light paffes thro' a refifting medium, or one which is not perfectly tranfparent; and from the difference of thofe ratios, namely, that of the fquares of the diftances, and that other higher ratio found by the experiment, the refiftance of the medium might be afcertained. This he took much pains to do with refpect to air, but did not fucceed; the tranfparency of air being fo great, that the diminution which light fuffers in paffing through a few inches, or even through feveral feet of it, is not fenfible.

Having found, upon repeated trials, that the light of a lamp, properly trimmed, is incomparably more equal than that of a candle, whofe wick, continually growing longer, renders its light extremely fluctuating, he fubftituted lamps to candles in thefe experiments, and made fuch other variations in the manner of conducting them as he thought bid fair to lead to a difcovery of the refiftance of the air to light, were it poffible to render that refiftance fenfible within the confined limits of his machinery. But the refults of them, fo far from affording means for afcertaining the refiftance of the air to light, do not even indicate any refiftance at all; on the contrary, it might almoft be inferred, from fome of them, that the intenfity of the light emitted by a luminous body in air is diminifhed in a ratio *lefs* than that of the fquares of the diftances; but as fuch a conclufion would involve an evident abfurdity, namely, that light moving in air, its abfolute quantity, inftead of being diminifhed, actually goes on to *increafe*, that conclufion can by no means be admitted.

Why not? Theories muft give place to facts; and if this fact can be fairly afcertained, inftead of rejecting the conclufion, 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 fay, that the fubftance of light is not latent in the atmofphere, as heat or caloric is now acknowledged to be latent, and that the agency of the former is not called forth by the paffage 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 combuftible fubftance? See Chemistry, n° 293, *Suppl.*

The ingenious author's experiments all confpired to fhew that the refiftance of the air to light is too inconfiderable to be perceptible, and that the affumed law of the diminution of the intenfity of light may be depended upon with fafety. He admits, however, that means may be found for rendering the air's refiftance to light apparent; and he feems to have thought of the very means which occurred for this purpofe to M. de Sauffure.

That eminent philofopher, wifhing to afcertain the tranfparency of the atmofphere, by meafuring the diftances at which determined objects ceafe to be vifible, perceived at once that his end would be attained, if he fhould find objects of which the difappearance might be accurately determined. Accordingly, after many trials, he found that the moment of difappearance can be obferved 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 ftill greater when the obfervation was made in the fun than in the fhade; and that even a ftill greater degree of accuracy was obtained, when the white fpace furrounding a black circle, was itfelf furrounded by a circle or ground of a dark colour. This laft circumftance was particularly remarkable, and an obfervation quite new.

If a circle totally black, of about two lines in diameter, be faftened on the middle of a large fheet of paper or pafteboard, and if this paper or pafteboard be placed in fuch a manner as to be expofed fully to the light of the fun, if you then approach it at the diftance of three or four feet, and afterwards gradually recede from it, keeping your eye conftantly directed towards the black circle, it will appear always to decreafe in fize the farther you retire from it, and at the diftance of 33 or 34 feet will have the appearance of a point. If you continue ftill to recede, you will fee it again enlarge itfelf; and it will feem to form a kind of cloud, the darknefs of which decreafes more and more according as the circumference becomes enlarged. The cloud will appear ftill to increafe in fize the farther you remove from it; but at length it will totally difappear. The moment of the difappearance, however, cannot be accurately afcertained; and the more experiments were repeated the more were the refults different.

M. de Sauffure, having reflected for a long time on the means of remedying this inconveniency, faw clearly, that, as long as this cloud took place, no accuracy could be obtained; and he difcovered that it appeared in confequence of the contraft formed by the white parts which were at the greateft diftance from the black circle. He thence concluded, that if the ground was left white near this circle, and the parts of the pafteboard at the greateft diftance from it were covered with a dark colour, the cloud would no longer be vifible, or at leaft almoft totally difappear.

This conjecture was confirmed by experiment. M. de Sauffure left a white fpace 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, fo that the black circle was only furrounded by a white ring a line in breadth.

 The

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 15½ 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 3½ 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 $\frac{1}{12}$ 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

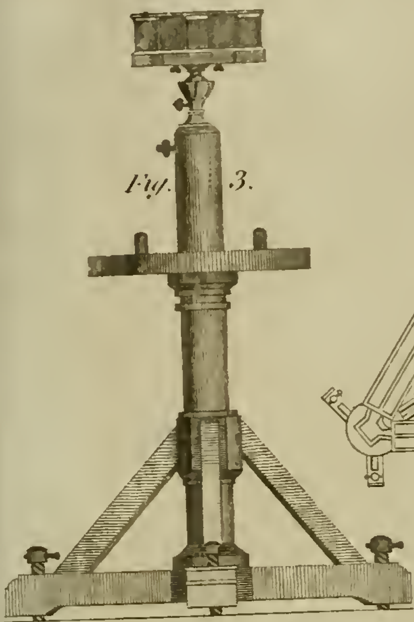


Fig. 3.

Fig. 1.

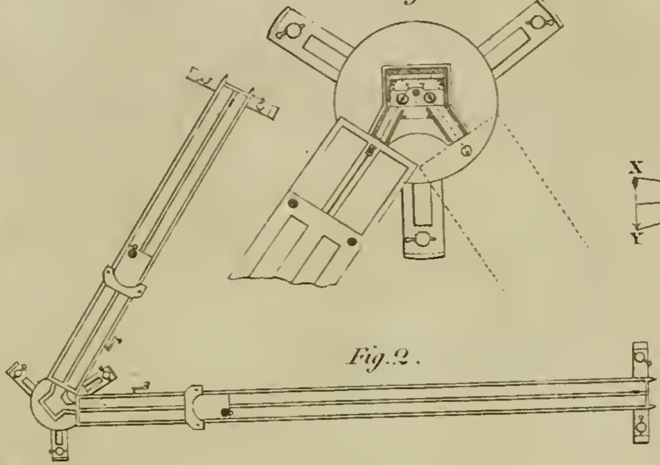
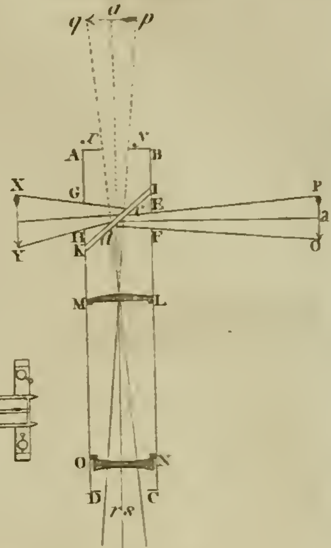


Fig. 2.

OPERA GLASS



PENNATULA

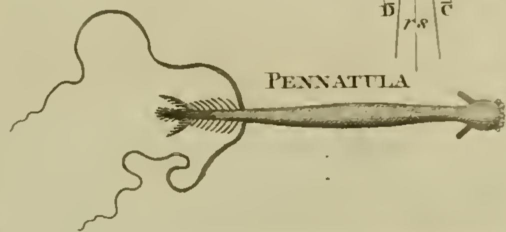
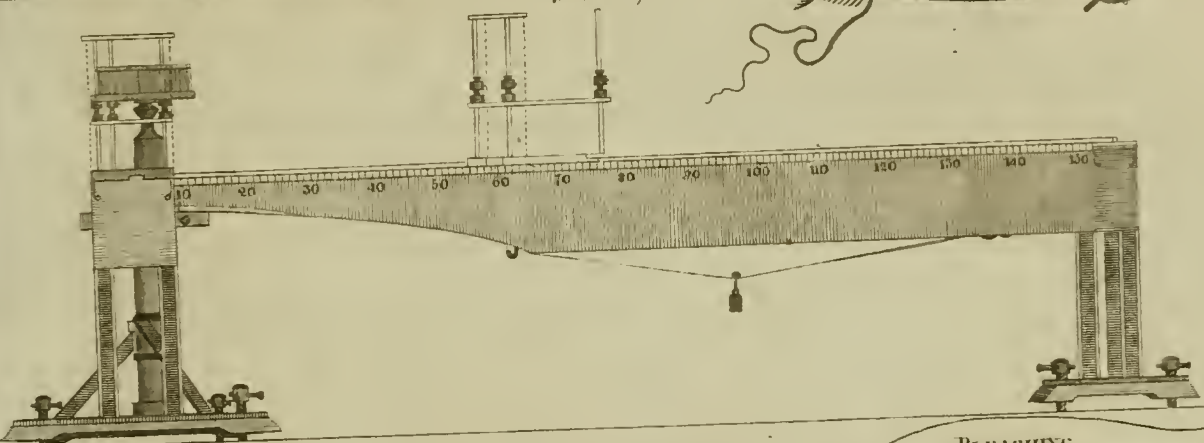


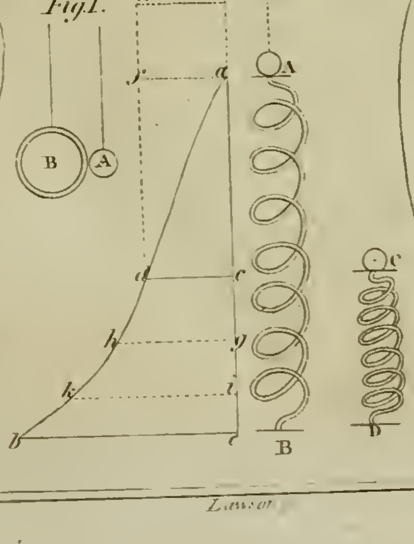
Fig. 4.



ORICOU

PERCUSSION

Fig. 1. *Fig. 2.*



BLEACHING

Fig. 1.

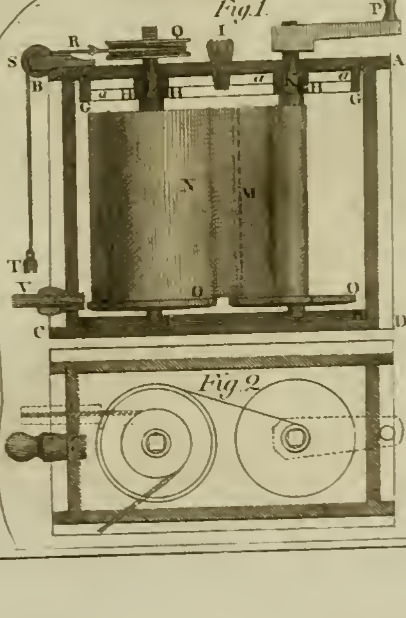


Fig. 2.

Piano Forte.

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 harpſicord 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

fpeedieft recruit from the fatigue of a long walk was to fit down for a few minutes to the harpfichord. He had feen feveral of the German attempts to make keyed dulcimers, which were, in fome meafure, fufceptible of the *forte* and *piano*: But they were all on one principle, and required a particular touch of the finger, of difficult acquifition, and which fpoiled it for harpficord practice. We have alfo feen of thofe inftruments, fome of very old date, and others of modern improvement. Some had very agreeable tones; but all were deficient in delicacy and juftnefs. The performer was by no means certain of producing the very ftrength of found that he intended. And, as Mr Mafon obferved, they all required an artificial peculiarity of fingering; without which, either the intended ftrength of tone was not brought out, or the tone was deftroyed by repeated rattling of the mallet on the wire.

Mr Mafon removed all thofe imperfections, by detaching the mallet entirely from the key, and giving them a connection quite momentary. The fketch in Plate XL. will give the reader a clear view of Mr Mafon's general principle by which the Englifh piano forte is diftinguifhed from all others. The parts are reprefented in their ftate of inaction. The key ABK turns, as ufual, on the round edge of the bar B, and a pin *b*, driven into the bar, keeps it in its place. The dot F reprefents a fection of the ftring. ED is the mallet, having a hinge of vellum, by which it is attached to the upper furface of the bar E. At the other end is the head D, of wood, covered with fome folds of prepared leather. The mallet lies in the pofition reprefented in the figure, its lower end refting on a cufhion-bar K, which lies horizontally under the whole row of mallets. The key AR has a pin C tipt with a bit of the fofteft cork or buckfkin. This reaches to within $\frac{1}{10}$th of an inch of the fhank of the mallet, but muft not touch it. The diftance E*e* is about $\frac{1}{3}$d or $\frac{1}{4}$th of the length of the fhank. When the end A of the key is preffed down on the ftuffing (two or three thickneffes of the moft elaftic woollen lift) it raifes the mallet, by means of the pin C, to the horizontal pofition E*d*, within $\frac{1}{8}$th or $\frac{1}{10}$th of an inch of the wire F; but it cannot be fo much preffed down as to make the mallet touch the wire. At the fame time that the key raifes the mallet by means of the pin C, it alfo lifts off the damper G (a bit of fponge) 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 caufed by the pin I, which is fixed into the key near to R. Thefe pieces are fo adjufted, that the firft touch of the key lifts the damper, and, immediately after, the pin C acts on the fhank of the mallet. As it acts fo near to its centre of motion, it caufes the head D to move brifkly through a confiderable arch D *d*. Being made extremely moveable, and very light, it is thus *toffed* beyond the horizontal pofition E*d*, and it ftrikes the wire F, which is now at liberty to vibrate up and down, by the previous removal of the damper G. Having made its ftroke, the mallet falls down again, and refts on the foft fubftance on the pin C. It is of effential importance that this mallet be extremely light. Were it heavy, it would have fo much force, after rebounding from the wire, that it would rebound again from the pin C, and again ftrike the wire. For it will be recollected, that the key is, at this time, down, and the pin C raifed as high as poffible, fo that there is very little room for this rebound. Leffening the momentum of the mallet by making it very light, making the cufhion on the top of the pin C very foft, and great precifion in the fhape and figure of all the parts, are the only fecurities againft the difagreeable rattling which thefe rebounds would occafion. In refpect to the folidity and precifion of workmanfhip, the Britifh inftruments are unrivalled, and vaft numbers of them are fent to all parts of the continent.

As the blow of fo light a mallet cannot bring much found from a wire, it has always been found neceffary to have two ftrings for each note. Another circumftance contributes to enfeeble the found. The mechanifm neceffary for producing it makes it almoft impoffible to give any confiderable extent to the belly or found board of the inftrument. There is feldom any more of it than what occupies the fpace between the tuning pins and the bridge. This is the more to be regretted, becaufe the baffes are commonly covered ftrings, that they may be of a moderate length. The bafs notes are alfo of brafs, which has a confiderably lower tone than a fteel wire of the fame diameter and tenfion. Yet even this fubftitution for fteel in the bafs ftrings is not enough. The higheft of them are much too flack, and the loweft ones muft be loaded, to compenfate for want of length. This greatly diminifhes the fulnefs, and ftill more the mellownefs and diftinctnefs of the tone, and frequently makes the very loweft notes hardly appreciable. This inequality of tone about the middle of the inftrument is fomewhat diminifhed by conftructing the inftrument with two bridges; one for the fteel, and the other for the brafs wires. But ftill the bafs notes are very much inferior to the treble. It would furely be worth while to conftruct fome piano fortes, of full fize, with naked baffes. If thefe were made with all the other advantages of the grand piano forte, they would furpafs all other inftruments for the regulating power of their thorough bafs. We wifh that the artifts would alfo try to conftruct them with the mechanifm of mallets, &c. above the found board. This would allow to it the full extent of the inftrument, and greatly improve the tone. It does not feem impoffible, nor (we think) very difficult.

For directions how to tune this pleafing inftrument, fee TEMPERAMENT in this *Supplement*.

PIARA, on the coaft of S. America, lies 13 or 14 leagues from Payta, in lat. 7 N. and is the firft town of any note. A river which wafhes it, falls into the bay of Chiroper; but as it abounds with fhoals, 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 fmall high ifland, fhaped like a fugar-loaf, lying a little to the northward, and in fight of Aurora Ifland; difcovered by the fore-named navigator in May, 1768.—*ib*.

PICA, a harbour on the coaft of Peru, where there is high and fteep land; 12 leagues N. of Lora river, and 5 fouth of Tarapaca, or as it is called by Britifh feamen, *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 Defeada. 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 a*, 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.

dows. In the lake (which is only a dilatation of the river, 19½ 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 Mitchigamias 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 Callao, 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,

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, wafting 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 waters 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

(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."

Plague.

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

(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 alexapharmics, 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

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 every

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.

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. Ingenhousz, 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. Rafn, 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. Rafn, the carbonic acid produces exactly the same effect as charcoal of wood.

According to Mr Rafn, 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; $2\frac{1}{2}$ 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

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

Plymouth, || Pneumatics.

county S. E. and Norfolk county N. W. It is fubdivided into 15 townfhips, of which Plymouth is the chief; and contains 4,240 houfes, and 29,535 inhabitants. Within the counties of Plymouth and Briftol, there are now in operation, 14 blaft, and 6 air furnaces, 20 forges, 7 flitting and rolling mills, befides a number of trip-hammer fhops, and an almoft incredible number of nail-fhops, and others for common fmithery. Thefe furnaces, fupplied 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 flitting and rolling mills, at leaft 1,500 tons. The various manufactures of thefe mills, have given rife to many other branches in iron and fteel, viz. cut and hammered nails, fpades and fhovels, card teeth, faws, fcythes, metal buttons, cannon balls, bells, fire arms, &c. In thefe counties are alfo manufactured hand-bellows, combs, fheet-iron for the tin manufacture, wire, linfeed oil, fnuff, ftone 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 poft-town of New-Hampfhire, fituated in Grafton county, at the mouth of Baker's river, on its S. fide, where it falls into the river Pemigewaffet; 45 miles N. of Concord, 71 north-wefterly of Portfmouth, and 445 N. E. of Philadelphia. The townfhip was incorporated in 1763, and contains 625 inhabitants.—*ib*.

Plymouth, formerly *Apple-Town*, in New-York State, lies on the weft fide of Seneca Lake, 12 miles fouth-eaft of Geneva, on a beautiful declivity, falling gradually towards the lake, and commands a delightful profpect to the weftern country, and up and down the lake. Twenty houfes were building here in 1796, and as the new State-road, from the Cayuga, interfects the town, a ferry eftablifhed, and another town laid out on the oppofite fide of the lake, it promifes fair to become a confiderable and very thriving village. It is well watered by copious fprings.—*ib*.

Plymouth, the name of two townfhips in Pennfylvania, the one in Luzerne county, the other in that of Montgomery.—*ib*.

Plymouth, a fmall poft-town of N. Carolina, on the fouth fide of Roanoke river, about 5 miles above Albemarle Sound. It is 23 miles fouth-weft by S. of Edenton, and 463 fouth by weft of Philadelphia.—*ib*.

Plymouth, a fettlement on the fouth peninfula of the ifland of St Domingo, and in the dependence of Jeremie.—*ib*.

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

PLYMPTON, a townfhip in Plymouth county, Maffachufetts, 45 miles S. E. of Bofton. It was incorporated in 1707, and contains 956 inhabitants.—*ib*.

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, publifhed in the Memoirs of the American Academy, vol. i. p. 497.

Dr Prince's air-pump.

Agreeably to your requeft, I will endeavour to give you fome account of the air-pump I have lately conftructed, upon a plan different from any I have ever feen.

Reading the account of the ingenious Mr *Smeaton's* air-pump, in vol. xlvii. of the Philofophical Tranfactions, and the high recommendation of it by Dr *Prieftley*, in vol. lxiv. of the fame work, I was defirous of poffeffing one of that kind: but finding, by the Doctor's paper, they were not commonly made by the philofophical inftrument-makers in *London*, it induced me to attempt making one myfelf, with fuch affiftance 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 leaft in fimplicity. With this in view, I have finifhed mine. To fhow the ground on which I have gone, it will be neceffary to confider the rationale of an air-pump, and make fome obfervations 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 fpring of the air acting againft it underneath, when the weight of the air is removed from the top of the valve, by raifing the pifton in the barrel. In order to remove this refiftance from the top of the valve moft effectually, the pifton fhould be made to fit very exactly to the valve-plate, when put down upon it: for if there be any fpace between the bottom of the pifton and valve, part of the air will be retained in it; and this air, even when the pifton is raifed to the higheft, will, by its expanfion, in fome meafure, obftruct 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 pifton being drawn up to the higheft) the valve can rife no longer, becaufe the refiftance above is equal to the power below. The refiftance from this air, retained in the barrel, againft the valve at the bottom, will be uniformly the fame, when the pifton is at the fame diftance from it; becaufe the weight of the atmofphere is continually preffing on the pifton-valve, and will prevent the air below paffing through it, while this air is rarer than the atmofphere: and when the pifton is put down to the bottom of the barrel, it will not efcape through the pifton, but only be compreffed into the vacancy between the bottom of the pifton and the valve-plate at the bottom of the barrel, and be of equal denfity with the atmofphere. Befides the refiftance arifing from this retained air, we muft confider the weight of the valve, its cohefion to the plate, occafioned by the oil, and its being ftretched tight over the hole, as increafing the obftruction: efpecially when the fpring of the air under the valve is much weakened by rarefaction. And if we take into the account the refiftance arifing from thefe caufes, the denfity of the air in the barrel, when compreffed into the abovementioned vacancy, will be as much greater than the denfity of the atmofphere above the pifton, as the addition of this refiftance; for this obftruction belongs to the pifton-valve, as well as to the other. And fo alfo, when this retained air is expanded, fay one hundred times, by raifing the pifton, the air in the receiver cannot be rarefied to the fame degree, becaufe of this refiftance 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 rarefy 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 rarefy 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 rarefying 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 rarefying 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 to expand itfelf into the barrel from the receiver. But to fhow in what manner I have attempted this, it will be neceffary to give fome further defcription of the machine.

I have, upon Mr *Smeaton's* plan, contrived to connect the valves on the top-plates with the receiver, occafionally, by means of a pipe and cock, by the turning of which, the machine may be made to exhauft or condenfe at pleafure. This is done in the following manner: There is a crofs-piece laid over the valves, extending from one barrel to the other, which has a duct through it, connected with a fmall pipe ftanding between the barrels: through this pipe the air paffes into a duct in the bottom-piece leading to the cock. In this piece is likewife the duct leading from the ciftern to the cock; and with this cock alfo is connected the pipe leading to the receiver. The key is pierced with two holes in fuch a manner, that one of them will connect the pipe coming from the receiver with the duct in the bottom-piece leading to the ciftern, or with the other leading to the valves, as may be required for exhaufting, or condenfing. The other hole through the key will open, occafionally, to the atmofphere, either of thefe ducts round the cock. So that having the direction of the air, which paffes through the valves, under the command of this cock, the pump may exhauft or condenfe at pleafure: for when the key connects the pipe from the receiver, and the duct leading to the cifterns together, the pump will exhauft; and when it connects the pipe with the duct leading to the valves, it will condenfe; as the other hole in the key, at the fame time, opens to the atmofphere the duct leading to the cifterns, by which paffage the air enters the barrel from the atmofphere, 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 condenfation, I have, by an additional part, endeavoured to get the air more perfectly out of the barrel.

We have feen that Mr *Smeaton*, by making the pifton of his pump fit more exactly to the bottom of the barrel, and by fhutting up the top to prevent the preffure of the atmofphere on the pifton-valve, was able to get more of the air above it than could be effected in the common pump. But ftill the difficulty, though fo far removed, remains in the top of the barrel: for as the pifton cannot be made to fit fo exactly to the top-plate, but that there will be fome lodgment for air, it is impoffible to expel it entirely; more, perhaps, might be expelled if the valve on the top could be made to open more eafily, by removing the weight of the air from it; for the atmofphere, preffing on this valve, will prevent its opening freely, in the fame manner as, when preffing on the pifton-valve, it obftructs the opening of that in the common pump.

The difficulty which Mr *Smeaton* removed from the pifton-valves, I have endeavoured to remove from the valve on the top-plate; that this valve, having the préffure of the atmofphere taken off, might open with the fame eafe as the pifton-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 fmall pump of the fame conftruction as the large one; having the barrel opening into a ciftern, the pifton-rod moving through a collar of leathers, and a valve near the top, through which the air is forced into the atmofphere. This pifton is folid; becaufe 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 ufe being to rarefy the air above the valves, or remove the weight of the atmofphere from off them. To ufe this pump, it is neceffary the key of the cock fhould be pierced differently from that of Mr *Smeaton's*; for as the pipes round his are placed at equal diftances, when the one from the bottom of the barrel is connected with that from the receiver to exhauft it, the other, from the valve on the top-plate, is opened to the atmofphere by the other paffage through the cock. But in order to rarefy the air above the valve in my pump, it is neceffary this laft paffage fhould be fhut up, when the valve-pump is ufed. Inftead, therefore, of placing the three ducts at equal diftances round the cock, I have divided the whole into five eqnal parts; leaving the diftance of one-fifth between the ducts leading from the ciftern and the valves to the cock, and two-fifths between each of thefe and the one leading from the cock to the receiver. By this adjuftment, when the communication is open between the receiver and valves, for condenfation, the other hole through the cock opens the ciftern to the atmofphere: but when the communication is made between the cifterns and the receiver, for exhauftion, a folid part of the key comes againft the duct leading to the valves, and fhuts it up; and the air, which is forced out of the barrel, paffes into the atmofphere through the valve-pump; for the valve of the fmall pump may be kept open while the great one is worked.

Now, to apply Mr *Smeaton's* reafoning to this conftruction. After mentioning his taking off the weight of the atmofphere from the pifton, by fhutting up the top of the barrel, he fays, "The confequence of this conftruction is, that when the pifton is put down to the bottom of the cylinder, the air in the lodgment under the pifton will evacuate itfelf fo much the more, as the valve of the pifton opens more eafily, when preffed by the rarefied air above it, than when preffed by the whole weight of the atmofphere. Hence, as the pifton 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 pifton 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 elfe being fuppofed perfect." The fame may be faid with regard to the valve on the top-plate in this machine. It will open more eafily, when preffed by the rarefied air above it than when preffed by the weight of the whole atmofphere. Hence, as by the conftruction 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 elfe being fuppofed perfect; and the nature of the air permitting it.

In this eftimation, any advantage which may arife from the removal of the valves at the bottom of the barrels and in the pifton, is not confidered: But if they made any refiftance 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 clamminefs 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 valve

[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.

Pneumatics valve on the top plate will rife only till the air be expanded one hundred times in a barrel of fix inches length, becaufe this is the proportion which the vacancy bears to the capacity of the whole barrel, (the refiftance of the valve not being taken into the account) it will rife till the air is expanded two hundred times in a barrel of twelve inches length, the diameters being the fame in both, becaufe the capacity of the barrel being doubled, the vacancy bears fo much lefs proportion to it than to one of fix inches. And if the air can be rarefied in proportion to the difference between the vacancy and the capacity of the barrel, by leffening this proportion, (which, after having made the work to fit as well as poffible, is to be done by enlarging the capacity of the barrel), the power of the pump muft be increafed.

This, Sir, is reafoning from theory: but thefe circumftances, I think, ought to be confidered in the conftruction of an air-pump; and experiment only muft determine how far an attention to them may be ufeful.

The rarefaction which a pump will produce, by experiment, may come very far fhort of what it ought to do by the theory of its conftruction. If the common pump will, in experiment, rarefy the air only one hundred times, when in its beft ftate, and Mr *Smeaton's*, by conftruction, in duplicate proportion to this, it ought to go to ten thoufand; every thing being fuppofed perfect: but in its beft ftate, Mr. *Smeaton's* pump will only rarefy the air about one thoufand times; fo that the nine-tenths which it falls fhort 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 thoufand times, or both thefe caufes together. The way to prove how far this is owing to the air itfelf, is by making a machine, which, in theory, will carry the rarefaction further. A pump conftructed without the valves, as mine is, ought to rarefy the air in duplicate proportion of what Mr *Smeaton's* fhould 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, fince we fee Mr *Smeaton's* pump, in experiment, falls fo far fhort of the theory. But fuppofing 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 fhort of this, muft be attributed either to the imperfection of the machine, or the nature of the air, or both together: or if this pump fhould rarefy the air only to the fame degree with Mr *Smeaton's*, fince by conftruction it ought to go fo much further, will it not afcertain 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 reafon why Mr *Smeaton's* pump, in experiment, fell fo far fhort of the theory? If this fhould be the cafe, will it not be a confirmation that the power of mechanifm 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 expanfion into fome other? I hope, in a little time, to be able to inform you what the refult is by experiment, and to what degree this pump will exhauft the receiver.

Note. Since this letter was communicated, I have feen, in the 67th vol. of the Philofophical Tranfactions, an account of fome experiments made by Mr *Nairne*, with a pump conftructed on Mr *Smeaton's* principle: from which it appears that Mr *Smeaton* was deceived with refpect to the rarefaction in his receiver, as indicated by the pear-gauge; and that the greateft power of the pump, when the experiment was properly made, would carry the rarefaction in the receiver only to fix hundred, inftead of one thoufand times. By an account of Mr *Cavallo's*, in the 73d vol. of the Philofophical Tranfactions, I find an improvement made in Mr *Smeaton's* pump, by Mr *Haas*, inftrument-maker. He has contrived to open the valve at the bottom of the barrel independent of the fpring of the air underneath; and by this improvement he has increafed the power of the pump to one thoufand 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 fimplicity, as Mr *Haas's* contrivance is complex, confifting of a ring lying at the bottom of the barrel, to which ring the valve is faftened; this ring is raifed by a pedal, connected with two wires moving through two collars of leathers, and is depreffed by a fpiral fpring contained in a focket, the whole being fixed under the barrel of the pump: But he has done nothing to remove the refiftance from the valve in the pifton, nor the weight of the atmofphere from off the valve on the top-plate.

Plate Append fig. 2.

Fig. 2. A perpendicular fection of one of the barrels, the two cifterns, condenfing gauge, &c. where A B reprefents the barrel; C D the ciftern on which it ftands; *a a a a* the leathered joint, funk into a focket, and buried in oil; E F is the pifton; the cylindrical rod paffing through a collar of leathers, G G, in the box H I. K fhows the place of the valve on the top-plate K L, covered by the crofs-piece M M, into which the pipe O O is foldered; that conveys the air from the valves to the duct going under the valve-pump, as may be feen in Plate I. Appendix fig. 2. *o* is part of the faid duct; *p* is the joint funk into a focket in the crofs-piece P P, which connects the cifterns, and has a duct through it leading to them. Into this duct open the ducts *q* and *r*, the firft 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 fhow fome of the parts more diftinctly; except Q Q, which is the top of the barrel retained and brought down out of its place, to fhow the top plate, that fhuts up the barrel, feparated from the box, which contains the collar of leathers. S fhows one of the holes in the plate over which the valve lies, and which is covered by R in the crofs piece. V V is the pifton fhowing the valve open on the top, which is to prevent labour when the pump condenfes. W X is the ciftern, in which is more diftinctly feen the fhoulder for the leather which clofes the joint between this and the barrel, and alfo the focket in which the oil lies over the leather. Y Z is the condenfing gauge, with the orifice of the tube raifed above the furface of the quick-filver. *e e* is the collar of leathers, through which the glafs tube moves. *i* is a fmall pipe coming up through the quick-filver to make a communication between the valves and the gauge.

Fig. 3. is a view of the upper furface of the top-plate which clofes the barrel, being foldered into it, fhowing the

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

Appendix, Plate 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. GH the duct leading from the cock, through the pipe A B, (fig. 1.) to the valves. DE 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.

Remarks on the account given by Dr Prince's pump in the Encyclopædia. 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 the

[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 obfervation in the original account of it. If he ever faw an experiment producing the extra-ofcillation he mentions, it muft have been made with a finge-barrelled pump, in which alone the defcent of the pifton can caufe a " downward ofcillation."

" To prevent this" (downward ofcillation) he fays, " valves were put into the piftons; but as thefe require force to open them, the addition feemed rather to increafe the evil, by rendering the ofcillation more fimultaneous with the ordinary rate of working." If fuch an evil were produced by the defcent of the pifton, it is difficult to conceive how putting valves into the piftons could have increafed it. They could not increafe the evil unlefs they increafed the refiftance to the air under the pifton. But it muft be a ftrange affertion, that a pifton with a *valve* in it will give more refiftance to the air than a *folid* pifton. He had before faid, one caufe of this ofcillation was the fudden rufhing of the air into the barrel, when the pifton comes into the ciftern. A pifton with a valve in it would not leave fo great a vacuum in the barrel above it, as a folid pifton. If therefore his firft pofition were true, that one caufe of the extra ofcillation was the rufhing of the air into this vacuum, the tendency of the valve would be to leffen it by gradually letting the air into the vacuum. It certainly would leffen the evil *below*, by leffening the refiftance of the pifton to the air under it, which, he fays, produces " a downward ofcillation." But theory and experiment prove that no fuch effect, as extra-ofcillation, will be produced by the *defcent* of the pifton, if the pump be properly made with two barrels, though there be no valves at the bottom.

' Neither will there be any greater ofcillation of the mercury produced in the gauge of the American pump, than there is in the common pump, by the rufhing of the air into the exhaufted barrels. The writer fpeaks of the " mercury fhooting up into the gauge, and getting into a ftate of ofcillation;" and that " the fubfequent rife of the pifton will frequently keep time with the fecond ofcillation, and increafe it;" as though this was peculiar to the American pump. Every experimenter knows, that in working any air-pump, having a barometer-gauge, the firft ftrokes of the winch, if made quick, will caufe a rapid rife and fall of the mercury; and that the ftrokes may be fo timed as to increafe the ofcillations by making them fimultaneous 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 illuftrate the method by which it exhaufts the receiver, there is a fuppofition made that the pifton is *folid*, and that in its defcent it is allowed to pafs *out* of the bottom of the barrel into the ciftern, by which an opening is made for the air to pafs from the receiver into the exhaufted barrel. Such a large and free paffage as this, fuddenly opened, might operate with fo much force on the gauge, as to caufe a very rapid rife of the mercury, on the firft working of the pump. But it is exprefsly ftated in the account, that " in working the pump, the pifton is not allowed to defcend entirely into the ciftern, fo far as to leave the bottom of the barrel open: but it defcends below a hole in the fide of the barrel, near the bottom, which opens a free communication between the barrel, ciftern, and receiver. Through this hole the air rufhes from the ciftern into the exhaufted barrel, when the pifton has dropped below it." [D] The air is more gradually admitted in this way than by opening the bottom of the barrel. No effential difference was found in the rifing 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 folid piftons were ufed. But when the piftons are made with valves on the top, as directed in the original account, there is no difference in the ofcillation of the gauge in the two pumps.

' A moment's attention to the two conftructions will fhew that there cannot be any difference. In the common pump the barrel is exhaufted *below* the pifton, by its rifing; and the air gradually paffes into the barrel through a hole under a valve at the bottom-plate. In the American pump the barrel is exhaufted *above* the pifton, by its defcending: and the air as gradually paffes through a hole in the pifton under a valve which covers it, into the exhaufted part of the barrel, as it does in the common pump. The effect on the gauge muft therefore be the fame in both pumps, in their firft working: for one can produce no more ofcillation than the other by the entering of the air into the exhaufted barrels. This part of the objection of extra-ofcillation in the American pump, faid to arife from " the air from the receiver immediately rufhing into the barrel, as foon as the pifton comes into the ciftern," 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 pafs through the piftons into the exhaufted barrel, in the firft working of the American pump; yet when the air becomes too weak to raife the valve on the top of the pifton, it will pafs through the hole in the fide of the barrel, where there is no refiftance, when the pifton falls below it. This is one of the principal advantages the American pump has over the common one: for the refiftance of the lower valve in the latter, will always limit its exhaufting power to a lefs degree than that of the former. And by the time the air becomes too weak to raife the pifton-valve, the mercury will have rifen fo high as to prevent any ofcillation in the gauge; fuppofing a folid pifton, and the want of a valve over the hole in the fide of the barrel, could have produced a great degree of it, in the firft working of the pump. It is neceffary to obferve, that the valves were not put " *in* the piftons," as this writer fays, but *on* them, that lefs room might be left for the lodgment of air between the piftons and top plates of the barrels.

' It is difficult to conceive what is meant by faying the valves in the piftons were alfo intended to " prevent a greater irregularity of working as a condenfer." There can be no irregularity in the gauge, of which he had been fpeaking, when the pump condenfes; whether the piftons

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

piftons be folid, 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 atmofphere, and the mercury remains quiefcent. There is no more irregularity in condenfing with the American pump, than there is extra-ofcillation in exhaufting. The valves on the piftons leffen the labour in condenfing with this pump, by taking off part of the refiftance of the atmofphere againft the piftons. For this purpofe they are often put into common condenfers. And this is the only ufe of them, in *condenfing* experiments, mentioned in the original account.

"If this difficulty (the great ofcillation) could be got over," fays the compiler, "the conftruction feems promifing." It is difficult to deftroy what does not exift. But if the evil did exift, it would be no hard matter to remove it. This might be done by placing a fmall ftop-cock over the gauge to cut off the communication between the barrels, or receiver, during the firft working of the pump. It is the firft ftrokes which caufe the moft rapid rife of the mercury in all air-pumps. When the receiver is nearly exhaufted, the air might be gradually let out of the tube, and the mercury would rife flowly in it. The exhauftion might then be completed without any ofcillation in the gauge, as the mercury rifes but very flowly when the receiver is nearly exhaufted. This is fuggefted, not becaufe there is any neceffity for it in the American double-barrelled air-pump; but left any perfon fhould wifh to poffefs a fingle-barrelled pump of this conftruction, in which fuch an ofcillation might take place.

'The next objection has more weight, though it is not peculiar to the American air-pump, as the writer infinuates. "It appears," fays he, "of very difficult execution. It has many long, flender, and crooked paffages, which muft be drilled through broad plates of brafs, fome of them appearing fcarcely practicable. It is rare to find plates and other pieces of brafs without air-holes, which it would be difficult to find out and clofe," &c. When a machine is defigned to effect more purpofes than one by the fame moving power, it is almoft neceffarily complex in its conftruction. It was by following the method ufed by Mr *Smeaton*, of making the pump perform exhaufting and condenfing experiments by the fame winch and barrels, that the American air-pump was, like his, made with a cock fo pierced as to regulate thefe effects; though in the American pump it is a little differently conftructed from the cock in Mr *Smeaton's* pump, but not more complex. The writer very juftly commends Mr *Smeaton's* pump, efpecially as made by Mr *Nairne;* but he has not given a figure of the original pump, with its regulating cock; though this is an effential part of Mr *Smeaton's* conftruction. It is omitted, perhaps, becaufe he has given a full account of Mr *Nairne's* improvement, in which this complex cock is excluded, and the fame effects produced by two others, added by Mr *Nairne*.

'In all air-pumps, made to exhauft and condenfe by the fame barrel and winch, there muft be more pipes, ducts and cocks than what are neceffary in the fimple exhaufting pump, to command and regulate the different operations. But it is furprifing that the compiler fhould object to "long, flender and crooked paffages" in the American air-pump: that he fhould fingle out this pump as the *moft* liable to fuch an objection, when by actual meafurement there is not fo much pipe and duct-work in the American air-pump, by more than one half, as in Mr *Nairne's* improved pump of *Smeaton*, againft which he brings no fuch objection. The original American pump has but one pipe, of feven inches length, ftanding between the barrels; one of fix 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 brafs which is connected with the receiver-plate. Through this piece, and the cock it contains, a paffage 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 brafs," connecting it with the other cock and the receiver-plate for condenfing. The pipe connecting the gauge with the receiver-plate in the American pump is ftraight; in Mr *Nairne's* "crooked." It is prefumed, that though it may be "rare to find plates and other pieces of brafs without air-holes," the brafs-work may be caft as free from them for one pump as another, where the forms are equally fimple. If the American pump be made only to exhauft, the pipe-work may be made nearly the fame as in the common pump.

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

'The pifton in *Cuthbertfon's* pump, which is complex, and muft be accurately made to anfwer its purpofe, does no more, with the aid of the lower wire-valve, and its rod working through a collar of leathers in the hollow pifton-rod, than the fimple pifton of the American pump, with a folid rod; and without any valve at the bottom of the barrel. The aim in both conftructions is to get the air from the receiver into the exhaufted barrels *above* the piftons, without any refiftance from valves. On this part of the two conftructions of the American, and *Cuthbertfon's*, pump, Mr *Nicholfon*, a philofopher of reputation, whofe writings are well known to the public, fays, "With regard to the lower valves, *Cuthbertfon*, by an admirable difplay of talents as a workman, has infured their action. *Prince*, on the other hand, has, by a procefs of reafoning, fo much improved the inftrument, that no valves are wanted. In this refpect he has the advantage of fimplicity and cheapnefs, with equal effect. [E] The late Mr *George Adams*, mathematical

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

matical inftrument-maker, whofe philofophical writings are alfo well known and whofe ability to judge of the merits of an air-pump cannot be doubted, advertifed " the American double-barrelled air-pump, the lateft improvement on this inftrument, in which the air receives no impediment from the action of valves or cocks, exceeding *Smeaton's* in accuracy and fimplicity, and far fuperior in both refpects to feveral later contrivances." And in his lectures on natural philofophy, vol. I. fpeaking of the invention of the air-pump and its improvements, after mentioning thofe by *Hook* and *Boyle*, he fays, " fubfequent improvements have been made by Meffrs *Gravefande*, *Nollet*, *Smeaton*, *Haas* and *Cuthbertfon*; but the laft and moft perfect is that of the Rev *John Prince*, of Bofton, in America, to which I have given the name of the American air pump." The Analytical Reviewers, in their review of the controverfy between Mr *Nairne* and Mr *Brook*, refpecting the difcovery of the true power of *Smeaton's* pump, fay, " the contention feems to relate to an object which has for fome time been rendered of no importance, by the invention of an air-pump on a much better conftruction than either, defcribed by the Rev *John Prince*, in the Tranfactions of the American Academy for the year 1783. The idea is fo fimple and fo valuable, that we are convinced we fhall receive the thanks of our readers if we devote a few lines to the defcription of it." After giving a fhort defcription of it, they add, " the conftruction evidently deferves the attention of the curious; and it is fomewhat wonderful that it fhould have fo long remained unapplied to the purpofe of exhaufting, when from the earlieft modern times it has been ufed in condenfing fyringes." [F] Mr *William Jones*, before mentioned, fpeaking of the American air-pump, gives this account of its power of exhaufting. " By the comparifon of the height of the mercury in a good barometer, I obferved not above $\frac{1}{20}$ of an inch difference with that of the barometer gauge to the pump; confequently the rarefaction was about 1200 times; and I judge it to be equal in power to what is faid of Mr *Cuthbertfon's*, or any pump whatfoever." [G] In a letter to the inventor of the American air-pump, Mr *Jones* further fays, " I have feen Mr *Cuthbertfon's* pump in experiment, and it certainly exhaufts to very great nicety; and I have alfo been witnefs 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 ftated in it againft the American air-pump pafs unnoticed, would look like a tacit acknowledgment of their truth: but it is prefumed the above remarks and teftimonies in favour of this pump will be fufficient to fhew the contrary; and prove that it is not, as the writer of thefe objections obferves, " rather a fuggeftion of theory than a thing warranted by its actual performance." To fome perfons, who are acquainted with the operation of the American air-pump, the partial and unjuft account of it in the Encyclopædia appeared at firft very furprifing. But their furprife abated, and the prejudice againft it was fully accounted for, on reading the compiler's remark at the end of his account of air-pumps. For he feems to have condemned it that he might be able to fay, " we may be indulged in one remark, that although this noble inftrument 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 fimple and convenient. It has been obferved above, that in all air-pumps, made to condenfe as well as exhauft by the fame barrels and winch, there muft be additional pipes, ducts and cocks to command and regulate the operations: But this is not the beft method of conftructing the inftrument for exhaufting and condenfing experiments: for a great ftrain is brought upon the rackwork of the pump when feveral atmofpheres are thrown into the receiver: and the pump may be made with lefs trouble and expenfe by fixing a common condenfing fyringe to it, in the following manner. Let a ftraight pipe be fixed to the cifterns, and pafs horizontally to the receiver-plate, as in the common table air-pump. At a convenient diftance from the barrels this pipe muft be fwelled out fo as to admit the key of a ftop-cock. The key of this cock muft be pierced quite through in the direction of its handle; and half way through, at a right angle to meet the other hole. A fmall pin muft be fixed in the handle, on that fide which correfponds with the fhort hole. A hole muft be made in the fide of the pipe to correfpond occafionally with the holes in the key. This cock is more fimple than the one in the original pump, and will regulate the exhaufting and condenfing experiments. To fet the cock for exhaufting the receiver, bring the handle of the key parallel with the pipe, with the folid part of the key againft the hole in the fide of the pipe; then will the communication be opened between the barrels and receiver, and the receiver may be exhaufted. To reftore the equilibrium, or let the air into the receiver, fet 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 atmofphere and receiver, through the hole in the fide of the pipe and the cock. In this fituation the folid part of the key will clofe the paffage in the pipe leading to the barrels. If a condenfer, having a valve at its end, be now attached to the fide of the pipe, oppofite the hole, the air may be forced into the receiver through the cock without entering the barrels. The fwelled part of the pipe, in which the key is inferted, fhould be fo made as that the condenfer may be fcrewed on or off, at pleafure. The equilibrium may be reftored in the receiver, either by unfcrewing the condenfer a little, or by letting the air out through the barrels.

' In this conftruction, the pipe ftanding between the barrels in the original pump, and the drilled paffages in the horizontal piece connecting this pipe with the regulating cock, are unneceffary. The pump is rendered more fimple, and every difficulty of execution on account of crooked paffages, &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 laft edition of the Encyclopedia was printed.

' Another alteration, fince made, is in the fituation 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. $3\frac{1}{2}$ 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 Écoumenac 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 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 *Cabello*, 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 unsuccessful 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, vallies, 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. ½ 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 Caguaya*, once a place of the greatest

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 Treſh, 83 S. S. W. of Baltimore, and 194 S. W. by S. of Philadelphia.—*ib.*

POSITION, Centre of, 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

Pofition. diftance, eftimated in any direction whatever, fhall be the average of the pofitions and diftances of every particle of the affemblage, eftimated in that direction.

This will be the cafe, if the point be fo felected that, when a plane is made to pafs through it *in any direction whatever*, and perpendiculars are drawn to this plane from every particle in the body or fyftem, the fum of all the perpendiculars on one fide of this plane is equal to the fum of all the perpendiculars on the other fide. If there be fuch a point in a body, the pofition and motion of this point is the average of the pofitions and motions of all the particles.

Plate XI. For if P (fig. 1.) be a point fo fituated, and if QR be a plane (perpendicular to the paper) at any diftance from it, the diftance P*p* of the point from this plane is the average of the diftances of all the particles from it. For let the plane APB be paffed through P, parallel to QR. The diftance CS of any particle C from the plane QR is equal to DS—DC, or to P*p*—DC. And the diftance GT of any particle G, lying on the other fide of APB, is equal to HT+GH, or to P*p*+GH. Let *n* be the number of particles on that fide of AB which is neareft to QR, and let *o* be the number of thofe on the remote fide 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 fum of the diftances of all the particles, fuch as C, is *n* times P*p*, after deducting all the diftances, fuch as DC. Alfo the fum of all the diftances of the particles, fuch as G, is *o* times P*p*, together with the fum of all the diftances, fuch as GH. Therefore the fum of both fets is $\overline{n+o} \times Pp$ + fum of GH — fum of DC, or $m \times Pp$ + fum of GH — fum of DC. But the fum of GH, wanting the fum of DC, is nothing, by the fuppofed property of the point P. Therefore $m \times Pp$ is the fum of all the diftances, and P*p* is the *m*th part of this fum, or the average diftance.

Now fuppofe that the body has changed both its place and its pofition with refpect to the plane QR, and that P (fig. 2.) is ftill the fame point of the body, and π P is a plane parallel to QR. Make *p*π equal to *p*P of fig. 1. It is plain that P*p* is ftill the average diftance, and that $m \times Pp$ is the fum of all the prefent diftances of the particles from QR, and that $m \times \pi p$ is the fum of all the former diftances. Therefore $m \times P\pi$ is the fum of all the changes of diftance, or the whole quantity of motion eftimated in the direction πP. Pπ is the *m*th part of this fum, and is therefore the average motion in this direction. The point P has therefore been properly felected; and its pofition, and diftance, and motion, in refpect of any plane, is a proper reprefentation of the fituation and motion of the whole.

It follows from the preceding difcuffion, 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, fo that PQ is the *m*th part of CN; for the fum of all the diftances has been diminifhed by the quantity CN, and therefore the average diftance muft be diminifhed 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, fuch that if a plane pafs through it, *in any direction whatever*, the fum of all the diftances of the particles on one fide of this plane is equal to the fum of all the diftances on the other.

It is eafy to fhew that fuch a point may be found, with refpect to a plane parallel to QR. For if the fum of all the diftances DC exceed the fum of all the diftances GH, we have only to pafs the plane AB a little nearer to QR, but ftill parallel to it. This will diminifh the fum of the lines DC, and increafe the fum of the lines GH. We may do this till the fums are equal. Pofition

In like manner we can do this with refpect to a plane LM (alfo perpendicular to the paper), perpendicular to the plane AB. The point wanted is fomewhere in the plane AB, and fomewhere in the plane LM. Therefore it is fomewhere in the line in which thefe two planes interfect each other. This line paffes through the point P of the paper where the two lines AB and LM cut each other. Thefe two lines reprefent planes, but are, in fact, only the interfection of thofe planes with the plane of the paper. Part of the body muft 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 fo fituated, therefore, that the fum of all the diftances from it to the particles lying above it fhall be equal to the fum of all the diftances of thofe which are below it. Therefore the fituation of the point P is now determined, namely, at the common interfection of three planes perpendicular to each other. It is evident that this point alone can have the condition required in refpect of thefe three planes.

But it ftill remains to be determined whether the fame condition will hold true for the point thus found, in refpect to *any other* plane paffing through it; that is, whether the fum of all the perpendiculars on one fide of *this fourth* plane is equal to the fum of all the perpendiculars on the other fide. Therefore

Let AGHB (fig. 3.), AXYB, and CDFE, be three planes interfecting each other perpendicularly in the point C; and let CIKL be any other plane, interfecting the firft in the line CI, and the fecond in the line CL. Let P be any particle of matter in the body or fyftem. Draw PM, PO, PR, perpendicular to the firft three planes refpectively, 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. Alfo draw MQ perpendicular to CE, and therefore parallel to AB, and meeting CI in S. Draw SV; alfo draw ST perpendicular to VP. It is evident that SV is parallel to CL, and that STRQ and STPM are rectangles.

All the perpendiculars, fuch as PR, on one fide of the plane CDFE, being equal to all thofe on the other fide, they may be confidered as compenfating each other; the one being confidered as pofitive or additive quantities, the other are negative or fubtractive. There is no difference between their fums, and the fum of both fets may be called 0 or nothing. The fame muft be affirmed of all the perpendiculars PM, and of all the perpendiculars PO.

Every line, fuch as RT, or its equal QS, is in a certain invariable ratio to its correfponding QC, or its equal PO. Therefore the pofitive lines RT are compenfated by the negative, and the fum total is nothing.

Every line, fuch as TV, is in a certain invariable ratio to its correfponding ST, or its equal PM, and therefore their fum total is nothing.

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

Pofition. each is in an invariable ratio to a correfponding perpendicular from P on the oblique plane CIKL. Therefore the fum of all the pofitive perpendiculars on this plane is equal to the fum of all the negative perpendiculars, and the propofition is demonftrated, *viz.* that in every body, or fyftem of bodies, there is a point fuch, that if a plane be paffed through it *in any direction whatever*, the fum of all the perpendiculars on one fide of the plane is equal to the fum of all the perpendiculars on the other fide.

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

If A and B (fig. 4) be the centres of pofition of two bodies, whofe quantities of matter (or numbers of equal particles) are a and b, the centre C lies in the ftraight line joining A and B, and $AC : CB = b : a$, or its diftance from the centres of each are inverfely as their quantities of matter. For let $\alpha C \beta$ be any plane paffing 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 fimilarity of triangles, $CA : CB = b : a$.

If a third body D, whofe quantity of matter is d, be added, the common centre of pofition E of the three bodies is in the ftraight 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, paffing the plane $\delta E \kappa$ through E, and drawing the perpendiculars $D\delta$, $C\kappa$, the fum of the perpendiculars from D is $d \times D\delta$; and the fum 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 diftance from this centre and from the fourth is inverfely as the quantities of matter: and fo on for any number of bodies.

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

For, let m be the number of particles in the fyftem. Suppofe any particle to move uniformly in any direction. It is evident from the reafoning in a former paragraph, that the motion of the common centre is the mth part of this motion, and is in the fame direction. The fame muft be faid of every particle. Therefore the motion of the centre is the motion which is compounded of the mth part of the motion of each particle. And becaufe each of thefe was fuppofed to be uniform and rectilineal, the motion compounded of them all is alfo uniform and rectilineal; or it may happen that they will fo compenfate each other that there will be no diagonal, and the common centre will remain at reft.

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

Cor. 2. The quantity of motion of fuch a fyftem is the fum 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 fyftem by the velocity of the centre. Pofition.

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 fum of thofe reduced motions by the quantity of matter in the fyftem.

By the felection of this point, we render the inveftigation of the motions and actions of bodies incomparably more fimple and eafy, freeing our difcuffions from numberlefs intricate complications of motion, which would frequently make our progrefs almoft impoffible.

POSITION, in arithmetic, called alfo *Falfe Pofition*, or *Suppofition*, or *Rule of Falfe*, is a rule fo called, becaufe it confifts in calculating by falfe numbers fuppofed or taken at random, according to the procefs defcribed in any queftion or problem propofed, as if they were the true numbers, and then from the refults, compared with that given in the queftion, the true numbers are found.

Thus, take or affume any number at pleafure for the number fought, and proceed with it as if it were the true number, that is, perform the fame operations with it as, in the queftion, are defcribed to be performed with the number required: then if the refult of thofe operations be the fame with that mentioned or given in the queftion, the fuppofed number is the fame as the true one that was required; but if it be not, make this proportion, *viz.* as your refult is to that in the queftion, fo is your fuppofed falfe 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 itfelf, the fum will be 240?

Suppofe 99

$$\begin{array}{rl} 49.5 & = \frac{1}{2} \\ 33. & = \frac{1}{3} \\ 24.75 & = \frac{1}{4} \\ \underline{16.5} & = \frac{1}{6} \\ 222.75 & = \text{refult} \end{array}$$

Then, as 222.75 : 240 : : 99 : 106.6 = Anfwer.

$$\begin{array}{rl} 53.\dot{3} & = \frac{1}{2} \\ 35.5 & = \frac{1}{3} \\ 29.6 & = \frac{1}{4} \\ \underline{17.\dot{7}} & = \frac{1}{6} \\ 240. & = \text{proof.} \end{array}$$

This is *fingle* pofition.

Sometimes it is neceffary to make two different fuppofitions or affumptions, when the fame operations muft be performed with each as in the fingle rule. If neither of the fuppofed numbers folve the queftion, find the differences between the refults and the given number; multiply each of thefe differences into the other's pofition; and if the errors in both fuppofitions be of the fame kind, *i. e.* if both fuppofitions be either lefs 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 fame kind, *i. e.* if the one be greater and the other lefs than the given number, divide the fum of the products by the fum of the errors. The quotient, in either cafe, will be the anfwer.

Example. Three partners, A, B, and C, bought a fugar-work which coft them L.2000; of which A, paid a certain fum 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
———

Answers. { 468.75 = sum paid by A.
518.75 = ——— B.
1012 5 = ——— C. }
———
2000... = proof.

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 Arca, 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 refpective dimenfions of the different parts of veffels of earthen-ware have alfo confiderable influence on their capability to ftand the fire.

In fome cafes the glazing or covering, efpecially when too thick, and of a nature different from the body of the pottery, alfo renders them liable to break. Thus in making fome kinds of pottery, it is always effential, *1ft*, To follow the beft proportion in the principles; *2d*, To give to the particles of the pafte, by grinding, a minutenefs fuited to the purpofe for which it is intended, and to all the parts the fame dimenfions as far as poffible; *3d*, To carry the baking to the higheft degree that the matter can bear without being fufed; *4th*, To apply the glazing in thin layers, the fufibility of which ought to approach as near as poffible to that of the matter, in order that it may be more intimately united.

C. Vauquelin, being perfuaded that the quality of good pottery depends chiefly on ufing proper proportions of the earthy matters, thought it might be of importance, to thofe engaged in this branch of manufacture, to make known the analyfis of different natural clays employed for this purpofe, and of pottery produced by fome of them, in order that, when a new earth is difcovered, it may be known by a fimple analyfis whether it will be proper for the fame object, and to what kind of pottery already known it bears the greateft refemblance.

	Heffian Crucibles.	Argil of Dieux.	Porcelain Capfules.	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 fulphuric acid.

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

Petunzé.—Silex 74, argil 14·5, lime 5·5, lofs 6. A hundred parts of this fubftance, treated with the fulphuric acid, gave feven or eight parts of alum. But this quantity does not equal the lofs fuftained.

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

There is a kind of earthen veffels, called *Alcarrezes*, ufed in Spain for cooling the water intended to be drunk. Thefe veffels confift of 60 parts of calcareous earth, mixed with alumina and a little oxyd of iron, and 36½ of filicious earth, alfo mixed with alumina and the fame oxyd. The quantity of iron may be eftimated at almoft one hundredth part of the whole. This earth is firft kneaded into a tough pafte, being for that purpofe previoufly diluted with water; formed into a cake of about fix inches in thicknefs, and left in that ftate till it begin to crack. It is then kneaded with the feet, the workmen gradually adding to it a quantity of fea falt, in the proportion of feven pounds to a hundred and fifty; after which it is applied to the lath, and baked in any kind of furnace ufed 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 fides. Hence the air which comes in contact with it by making it evaporate, carries off the caloric contained in the water in the veffel, which is thus rendered remarkably cool.

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

POUGHKEEPSIE, a poft-town of New York, and capital of Dutchefs county, delightfully fituated a mile from the E. bank of Hudfon's river, and contains a number of neat dwellings, a court-houfe, a church for Prefbyterians, one for Epifcopalians, and an academy. Here is alfo 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 townfhip is bounded foutherly by Wappinger's Kill, or Creek, and wefterly by Hudfon's river. It contains 2,529 inhabitants, including 429 electors, and 199 flaves.—*ib.*

POULES, or Foulques, one of the principal nations which inhabit the banks of the Senegal. They poffefs an extent of more than fixty leagues along the river, and exact heavy cuftoms from the Senegal traders with the interior of the country. They are not fo black as the other negroes, but of a copper colour, much inclining to red. It is remarkable, however, that their children who are fent to Senegal, and refide there for fome years, become much blacker. The females are very handfome and the whites of Senegal generally take care to procure fome of them. But they are of a bad difpofition, and utterly incapable of attachment. When a man has a miftrefs of this nation, he muft watch her conduct very narrowly, and even chaftife her, that fhe may not be guilty of infidelity to him whom fhe honours with her favours. The dread of the baftinado will, in fuch cafe, effect what attention and complaifance can never bring about.

Although the Poules inhabit one of the fineft fpots in Africa, they are neverthelefs a wretched people; they are bafe, cruel, thievifh, and fanatic in the extreme. They are commanded by a chief of their religion, which is a contemptible mixture of Mahometanifm and idolatry. This chief is called the *Almamy*; he is always chofen from among the Tampfirs, who are twelve in number. The Tampfirs are the interpreters of the law, and are the moft learned or rather the moft fanatical among them. The Almamy has the power of life and death over his fubjects; yet he may be depofed by an affembly of Tampfirs: it is therefore his intereft to keep on good terms with them. The payment of cuftoms is made to the Almamy, and is afterwards diftributed among the Tampfirs; and although a part belongs to the former, he neverthelefs requires a feparate prefent for himfelf.

POULTNEY, a fmall river of Vermont, which falls into Eaft Bay, together with Caftleton river, near Col. Lyon's iron works.—*Morse.*

Poultney, a confiderable and flourifhing townfhip in Rutland county, bounded wefterly by Hampton in New York, which adjoins Skeenfborough on the weft. 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 Droogc.—*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, 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.

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.*

Prince William'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 thoſe 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 n° 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 floorcloths, 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 carved 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

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 B, 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."

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 those 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

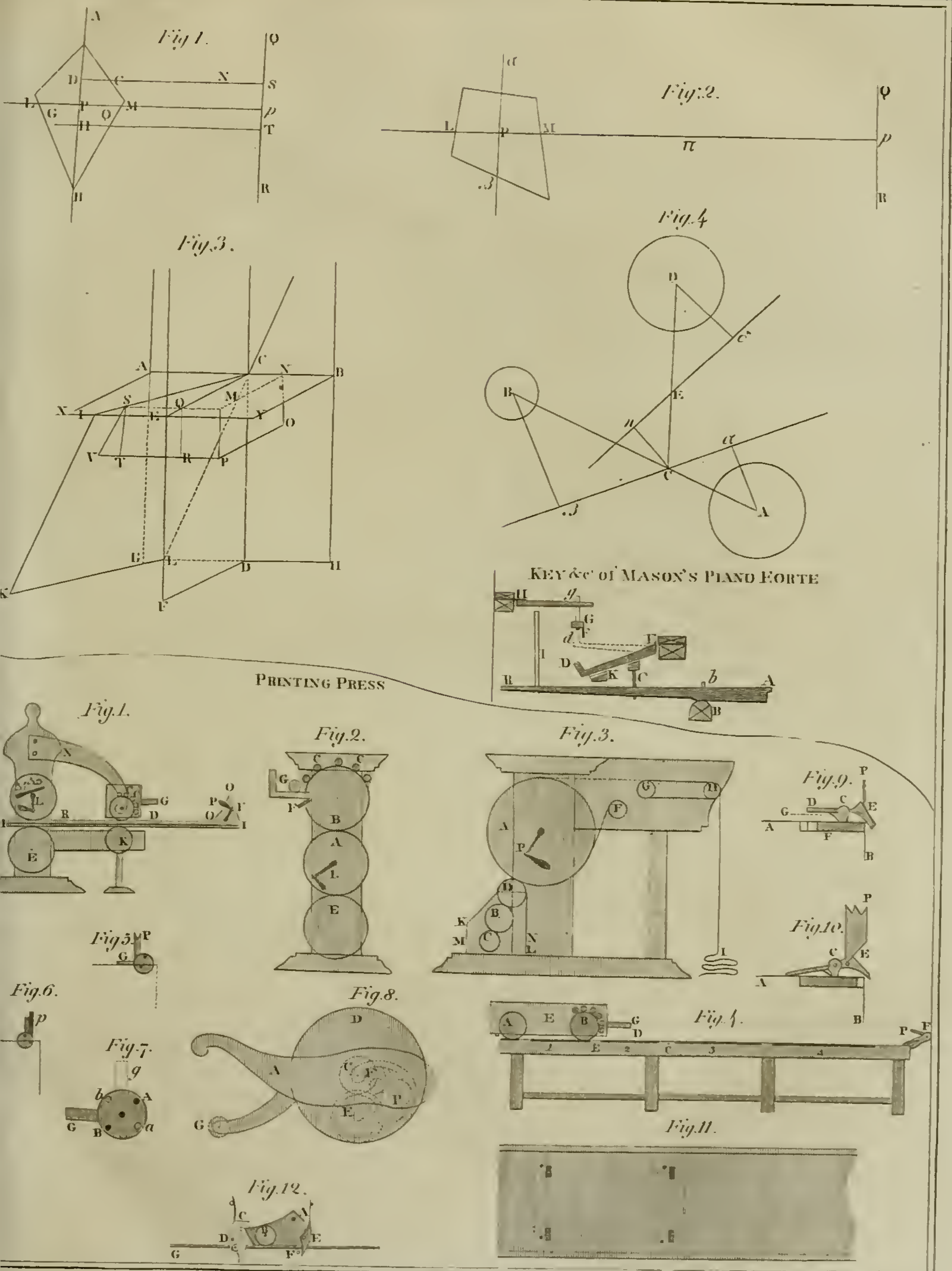
Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
KEY &c. OF MASON'S PIANO FORTE
PRINTING PRESS
Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7.
Fig. 8.
Fig. 9.
Fig. 10.
Fig. 11.
Fig. 12.

cell is looked upon as the fevereft ufage; next, folitary confinement in a cell with the admiffion of light; and, laftly, labour in company with others. The longeft period of confinement is for a rape, which is not to be lefs than ten years, nor more than twenty-one; for high treafon, it is not to exceed twelve, nor fall fhort of fix years.

The prifoners are obliged to bathe frequently, proper conveniencies for that purpofe being provided within the walls of the prifon, and alfo to change their linen, with which they are regularly fupplied. Thofe in folitary confinement are kept upon bread and water; but thofe who labour are allowed broth, porridge, and the like. Meat is difpenfed only in fmall quantities, twice in the week; and on no pretence whatever is any other beverage than water fuffered to be brought into the prifon. Thofe who labour are employed in the trade to which they have been accuftomed; and for thofe acquainted with no particular trade, fome kind of work is devifed which they can perform. One room is fet apart for fhoemakers, another for tailors, a third for weavers, and fo on. In the yards are ftone fawyers, with fhops for fmiths, nailers, &c. In a word, this prifon has all the advantages of the rafping houfe of Amfterdam, without any of its enormous defects. See *Correction-Houfe* in this *Suppl.*

The prifon of Venice is of a very different defcription, and is worthy of notice here only as a curiofity in the annals of tyranny, which has, we hope, paffed away with the government which contrived it. Dr Mofeley, in confequence of his being an Englifh phyfician (a character then highly refpected in Venice), was permitted on the 16th of September 1787, to vifit the common prifon, but was abfolutely refufed admittance into the *Sotto Piómbi* where the ftate prifoners were kept. As the Doctor believes that no foreigner befides himfelf ever witneffed the fcenes, even in the common prifon, which he relates, we fhall give his relation in his own words.

"I was conducted (fays he) through the prifon by one of its inferior dependants. We had a torch with us. We crept along narrow paffages as dark as pitch. In fome of them two people could fcarcely pafs each other. The cells are made of maffy marble; the architecture of the celebrated Sanfovini.

"The cells are not only dark, and black as ink, but being furrounded and confined with huge walls, the fmalleft breath of air can fcarcely find circulation in them. They are about nine feet fquare on the floor, arched at the top, and between fix and feven feet high in the higheft part. There is to each cell a round hole of eight inches diameter, through which the prifoner's daily allowance of twelve ounces of bread and a pot of water is delivered. There is a fmall iron door to the cell. The furniture of the cell is a little ftraw and a fmall tub; nothing elfe. The ftraw is renewed and the tub emptied through the iron door occafionally.

"The diet is ingenioufly contrived for the perduration of punifhment. Animal food, or a cordial nutritious regimen, in fuch a fituation, would bring on difeafe, and defeat the end of this Venetian juftice. Neither can the foul, if fo inclined, fteal away, wrapt up in flumbering delufion, or fink to reft; from the admonition of her fad exiftence, by the gaoler's daily return.

"I faw one man who had been in a cell thirty years; two who had been twelve years; and feveral who had been eight and nine years in their refpective cells.

"By my taper's light I could difcover the prifoners 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 loft the arrangement of words and order of language. When I fpoke to him, he made an unintelligible noife and expreffed fear and furprife; and, like fome wild animals in deferts, which have fuffered by the treachery of the human race, or have an inftinctive abhorrence of it, he would have fled like lightning from me if he could.

"One whofe faculties were not fo obliterated; who ftill recollected the difference between day and night; whofe eyes and ears, though long clofed with a filent blank, ftill languifhed to perform their natural functions—implored, in the moft piercing manner, that I would prevail on the gaoler to murder him, or to give him fome inftrument to deftroy himfelf. I told him I had no power to ferve him in this requeft. He then entreated I would ufe my endeavours with the inquifitors to get him hanged, or drowned in the Canal' Orfano. But even in this I could not ferve him: death was a favour I had not intereft enough to procure for him.

"This kindnefs of death, however, was, during my ftay 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 fome converfation with him; this was fix days previous to his execution. His tranfport at the profpect of death was furprifing. He longed for the happy moment. No faint ever exhibited more fervour in anticipating the joys of a future ftate, than this man did at the thoughts of being releafed from life, during the four days mockery of his trial.

"It is in the Canal' Orfano where veffels from Turkey and the Levant perform quarantine. This place is the watery grave of many who have committed political or perfonal offences againft the ftate or fenate, 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 fack with a large ftone faftened to it, and thrown into the water. Fifhermen are prohibited on forfeiture of their lives, againft fifhing in this diftrict. The pretence is the plague. This is the fecret hiftory of people being loft in Venice.

"The government, with age, grew feeble; was afraid of the difcuffion of legal procefs and of public executions; and navigated this rotten Bucentaur of the Adriatic, by fpies, prifons, affaffination, and the Canal' Orfano."

This is indeed a frightful narrative, and, we doubt not, true as well as frightful; but when, from the ftate of the Venetian prifons, the author infinuates, that Howard was not actuated by genuine benevolence, and infers, or wifhes his reader to infer, that the propofal of that celebrated philanthropift for fubftituting folitary confinement, in many cafes, for capital punifhment, muft have refulted from his not taking into confideration

tion the *mind* of the criminal—the infinuation, to fay the leaft of it, is ungenerous, and the conclufion is at war with the premifes. That there was fomething romantic and fuperfluous in Howard's wanderings, we readily admit; but it feems impoffible to doubt of the reality of his benevolence; and though the horrid prifon of Venice, into which, as the Doctor affures us, Mr Howard never entered, was calculated to injure the body, without improving the mind of the criminal, it does not follow but that folitary confinement, under fuch regulations as at Philadelphia, is the beft means that have yet been thought of for obtaining the object neareft Howard's heart, the reformation of the morals of the criminal.

PROCYON, in aftronomy, a fixed ftar of the fecond magnitude, in Canis Minor, or the Little Dog.

PROSPECT; Frankfort, in the Diftrict of Maine is now fo called. It adjoins Buckfton on Penobfcot river, and is 16 miles below Orrington.—*Morse.*

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

PROSTHAPHERESIS, in aftronomy, 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 alfo *equation of the orbit*, or *equation of the centre*, or fimply the *equation*; and it is equal to the angle formed at the planet, and fubtended by the eccentricity of its orbit.

PROTECTWORTH, a townfhip in the northern part of Chefhire county, New-Hampfhire. It was incorporated in 1769, and contains 210 inhabitants.—*Morse.*

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

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

PROVIDENCE, a river which falls into Narraganfet bay on the W. fide of Rhode-Ifland. It rifes by feveral branches, part of which come from Maffachufetts. It is navigable as far as Providence for fhips of 900 tons, 30 miles from the fea. It affords fine fifh, oyfters and lobfters.—*Morse.*

Providence, a county of Rhode-Ifland State, bounded by Maffachufetts N. and E. Connecticut W. and Kent county on the fouth. It contains 9 townfhips, and 24,391 inhabitants, including 82 flaves. 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, fituated 30 miles N. by W. ¼W. from Newport, and 35 from the fea; feated at the head of navigation of Narraganfet Bay, on both fides of Providence river, the two parts of the town being connected by a bridge 160 feet long and 22 wide. It is the oldeft town in the State, having been fettled 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 Bofton, and 291 north-eaft of Philadelphia. Ships of almoft any fize fail up and down the channel, which is marked out by ftakes, erected at points of fhoals and beds lying in the river, fo that a ftranger may come up to the town without a pilot. A fhip of 950 tons, for the Eaft-India trade, was lately built in this town, and fitted for fea. In 1764, there were belonging to the county of Providence 54 fail of veffels, containing 4,320 tons. In 1790, there were 129 veffels, containing 11,942 tons. This town fuffered much by the Indian war of 1675, when a number of its inhabitants removed to Rhode-Ifland for fhelter. In the late war, the cafe was reverfed; many of the inhabitants of that ifland removed to Providence. The public buildings are an elegant meeting houfe for Baptifts, 80 feet fquare, with a lofty and beautiful fteeple, and a large bell caft at the Hope Furnace in Scituate; a meeting-houfe for Friends or Quakers; 3 for Congregationalifts, one of which, lately erected, is the moft elegant perhaps in the United States; an Epifcopal church; a handfome court-houfe, 70 feet by 40, in which is depofited a library for the ufe of the inhabitants of the town and country; a work-houfe; a market-houfe, 80 feet long and 40 wide, and a brick fchool-houfe, in which 4 fchools are kept. Rhode-Ifland college is eftablifhed at Providence. The elegant building erected for its accommodation, is fituated on a hill to the eaft of the town; and while its elevated fituation renders it delightful, by commanding an extenfive, variegated profpect, it furnifhes it with a pure, falubrious air. The edifice is of brick, 4 ftories high, 150 feet long, and 46 wide, with a projection of 10 feet each fide. It has 48 rooms for ftudents, and 8 larger ones for public ufes. The roof is flated. It is a flourifhing feminary, and contains upwards of 60 ftudents. It has a library containing between 2 and 3000 volumes, and a valuable philofophical apparatus. The houfes in this town are generally built of wood, though there are fome brick buildings which are large and elegant. At a convenient diftance from the town, an hofpital for the fmall-pox and other difeafes has been erected. There are two fpermaceti works, a number of diftilleries, fugar-houfes 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 extenfive trade with Maffachufetts, Connecticut, and part of Vermont; with the Weft-Indies, with Europe, and lately with the Eaft-Indies and China. A bank has alfo been eftablifhed here, and a cotton manufactory, which employs 100 hands; with which is connected a mill for fpinning cotton, on the model of Sir R. Arkwright's mill. It is erected at Pawtucket Falls, in North-Providence, and is the firft 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 flaves. —*ib.*

Providence, *North*, a townfhip of Rhode-Ifland, in Providence county, north of the town of Providence; fouth of Smithfield, and feparated from the State of Maffachufetts on the eaft by Pawtucket river. It contains 1071 inhabitants, including 5 flaves.—*ib.*

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

Providence, *Upper* and *Lower*, townfhips in Delaware county, Pennfylvania.

Providence, a townfhip in Montgomery county, Pennfylvania.—*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 feem to be the rude fragments of primitive mountains, feparated from the great continent in the lapfe of time. The principal ifland is eleven or twelve miles in length, and about three in breadth. It is in the form of a crefcent, and confifts of a ridge of peaked hills. Its latitude, as calculated from a meridional obfervation, is 8° 40′ north from the equator; and its longitude, according to a good chronometer, is 105° 55′ eaft from Greenwich.

"The Englifh had a fettlement on Condore until the beginning of the prefent century, when fome Malay foldiers in their pay, in refentment for fome unjuftifiable treatment, murdered their fuperiors, with the exception of a very few who efcaped off the ifland, where no Europeans have fince refided. At the bottom of the bay was a village fituated clofe to a fine fandy beach, with a long range of cocoa-nut trees before it, and it was defended from the north-eaft fea by a reef of coral rocks, within which was good anchorage for fmall veffels, and an eafy landing for boats. A party went on fhore from Lord Macartney's fquadron, with the precaution, however, of being armed, as large canoes were efpied 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 fhore, and conducted them to the houfe of their chief. It was a neat bamboo cabin, larger than the reft. The floor was elevated a few feet above the ground, and ftrewed with mats, on which were affembled as many men as the place could hold. It was apparently on the occafion of fome feftival, or pleafurable meeting. There was in one of the apartments an altar decorated with images, and the partitions hung with figures of monftrous deities; but the countenances and deportment of the people conveyed no idea of religious awe, and no perfon was feen in the pofture of prayer or adoration. A few fpears ftood againft the wall with their points downwards, together with fome matchlocks and a fwivel gun. The drefs of thofe people was compofed chiefly of blue cotton worn loofely about them; and their flat faces and little eyes denoted a Chinefe origin or relation. Several long flips of paper, hanging from the ceiling, were covered with columns of Chinefe writing. One of the miffionaries, who was of the party, could not, however, in any degree, underftand their converfation; but when the words were written, they inftantly became intelligible to him. Though their colloquial language was altogether different from what is fpoken in China, yet the characters were all Chinefe; and the fact was clearly afcertained on this occafion, that thofe characters have an equal advantage with Arabic numbers, of which the figures convey the fame meaning wherever known; whereas the letters of other languages denote not things, but elementary founds, which combined varioufly together, form words, or more complicated founds, conveying different ideas in different languages, though the form of their alphabet be the fame.

"The inhabitants of Pulo Condore were, it feems, Cochin-Chinefe, with their defcendants, who fled from their own country, in confequence of their attachment to one of its fovereigns, dethroned by feveral of his own fubjects. It was propofed to purchafe provifions here; and the people promifed to have the fpecified quantity ready, if poffible, the next day, when it was intended, if the weather fhould be favourable, to land the invalids. The next morning was fair in the beginning; and a party of pleafure was made from the Hindoftan to a fmall ifland clofe to Pulo Condore. They were fcarcely arrived upon it when the weather began to lower; and the boat fet off on its return, in order to reach the fhip before the impending ftorm fhould begin.

"With difficulty it reached the fhip; and as foon as the weather became fair, meffengers were difpatched on fhore to receive and pay for the provifions promifed. When they arrived at the village, they were aftonifhed to find it abandoned. The houfes were left open, and none of the effects, except fome arms, that had on the firft vifit 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 Chinefe language, of which the literal tranflation purported, as nearly as it could be made, that 'the people of the ifland were few in number, and very poor, yet honeft, and incapable of doing mifchief; but felt much terror at the arrival of fuch great fhips and powerful perfons, efpecially as not being able to fatisfy their wants in regard to the quantity of cattle and other provifions, of which the poor inhabitants of Pulo Condore had fcarcely any to fupply, and confequently could not give the expected fatisfaction. They therefore, through dread and apprehenfion, refolved to fly to preferve their lives. That they fupplicate the great people to have pity on them; that they left all they had behind them, and only requefted that their cabins might not be burnt; and conclude by proftrating themfelves to the great people a hundred times.'

"The writers of this letter had probably received ill treatment from other ftrangers. It was determined that they fhould not continue to think ill of all who came to vifit them. On their return they were perhaps as much furprifed to find their houfes ftill entire, as their vifitors had been who found they were deferted. Nothing was difturbed; and a fmall prefent, likely to be acceptable to the chief, was left for him in the principal dwelling, with a Chinefe letter, fignifying that 'the fhips and people were Englifh, who called merely for refrefhment, and on fair terms of purchafe, 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 themfelves."

Pulo Lingen, another of this clufter, is likewife a confiderable ifland, remarkable for a mountain in its centre, terminating in a fork like Parnaffus; but to which the unpoetical feamen beftow the name of *affes ears*. Every day prefented new iflands to the view, difplaying a vaft variety in form, fize, and colour. Some ifolated, and fome collected in clufters. Many were clothed with verdure; fome had tall trees growing on them; others were mere rocks, the refort of innumerable birds, and whitened with their dung.

PUNA, an ifland near the bay of Guyaquil, on the coaft of Peru, about 12 or 14 leagues long from E. to W. and 4 or 5 broad. There is an Indian town of the fame name, on its fouth fide, having about 20 houfes, and a fmall church. The houfes all ftand on pofts 10 or 12 feet high, with ladders on the outfide to go up to them. From the ifland Santa Clara in the bay of Guyaquil to the wefternmoft point of the ifland, 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 prætereu, 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 ῥηματα; 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.*

Marginal notes (partly cut off): Punctuation. | ...ui pri... perio... et co... mon... rit. Suidas ... Thrasymacho. | ...cero ... § 33. ...et. Lib. ... 5. | ...rn. Or... rud. Li... tab. edit. ... 9. | ...c. de ... t. l. iii. ... ibid. ...rat. pro ...rana, ... 5. | ...n. Epist. | Punta, ‖ Purysburg. | ‡ 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, ‖ Pyrites.

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 Staees; 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, ‖ Quadrature.

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 $x^n = \sqrt{\frac{1}{3}}|^8 = \frac{1}{81}$, 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

adra-
ure.

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:

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,

Quadrature, ‖ Quampeagan.

$$=\left\{\begin{array}{l} +\left\{\begin{array}{l} \frac{81\sqrt{12}}{80}-\frac{8A}{9.80}+\frac{16B}{17.80}-\frac{24C}{25.80}+\frac{32D}{33.80},\text{ \&c.} \\ \frac{81\sqrt{12}}{5.9.80}-\frac{8A}{13.80}+\frac{16B}{21.80}-\frac{24C}{29.80}+\frac{32D}{37.80},\text{ \&c.} \end{array}\right. \\ \hline -\left\{\begin{array}{l} \frac{81\sqrt{12}}{3.3.80}-\frac{8A}{11.80}+\frac{16B}{19.80}-\frac{24C}{27.80}+\frac{32D}{35.80},\text{ \&c.} \\ \frac{81\sqrt{12}}{7.27.80}-\frac{8A}{15.80}+\frac{16B}{23.80}-\frac{24C}{31.80}+\frac{32D}{39.80},\text{ \&c.} \end{array}\right. \end{array}\right.$$

"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 fcows. Here the river has the English name of Salmon Falls river, from the plenty of falmon there caught. In the memory of people who lived 50 years ago, thefe fifh were fo plenty as to be ftruck with fpears on the rocks; but none now alive remember to have feen any there. The faw-mills where the dam croffes the ftream are the fure deftruction of that fpecies of fifh. Tom-cod, or froft-fifh, fmelts and alewives abound here. The place called Salmon Falls is covered with ufeful mills. Above thefe we meet with the Great Falls, where faw-mills are continued to great advantage. On many places from Quampeagan to the pond, from whence it iffues, are mills for boards and corn.—*Morse.*

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

QUAREQUA, a place fituated in the Gulf of Darien. Here Vafques Nunez met with a colony of negroes; but how they had arrived in that region, or how long they had refided in it, are not recorded by the Spanifh hiftorians.—*ib.*

QUART, a meafure of capacity, being the quarter or 4th part of fome other meafure. The Englifh 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, befides their quart or pot of two pints, have various other quarts, diftinguifhed by the whole of which they are quarters; as *quart de muid*, and *quart de boiffeau*.

QUARTILE, an afpect of the planets when they are at the diftance of three figns 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 fmall town of Prince George county, Maryland, fituated on the W. fide of Patuxent river, acrofs which a wooden bridge is built. The town is fmall, but is laid out in a regular plan, at the foot of a hill. Here are a few ftores and two warehoufes for the infpection of tobacco. It is about 22 miles E. N. E. of the city of Wafhington, 13 S. W. of Annapolis, and 39 S. by W. of Baltimore.—*ib.*

QUEEN ANN's, a county of Maryland, bounded wefterly by Chefapeak Bay, and N. by Kent county. It contains 15,463 inhabitants, including 6,674 flaves. Chief town, Centerville. Kent Ifland belongs to this county; 14 miles in length, from N. to S. and 6¼ in breadth, from E. to W. It is low, but fertile land, and its eaftern fide is bordered with falt marfh.—*ib.*

QUEEN *Charlotte's Iflands*, on the N. W. coaft 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 *Wafhington ifles* by American navigators.—*ib.*

QUEEN's, the middle county of Long-Ifland, New-York. Lloyd's Neck, or Queen's Village, and the iflands called the Two Brothers and Hallett's Iflands, are included in this county. It is about 30 miles long, and 12 broad, and contains 6 townfhips, and 16,014 inhabitants, including 2,309 flaves. Jamaica, Newtown, Hampftead, in which is a handfome court-houfe, and Oyfter Bay, are the principal towns in this county. The county court-houfe 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. fide of the Bay of Fundy. The fettlements are as follows: Argyle, on the fouth fide of the Bay of Fundy, where a few Scotch and Acadians refide; next to this, is Yarmouth, fettled chiefly by emigrants from New-England; Barrington, within the ifland called Cape Sable, fettled originally by Quakers from Nantucket. Befides thefe are Port Raifoir, fo called by the French, and originally fettled by the North Irifh; Liverpool and Port Rofeway, fettled and inhabited by emigrants from New England.—*ib.*

QUEENSBURY, a townfhip in Wafhington county, New-York, bounded eafterly by Weftfield and Kingfbury, and foutherly by Albany county. It contains 1,080 inhabitants, of whom 122 are electors.—*ib.*

QUEENSTOWN, in Queen Ann's county, Maryland, a fmall town on the eaftern fide of Chefter river, 6 miles fouth-weft of Centerville, and nearly 20 E. of Annapolis.—*ib.*

QUEENSTOWN, in upper Canada, lies on the weft fide of the Straits of Niagara, near Fort Niagara, and 9 miles above the falls.—*ib.*

QUELPAERT, an ifland lying in the mouth of the channel of Japan, and fubject to the king of COREA (See that article *Encycl.*) Till the laft voyage of La Peroufe, this ifland was known to Europeans only by the wreck of the Dutch fhip Sparrow-hawk in 1635. On the 21ft of May 1787, the French Commodore made this ifland, and determined the fouth point of it to be in Lat. 33° 14′ north, and in Lon. 124° 15′ eaft from Paris. He ran along the whole fouth eaft fide, at fix leagues diftance, and fays that it is fcarcely poffible to find an ifland which affords a finer afpect; a peak of about a thoufand toifes, which is vifible at the diftance of eighteen or twenty leagues, occupies the middle of the ifland, of which it is doubtlefs the refervoir; the land gradually flopes towards the fea, whence the habitations appear as an amphitheatre. The foil feemed to be cultivated to a very great height. By the affiftance of glaffes was perceived the divifion of fields; they were very much parcelled out, which is the ftrongeft proof of a great population. The very varied gradation of colours, from the different ftates of cultivation, rendered the view of this ifland ftill more agreeable. Unfortunately, it belongs to a people who are prohibited from all communication with ftrangers, and who detain in flavery thofe who have the misfortune to be fhipwrecked on thefe coafts. Some of the Dutchmen of the fhip Sparrow-hawk, after a captivity of eighteen years there, during which they received many baftinadoes, found means to take away a bark, and to crofs to Japan, from which they arrived at Batavia, and afterwards at Amfterdam.

QUEUE D'ARONDE or *Swallow's Tail*, in fortification, is a detached or outwork, whofe fides fpread or open towards the campaign, or draw narrower and clofer towards the gorge. Of this kind are either fingle or double tenailles, and fome horn-works, whofe fides are not parallel, but are narrow at the gorge, and open at the head, like the figure of a fwallow's tail. On the contrary, when the fides are lefs than the gorge, the work is called *contre queue d'aronde*.

QUEUE d'aronde, in carpentry, a method of jointing, called alfo *dovetailing*.

QUIBBLEble- n, figa- nd.

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, || Quixos.

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.

iby, || hitis.

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: Rachitis.

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

Rachitis. 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: Rachitis.

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

Rachitis. certained that the ferum of milk contains this falt naturally. Vauquelin had proved its exiftence, as well as that of pure foda, in the feminal fluid; but was it poffible that it could pafs unaltered from the ftomach and inteftines into the veffels which contain the blood and lymph? Could it by this means apply itfelf to the bones? This was to be afcertained by experiments; and the following are the experiments made by Bonhomme for that purpofe. We give them in a tranflation of his own words.

"I caufed (fays he) feveral young fowls of the fame incubation to be fed in different manners. Some received the ufual food without any mixture; others received daily a certain quantity of calcareous phofphate mixed in the fame pafte as formed the fupport of the others; and, laftly, one of them was fed with variations in the ufe of the mixture: the calcareous phofphate was fometimes given and fometimes fufpended. When thefe fowls, after two months, had acquired their ordinary growth, I examined and carefully compared the ftate of their bones. The progrefs of the offification in the epiphyfes was various according to the nature of the food the animal had received. The bones of the laft fowl, which had received the phofphate only from time to time, were rather more advanced than the bones of thofe which had been fed without mixture. The bones of thofe fowls which had been habitually fed with the mixture were evidently more folid, and their epiphyfes were much lefs perceptible. Simple infpection was fufficient to fhew thefe differences when the bones were mixed together.

"I had fed feveral young fowls of the fame incubation according to another plan. Some were fed on a fimple pafte, without mixture; for others it was mixed with pulverifed madder-root; and a third compofition was made of this laft pafte and calcareous phofphate. This was alfo given habitually to other fowls. When after two months I examined the progrefs of offification in the bones of thefe different animals, I eafily perceived the red traces of the madder in the offified parts of all thofe which had ufed it; but I obferved, that the offification was not more advanced by the fimple mixture of this root than by the ordinary food: on the contrary, the bones of thofe fowls which had fwallowed the phofphate mixed with madder were much more folid than the others. The red colour ferved admirably to diftinguifh the extremities of the long bones from their epiphyfes. After an exact comparifon, there could be no doubt of the efficacy of calcareous phofphate in favour of the progrefs of offification. The virtue of the madder feemed confined to that of giving colour to the offified parts."

From thefe experiments, it was natural to make the trial of calcareous phofphate in addition to the remedies made ufe of in the treatment of rachitic fubjects. Here follows what the author himfelf fays of two remarkable inftances in which the calcareous phofphate was adminiftered with fuccefs:

"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 prefented epiphyfes very prominent. In this fituation fhe exhibited the appearance of imperfect rachitis, or the firft period of this diforder. Alkaline lotions which I immediately advifed, were attended with a good effect. Her fleep became more firm; and as the firft paffages were in a good ftate, I gave, without internal preparation, one fcruple of a mixture of equal parts of phofphate of lime and phofphate of foda twice a day. In the courfe of three weeks her legs were perfectly reftored; and this amiable infant has ever fince had the fatisfaction to run with fpirit and agility. Rachitis.

"A female infant, of the name of Boiard, aged four years, had experienced from her birth the moft decided fymptoms of rachitis. The protuberance of the epiphyfes and tumefaction of the abdomen firft indicated the difeafe. The impoffibility of fupporting herfelf and walking at the ufual age confirmed thefe unfortunate fymptoms. By degrees the glands of the neck and of the mefentery became fwelled; the teeth were blackened, became carious, and were not replaced. This fituation became ftill more afflicting by crifes almoft periodical at an interval of three or four weeks. At thefe afflicting periods, a fever of confiderable ftrength, cardialgia, and even convulfions, particularly in the night, were obferved. The termination of each paroxyfm was announced or afcertained by abundant ftools, and the evacuation of urine ftrongly charged with an earthy fediment. The imprudent exhibition of a purge at the beginning of one of thefe crifes had nearly deprived the patient of her life. In this ftate it was that I beheld her for the firft time in the month of January 1791. The alkaline lotion was the only remedy the mother adopted in the firft inftance, and it produced a remarkable effect. After eight days the infant was fo much better as to be able to fupport herfelf. The remedy was then laid afide, and eight days afterwards the child was incapable of ftanding without fupport. The ufe of the alkaline folution being renewed, was attended with the fame fuccefs, and its difcontinuance was again followed by the complete return of all the fymptoms. In the firft days of March, the other remedies I had advifed were exhibited. The conftipation which had always exifted became lefs, and the following crifis was effected without pain. And at length the convulfions, the pains, and the crifes difappeared; but the impoffibility of walking ftill remained. At this time, namely on the fecond of May, I gave the child the phofphate of foda and calcareous phofphate mixed together, in the dofe of half a dram twice a-day. At the end of the month fhe was able to ftand upright, leaning againft a chair, and the fwellings began to diminifh. She continued for a long time afterwards to take the mixture of the phofphates. I likewife gave her occafionally one grain of the extract of bile, prepared with fpirit of wine; and at length in the month of July I had the pleafure to fee the patient run and play in the middle of the ftreet with the other children of her own age, &c.

The author gives other inftances of this medicine being adminiftered with complete fuccefs to rachitic children, and one in which it was attended with the beft effects in a cafe of incurvated fpine. Thefe it is needlefs to infert, becaufe we truft that none of our lefs learned readers will have recourfe to the medicine without the advice of a phyfician; and to him an enumeration of cafes could ferve no purpofe. 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 ufed.

"In

"In ordinary cafes of rachitis, particularly at the commencement of the diforder, it is of advantage to ufe a fimple folution of pot-afh to wafh the parts affected. This folution is made by diffolving from half an ounce to an ounce of purified pot-afh in a pound of diftilled or very pure fpring water. When it is to be ufed, the fkin muft firft be rubbed with a dry cloth or a piece of fine flannel. After this precaution, the difeafed extremities are to be wafhed carefully with the warm folution, and at length wiped, fo as to leave no trace of moifture. This practice and wafhing muft be repeated at leaft twice a-day. I can affirm, from repeated trials, that it will foon be attended with fuccefs."

In a note on this paffage, M. Hallé, who analyfed the memoir at the defire of the Society of Medicine at Paris, juftly obferves, that as pure potafs, or the vegetable alkali, is a moft powerful cauftic, it cannot be ufed in thefe proportions: adding, that he found one-eighth part of the falt here indicated to form too ftrong a lotion for the fkin of an infant. M. Bonhomme, upon enquiry being made, informed him, that the potafs which he ufed was that of the fhops, which is very far from being pure; and Mr Nicholfon conjectures that it was the common falt of tartar of our fhops. This, we think, extremely probable, efpecially as M. Bonhomme affures us that even a lixium of wood afhes, fuch as is ufed for wafhing fine linen, may anfwer the purpofe extremely well.

For a fuller account of this interefting memoir our readers are referred to the 17th volume of the *Annals de Chimie*, or to the firft volume of *Nicholfon's Philofophical Journal*.

RADNOR, a fmall pleafant town of Delaware county, Pennfylvania. This place was originally called *Amftel*, by the Dutch, who began to build here.—*Morse*.

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

RAGGED *Harbour*, on the eaft coaft of Newfoundland, is a part of Catalina Bay. Many craggy rocks lie about the entrance of it, both within and without; fo 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 fouth fide of the fouth peninfula of the ifland of St Domingo; 2 leagues weft of Point Baynet and 11 weft of Cape Marechaux. It has the cove Petite Anfe on the eaft, and that of Brefiliere on the weft.—*ib*.

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

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

RAJA, the *ray fifh*. See *Encyclopædia*, where is is faid that the *oxyrinchus* or fharp nofed ray, is fuppofed to be the *bos* of the ancients; but if there be any truth in the following narrative, which we confefs has much the air of fiction, this is probably a miftake. It is the narrative of Vaillant, and we fhall give it in his own words.

"In the latitude 10° 15′ north, and longitude 355°, an enormous flat fifh of the ray genus (fays he), came and fwam round our veffel. It differed from the common ray, however, in the fhape of its head, which, inftead of being pointed, formed a crefcent, and from the extremities of the femicircle iffued two arms as it were, which the failors called horns. They were two feet wide at the bafe, and only five inches at the extremity. This monfter they told me was called the *fea-devil*.

"A few hours after, we faw two others with this, one of which was fo extremely large, that it was computed by the crew to be *fifty* or *fixty* feet wide. Each fwam feparately, and was furrounded by thofe fmall fifh which ufually precede the fhark, and which are therefore called by feamen *pilot-fifh*. Laftly, all three carried on each of their horns a white fifh, about the fize of a man's arm, and half a yard long, which appeared to be ftationed there on duty.

"You would have faid they were two fentinels placed to keep watch for the fafety of the animal, to inform him of any approaching danger, and to guide his movements. If he approached too near the veffel, they quitted their pofts, and, fwimming brifkly before, led him away. If he rofe too high above the water, they paffed backward and forward over his back till he had defcended deeper. If, on the contrary, he fwam too low, they difappeared, and we faw no more of them, becaufe, no doubt, they were paffing underneath, as in the preceding inftance they had paffed above him. Accordingly we found him re-afcend towards the furface, and then the two fentinels reaffumed their pofts, each on his horn."

Thefe manœuvres continued three days; and to give our author the better opportunity of obferving them, the fhip moft fortunately was becalmed the whole time. He was naturally very defirous of catching one of them that he might examine it at leifure; and, by bribing the feamen with a dozen of bottles of wine, he accomplifhed his object. One of the fifh was ftruck with twelve or fifteen harpoons; feveral halfers were paffed round his body, and he was hoifted on board.

"This (fays our author) was the leaft 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 fwallow a man with eafe. The fkin was white under the belly, and brown on the back, like that of the ray. We reckoned the animal to weigh not lefs, certainly, than a ton."

We think it was fortunate that they chanced to ftrike the fmalleft fifh; for an addition of eight or ten ton weight, which the largeft ray muft have weighed, as certainly as the fmalleft weighed one ton, might have been very inconvenient on board a fhip already loaded. We do not remember to have anywhere met with a defcription of this ray before, and we think it fhould be confidered as a new fpecies; but we fhall not give it a name till its exiftence be better afcertained, when we fubmit 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 Roufe Boughton's *Differtation concerning the Landed Property of Bengal*, that this title is conferred

upon

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

RALEIGH, the prefent feat of government of N. Carolina; fituated in Wake county, about 10 miles from Wake court-houfe. In December, 1791, the general affembly of the State appropriated £10,000 towards erecting public buildings, and named it after the celebrated Sir Walter Raleigh, under whofe direction the firft fettlement in N. America was made at Roanoke Ifland, in Albemarle Sound. The ftate-houfe, a large handfome building, has been lately finifhed, and coft £6,000. Several other buildings have been erected, and a number of dwelling-houfes. The fituation is healthy. Its remotenefs from navigation is the greateft difadvantage. It is 61 miles north by eaft of Fayetteville, 147 from Peterfburg in Virginia, and 448 fouth-weft 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 fituated at the confluence of Deep, with the north-weft branch of Cape Fear river; about 35 miles fouth-wefterly of Hillfborough, and 55 S. E. of Guildford court-houfe. —*ib.*

RANAI, one of the Sandwich Iflands, in the North Pacific Ocean, north of Tahoorowa, and north-weft of Mowee and Owhyhee. It has about 24,000 inhabitants. It abounds with yams, fweet 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 fmall ifland on the coaft of New Mexico, in lat. 7 14 N. It is near the ifland of Quibo, and affords timber fit for mafts.—*ib.*

RANDOLPH, a townfhip of Maffachufetts, formed of the fouth precinct of Braintree, in Norfolk county in the year 1793. It is 15 miles fouth by eaft of Bofton.—*ib.*

Randolph, a county of Hillfborough diftrict, N. Carolina, bounded north-eaft by Orange, and north-weft by Guildford. It contains 7,276 inhabitants, including 452 flaves. Its court-houfe is 585 miles from Philadelphia.—*ib.*

Randolph, a county of Virginia, bounded north by Monongalia, and fouth by Pendleton. It contains 951 inhabitants, including 19 flaves. Cheat river, the eaftern branch of Monongahela river rifes here, on the north-weft fide of the Alleghany mountains.—*ib.*

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

RANDOM, a townfhip in Effex county, Vermont, weft of Brunfwick, granted in 1780.—*ib.*

RAPHAEL, a fertile and healthy canton, or diftrict, the wefternmoft in the Spanifh part of the ifland of St Domingo. Its boundary to the north is formed in part of the French parifh of Gonaives. The air round St Raphael is very cool and falubrious, but the town which is in a hollow, is very hot. It has a little garrifon which ferved as a check on the fmuggling trade with the French. Atalaye, (that is the centinel or difcovery) the wefternmoft town of all the Spanifh colony, is 2½ leagues S. W. of the town of St Raphael, both which parifhes are annexed to Hinche. The town of St Raphael is 10 leagues foutherly of Cape Francois, and 72 N. W. of St Domingo city, as the road runs.—*ib.* Raphael, || Ratio.

Raphael, *Cape St*, at the eaft end of the ifland of St Domingo is the fouth-eaft limit of Samana Bay, 7½ leagues diftant in that direction from Cape Samana or Cape Rezon, which laft is fituated 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 Efpada, the fouth-eaft point of the ifland, the country is level 16 leagues, by a breadth nearly equal.—*ib.*

RAPHOE, a townfhip in Lancafter county, Pennfylvania.—*ib.*

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

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

RAPPAHANNOCK, a large navigable river of Virginia, which rifes in the Blue Ridge, and runs about 130 miles from north-weft to fouth-eaft, and enters into Chefapeak 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 Iflands, and 6 northward of New Point Comfort. A fingle 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 difcovered in its neighbourhood.—*ib.*

RARITON *River*, in New-Jerfey, is formed by two confiderable ftreams, called the N. and S. branches; the fource of the one is in Morris county, that of the other in Hunterdon county. It paffes by Brunfwick 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 paffes, is a fmall cafcade, where the water falls 15 or 20 feet, very romantically between two rocks. Oppofite to Brunfwick, the river is fo fhallow, that it is fordable at low water for horfes and carriages; but a little below it deepens fo faft, that a 20 gun fhip may ride fecurely at any time of tide. The tide rifes fo high, that large fhallops ufed to pafs a mile above the ford; fo that it was no uncommon thing to fee veffels of confiderable burthen riding at anchor, and a number of large river craft lying above, fome dry, and others on their beam-ends for want of water, within gun fhot 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 fold for £62 fterling per ton, being of inferior quality to that on Paffaik river.—*ib.*

Rariton, a town fituated between the mouth of the north branch of the above river, and Boundbrook, 5 miles weft-north-weft of Boundbrook, and 12 north-weft of Brunfwick.—*ib.*

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

RATIO (See *Encyclopædia*) has been defined by Euclid

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 transfaction, he fhewed, indeed, that he poffeffed not a proper fenfe of honour; for he paid poor Yvon with twenty-five louis d'ors for writing theological articles, for which he received himfelf fix times that fum. This trick was difcovered, Raynal was difgraced, and compelled to pay up the balance to Abbé Yvon; but tho' he had thus fhewn himfelf to be without honour, it is difficult to believe that he had yet proceeded fo far as to blafpheme Chrift, fince he had employed a Chriftian divine to fupply his place in the *Encyclopédie*.

His firft work of eminence, and that indeed upon which his fame is chiefly built, is his "Political and Philofophical Hiftory of the European Settlements in the Eaft and Weft Indies." That this hiftory is written in an animated ftyle, and that it contains many juft reflections, both political and philofophical, is known to all Europe; for it has been tranflated into every European language. Its beauties, however, are deformed by many fentiments that are irreligious, and by fome that are impure. It was followed, we think, in 1780, by a fmall tract entitled "The Revolution of America;" in which the author pleads the caufe of the revolted colonifts with a degree of zeal, cenfures the conduct of the Britifh government with a keennefs of afperity, and difplays a knowledge of the principles and intrigues of the different factions which at that period divided the Englifh nation, that furely was not natural to the impartial pen of a philofophic foreigner. Hence he has been fuppofed to have been incited to the undertaking, and to have been furnifhed with part of his materials, by that defperate faction which uniformly oppofed the meafures of Lord North, and fecretly fomented the oppofition in America. Be this as it may, he propagated, both in this tract and in his hiftory, a number of licentious opinions refpecting government and religion, of which he lived to regret the confequences.

A profecution was inftituted againft him by the French government on account of his hiftory of the Eaft and Weft Indies; but it was conducted with fo little feverity, that he had fufficient time to retire to the dominions of the King of Pruffia, who afforded him the protection he folicited, although his Majefty's character was treated by the author in his book with no great degree of veneration. Raynal alfo experienced the kindnefs of the Emprefs of Ruffia; and it is not a little remarkable of this fingular perfonage, that, although he was always fevere in difcuffing the characters of princes, yet the moft defpotic among thefe heaped upon him many marks of favour and generofity. The Abbé alfo received a very unufual mark of refpect from a Britifh Houfe of Commons. It was once intimated to the fpeaker that Raynal was a fpectator in the gallery. The bufinefs was immediately fufpended, and the ftranger conducted to a more convenient and honourable fituation. How different was the conduct of Dr Johnfon, who, when a friend advanced to him with our author, faying, "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 wifhing to vindicate the rudenefs of the fage; but it was perhaps as proper as the politenefs of the Houfe 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 fee fome of the confequences of this, in the progrefs of the French Revolution, he made one glorious effort to retrieve his errors. In the month of May 1791, he addreffed to the conftituent affembly one of the moft eloquent, argumentative, and impreffive letters that ever was written on any fubject: a letter which, if the majority of them had not been intoxicated with their newly acquired confequence, muft have given fome check to their mad career. After complimenting them upon what they had done, he proceeds thus: "I have long dared to fpeak to kings of their duty; fuffer me now to fpeak to the people of their errors, and to their reprefentatives 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 myfelf for being one of thofe who, by feeling a noble indignation againft arbitrary power, may perhaps have furnifhed arms to licentioufnefs? Do then religion, the laws, the royal authority, and public order, demand back from philofophy and reafon the ties which united them to the grand fociety of the French nation, as if, by expofing abufes, and teaching the rights of the people and the duties of princes, our criminal efforts had broken thofe ties? But no!—never have the bold conceptions of philofophy been reprefented by us as the ftrict rule for acts of legiflation.

"You cannot juftly attribute to us what could only be the refult of a falfe interpretation of our principles. Alas! now that I ftand on the brink of the grave; now that I am about to quit this immenfe family, whofe happinefs I have ardently defired, what do I fee around me? Religious troubles, civil diffenfions, conflernation on the one hand, tyranny and audacity on the other; a government the flave of popular tyranny; the fanctuary of the laws furrounded by unruly men, who alternately dictate or defpife thofe laws; foldiers without difcipline; leaders without authority; minifters without means; a king, the firft friend of his people, plunged into bitternefs, infulted, menaced, ftripped of all authority; and the public power no longer exifting but in clubs, in which ignorant and rude men dare to decide all political queftions."

He then proceeds to prove, which he does very completely, that it was not the bufinefs of the affembly to abolifh every ancient inftitution; that the genius of the French people is fuch, that they never can be happy or profperous but under a well-regulated monarchical government; and that, if they wifhed not the nation to fall under the worft kind of defpotifm—the defpotifm of a low faction, they muft increafe the power of the king. "Alas! (continues he) what are my fufferings, when in the heart of the capital, in the centre of knowledge, I fee this mifguided people welcome, with a ferocious joy, the moft criminal propofitions, fmile at the recital of murder, and celebrate their crimes as conquefts!"

He had then feen comparatively but little; but he lived to fee more—to fee his countrymen celebrate, as virtues, crimes, compared with which the atrocities of 1790 appear almoft as harmlefs. Being ftripped 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.

Befides the works which we have already mentioned, he wrote "A Hiftory of the Parliament of England,"

and a "Hiftory of the Stadholderate;" but thefe are both of them more remarkable for a fpecious ftyle and loftinefs of invention than for ufeful obfervation or folid argument. He wrote likewife "The Hiftory of the Divorce of Catharine of Arragon by Henry the Eighth," which is not fo much a recital of, and commentary upon, the fact from which he takes the title, as it is an able picture of univerfal Europe at that period, of the views, interefts, 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 faid to have left among his manufcripts a "Hiftory of the Revocation of the Edict of Nantes," in four volumes; but it is alfo very certain, that, during the fanguinary reign of Robefpierre, he burnt a great part of his papers.

RAYNHAM, a townfhip of Maffachufetts, in Briftol county, taken from Taunton, and incorporated in 1731. It contains 1094 inhabitants. A confiderable 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 fifh, but fo unfavourable is it, in this place, to feining or fifhing, that the exclufive privilege of fifhing is annually fold for lefs than twelve fhillings; whilft the fame privilege, in Bridgewater and Middleborough, (towns which bound this; the former on the eaft, the latter on the north) is annually fold for £250. Befides the great river, there are feveral ufeful ftreams, upon which are 6 faw-mills, 3 grift-mills, 1 furnace, a forge, and fulling-mill. There are numerous ponds in this townfhip, of which Nippaniquit or Nippahonfet is 2 miles long, and one in breadth. Here alewives, in millions, annually refort and leave their fpawns. An excellent kind of iron ore, and various kinds of fifh are found here. Befides the ufual bufinefs of hufbandry and mechanics, numbers are here employed in the manufactories of bar-iron, hollow ware, nails, iron for veffels, iron fhovels, potafh, fhingles, &c. The firft forge fet up in America was introduced into this town by James and Henry Leonard, natives of England, in 1652. This forge was fituated on the great road, and is ftill 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-houfe ftood on the northern fide of *Fowling Pond*, which is 1½ miles from the forge. In the winter feafon the Indian monarch refided at Mount Hope, probably for the benefit of fifh. Philip and the Leonards lived on fuch good terms, and fuch was Philip's friendfhip and generofity, that, as foon as the war broke out in 1675, which ended in the death of the king and the ruin of his tribe, he gave out ftrict orders to all his Indians, never to hurt the Leonards. Before Philip's war, *Fowling Pond* was two miles long, and ¾ths of a mile wide. Now, the water is almoft gone, and the large tract it once covered, is grown up to a thick fet fwamp of cedar and pine. The foil of this pond has alfo a prolific virtue in generating ore. Copious beds of ore, in this part of the country, are ufually found in the neighbourhood of pine fwamps, or near to foils natural to the growth of pine or cedar. In this place there has been almoft an inexhauftible fund of excellent ore, from which the forge has been fupplied and kept going for more than 80 years, befides great quantities carried to other works, and yet here is ore ftill. Though, like other things in a ftate of youth, it is weak and incapable of being wrought into iron of the beft quality.—*Morse*.

RAZOIR, *Port*, at the S. W. extremity of the coaft of Nova-Scotia, and N. E. of Cape Negro.—*ib*.

RAZOR *Ifland* is 4 leagues S. of the mouth of Rio Janeiro Bay, or Santa Cruz Point, on the coaft of Brazil, S. America.—*ib*.

READFIELD, a townfhip in Lincoln county, Diftrict of Maine, 8 miles from Hallowell, which bounds it on the E. and the eaftern branch of Androfcoggin river feparates 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 Bofton.—*ib*.

READING, a townfhip of Connecticut, Fairfield county, S. of Danbury, adjoining.—*ib*.

Reading, a large townfhip of Maffachufetts, in Middlefex county, 14 miles N. of Bofton. It was incorporated in 1644, and contains 1802 inhabitants.—*ib*.

Reading, a townfhip of Vermont, Windfor county, W. of Windfor, adjoining. It contains 747 inhabitants.—*ib*.

Reading, a poft-town, and the capital of Berk's county, Pennfylvania; fituated on the N. E. fide 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 thofe of Schuylkill river) and 54 N. W. of Philadelphia. It is a flourifhing town, regularly laid out, and inhabited chiefly by Germans. It contains about 600 houfes. The public buildings are a ftone gaol, a court-houfe, an elegant church for German Lutherans, erected in 1793, a church for Calvinifts, one for Roman Catholics, a meeting-houfe for Friends, and a large edifice for the public offices. In the vicinity of the town is a remarkable fpring, 100 feet fquare, and 140 feet deep, with a ftream iffuing from it fufficient to turn a mill. The water is clear and tranfparent, and affords abundance of fifh. In the neighbourhood are 10 fullingmills and feveral 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 ftone arched bridge over the Schuylkill at this town, on the high road to Harrifburg, 53 miles diftant to the weft by fouth.—*ib*.

Reading, a townfhip in York county, Pennfylvania.—*ib*.

READINGTOWN, or *Riddentown*, in Hunterdon county, New-Jerfey, 17 miles N. W. by W. of New-Brunfwick, and about 11 eaftward of Lebanon.—*ib*.

READ's *Bay*, a road for fhips in the ifland 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 fafety, in from 6 to 12 fathoms water, the ground foft 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; fituated on a plain, on the eaftern bank of

Reaping. of a river of its name, near its mouth, 30 miles N. W. of Leon, to which it ferves as a harbour. It has 3 churches, and an hofpital, furrounded by a very fine garden; but the place is fickly, by reafon of the neighbouring fwamps. 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 fickle or by the fcythe. Reaping by the fickle is by much the moft common practice, and that which, we believe, prevails univerfally in Scotland; yet the other method, where it is practicable, is certainly the leaft laborious, and by much the moft expeditious. To the fcythe, as an inftrument of reaping, many objections are urged.

It is faid that it fhakes the ear, fo that many of the grains are loft; that it lets the corn fall, after cutting it, in a confufed and fcattered ftate, fo that either much of it is loft, or a great deal of time is confumed in gathering it together; that it can only be made ufe of in land which is very even and free from ftones; that it does not leave fufficient length of ftubble in the ground to lay the corn on when cut; that it mixes bad weeds with the corn, the feeds of which are fown the next year; and, laftly, that the ufe of the fcythe is prejudicial to the health of the reaper.

Thefe objections, however, are either of no weight, or they are made by thofe who are not acquainted with the fcythes which have been adapted to this purpofe, and with the proper manner of ufing them. With a good fcythe, properly managed, the corn, after being cut remains at firft upright, and then falls very gently upon the rake fixed to the fcythe, without any fhake or jolt; or at leaft with lefs than that which it receives when reaped with the fickle. With refpect to the lofs of grain, that proceeds chiefly from the corn being too dry; confequently it fhould be reaped only upon proper days, and proper times of the day, which is much more eafily done with the fcythe than with the fickle, becaufe the work is fo much fhorter. The ftalks, kept together by the rake, may be laid upon the ground, or rather againft the corn not yet cut, in fo regular and collected a ftate, that thofe who gather and tie the fheaves, whether they are women or children, have nothing but their own negligence to accufe if any thing is left behind. When land is properly ploughed and harrowed, it is fufficiently even; and in fuch as is ftony, the only precaution neceffary is to keep the fcythe a little higher in ufing it, that it may not ftrike againft the ftones. If the ftubble left in the ground be fhort, the ftraw which is cut off will be the longer; and the latter is certainly of more value than the former, which only ferves to incommode the cattle which afterwards go to feed in the field.

Thefe confiderations, and others of a like nature, induced the patriotic fociety of Milan to fend, fome years ago, to thofe parts in which fcythes are made ufe of for reaping; and having procured a model of a fcythe from Silefia, they caufed one to be made of a proper fize. It was firft tried upon corn, and afterwards upon millet; and although the firft fcythe was not accurately made, and the reaper had never before made ufe of fuch an inftrument, yet it was found that nearly half the ufual time was faved, and that the labour and fatigue were much diminifhed; the corn alfo was cut without receiving any fhock that could be hurtful to it, and fell in an even and regular ftate, fo that it was afterwards eafily bound up in compact fheaves. They were afterwards prefented with a fcythe fomewhat different from the Silefian, which is very generally ufed in Auftria.

Thefe inftruments are fo fimple, that the figure of one of them renders the defcription of either almoft unneceffary. In fig. 1. is fhewn the Silefian fcythe tried by the Society; the difference between that and the Auftrian one we fhall mention in our defcription. The firft, or Silefian fcythe, differs very little from the fcythe we commonly ufe for mowing grafs, except that the blade is rather fmaller; to it are added four teeth of wood, parallel to the blade, fixed and fecured in a proper manner, and intended to keep the corn together after being cut, fo that inftead of its falling in a confufed ftate, the reaper may lay it down in a regular and compact one. The fecond, or Auftrian fcythe, is fimilar to the former, except that the blade is larger; confequently the wooden teeth, of which there are five, are longer; the handle is alfo more flat, and rather crooked. Plate XLII.

In the *firft*, the handle *a b* (fee fig. 1.) is two Milanefe braffes (A), and nine inches and a half in length; the blade *b c* is one brafs three inches and a half; the piece of wood in which the teeth are fixed, one brafs one inch and a half. In the *fecond*, the handle is two braffes, and feven inches long; the blade, one brafs 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 conftruction of thefe two fcythes makes it requifite to ufe them in a different manner; but that will be better acquired in practice than by precept. Such of our countrymen as are accuftomed to the ufe of the common fcythe will very foon find out the moft convenient and advantageous manner of ufing thefe new kinds of fcythe, and of laying down the corn properly when cut.

It fhould, however, be obferved, that in mowing grafs the feet are kept almoft parallel to each other, whereas in reaping corn they fhould be kept upon a line, one behind the other, thrufting the right foot forward, and drawing the left towards it. This is neceffary, becaufe when grafs is mowed it is left to fall juft where it is cut; but when corn is cut, it is to be carried and laid in a proper manner againft 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 thefe obfervations, the fociety made farther experiments upon the fubject; in which it was found, that when, on account of very wet weather, the ftalks of the corn are bent down, the wooden teeth of the forementioned fcythes are apt to lay hold of fome ears, to the ftalks of which the iron does not reach, and confequently not being cut below, they are pulled fo that the grain is fcattered. This happens

(A) One hundred Milanefe *braffes* are equal to fifty-eight Englifh 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

Turkey-Red.

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.

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

galling comes aluming, which is performed twice, with an interval of two days, and which confifts in dipping the cotton into a bath of water in which five occas of alum have been infufed, mixed with five occas of water alkalifed by a ley of foda. The aluming muft be performed with care, as it is this operation which makes the colouring particles combine beft with the cotton, and which fecures them in part from the deftructive action of the air. When the fecond aluming is finifhed, the cotton is wrung; it is then preffed, and put to foak in running water, after being inclofed in a bag of thin cloth.

The workmen then proceed to the dyeing. To compofe 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 pulverifed, is moiftened with one occa of ox or fheep's blood. The blood ftrengthens the colour, and the dofe is increafed or leffened according to the fhade 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 fkains are then gradually immerfed before the liquor becomes too hot. They are then tied with packthread to fmall rods placed croffwife above the kettle for that purpofe; and when the liquor boils well, and in an uniform manner, the rods from which the fkains were fufpended are removed, and the cotton is fuffered to fall into the kettle, where it muft remain till two-thirds of the water is evaporated. When one third only of the liquor remains, the cotton is taken out and wafhed in pure water.

The dye is afterwards brought to perfection by means of a bath alkalifed with foda. This manipulation is the moft difficult and the moft delicate of the whole, becaufe it is that which gives the colour its tone. The cotton is thrown into this new bath, and made to boil over a fteady fire till the colour affumes the required tint. The whole art confifts in catching the proper degree: a careful workman, therefore, muft watch with the utmoft attention for the moment when it is neceffary to take out the cotton; and he will rather burn his hand than mifs that opportunity.

It appears that this bath, which the Greeks think of fo much importance, might be fupplied by a ley of foap; and it is probable that faponaceous water would give the colour more brightnefs and purity.

M. Felix feems doubtful whether the ali-zari of the Greeks be the fame plant with the European madder. If it be, its fuperiority muft arife 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 fixth year of its growth, when it has acquired its full ftrength; and as it is the woody part of the roots which affords the greateft quantity of colouring particles, this muft give it an obvious fuperiority over madder, which is collected before it has arrived at maturity. The mode of deficcation contributes alfo, 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 eafy in a country where great drynefs prevails in the atmofphere, while in our damp climates we are obliged to dry the madder by ftoves. Hence it happens that the fmoke, which mixes itfelf with the cold air, and penetrates the roots, impregnates them with fuliginous particles, which alter the colouring fubftance; an accident which does not take place when the madder is dried without the affiftance of fire.

For the philofophical principles of thefe proceffes of dyeing, fee *Animal and Vegetable* SUBSTANCES in this *Supplement*.

RED, a river of the State of Tenneffee, a water of Cumberland river, with which it mingles its waters at the north bend, about 2 miles N. W. of Clarkfville. It is boatable a confiderable diftance.—*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. courfe, into Kentucky river, about 9 miles above Boonfborough. It is 60 yards wide at the mouth.—*ib*.

RED, a weftern branch of the Miffiffippi river, in lat. 31 N. Here, it is faid, Ferdinando de Soto died, at a place called Guacoyi, May 21, 1542.—*ib*.

RED *Bank*, on the S. E. fide of Delaware river, in the town of Woodbury, in Gloucefter county, New-Jerfey. The fituation is elevated, and the fort built here during the war, ftood 1900 yards from Fort Ifland, and about 7 miles fouth of Philadelphia. It coft the Britifh 400 men, killed and wounded, before they could reduce the garrifon in 1777.—*ib*.

RED *Hook*, in Dutchefs county, New-York, where a poft-office is kept, is on the eaft bank of Hudfon's river, 21 miles S. of Hudfon, 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 Montferrat and Nevis Carribbee Iflands. 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 *Readfborough*, the fouth-eafternmoft townfhip of Bennington county, Vermont. It contains 64 inhabitants.—*Morse*.

REEDY *Ifland*, in Delaware river, 50 miles below Philadelphia. It is 20 miles from Bombay Hook, and is the rendezvous of outward bound fhips in autumn and fpring, waiting for a favourable wind. The courfe from this to the fea is S. S. E. fo that a N. W. wind, which is the prevailing wind in thefe feafons, is fair for veffels to put out to fea. There is a fecure harbour here, at Port Penn, where piers have been erected by the State of Pennfylvania. The ifland 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 fide of the ifland; but veffels, efpecially large ones, choofe to keep the eaftern fide.—*ib*.

REELFOOT, a fmall navigable river of the State of Tenneffee, which empties into the river Miffiffippi, about 35 miles fouth of the Ohio. It is 30 yards wide 7 miles from its mouth. One of its branches rifes on the borders of Kentucky.—*ib*.

REEMSTOWN, or *Reamftown*, a fmall town of Lancafter county, Pennfylvania; fituated on a ftream which empties into Calico Creek, a water of Coneftoga, which falls into the Sufquehannah. It contains about 40 houfes, and is 16 miles N. E. of Lancafter, and 62 N. W. by N. of Philadelphia.—*ib*.

REFLECTOR FOR A LIGHT-HOUSE, is compofed of 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

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*.

* Biog. Dict. new edit.

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 Miſſiſippi 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 Miſſiſippi, 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, Reid.

Gregories, who were at the fame time profeffors of aftronomy, or mathematics, in the univerfities of Oxford, Edinburgh, and St Andrews.

He was born at the parfonage-houfe of Strachan in April 1710, and received the rudiments of his education at the parifh fchool of Kincardine-oniel. At that period the parochial fchools of Scotland were very fuperior to what they are now; and young men went from them to the univerfity well furnifhed with philological learning. The progrefs of young Reid muft have been rapid; for he was removed from fchool to the Marifchal College, Aberdeen, when not more than twelve years of age; and we have never heard that he was admitted into the univerfity before he was qualified to profit by the lectures of the profeffors. On the contrary, he foon difplayed the genius of his mother's family, and fhone confpicuous among the ftudents of mathematics in a college where that fcience has been at all times cultivated with ardour and fuccefs.

After the ufual courfe of four years employed in the ftudy of Latin, Greek, Mathematics, and Philofophy, he probably took his degree of M. A. which at that period, and for a long time fubfequent to it, was the univerfal practice in the univerfity of Aberdeen, and then commenced the ftudy of theology. In due time he was licenfed to preach the gofpel according to the forms of the church of Scotland; but continued to refide for fome years in Aberdeen, cultivating his favourite fcience, mathematics.

The mathematical chair in Marifchal College was then filled by Mr John Stuart, a man of great eminence in his profeffion; but who, like many other profound mathematicians, was not happy in his mode of communicating fcience, at leaft to the duller part of his pupils. Mr Reid occafionally read lectures for the profeffor; and a friend of ours, by no means dull, has often been heard to exprefs great fatisfaction that Mr Stuart was kept a whole winter from the fchools, when he was a ftudent, and that the clafs was taught by Mr Reid. "Had it not been for this circumftance (faid he) I fhould never have underftood more of mathematics than the firft fix books of Euclid's elements; but Mr Reid had the faculty of making every thing intelligible to the ftudents which he clearly apprehended himfelf."

He could not, however, fpend his life in the ftudy 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 profpect of gaining a livelihood. He was accordingly prefented, we know not in what year, to the church of *New Machar* in Aberdeenfhire, at a time when the good people of Scotland were very far from being reconciled to the rights of patronage; and the confequence was, that his fettlement met with much popular oppofition. Even a little riot took place in the church at his ordination; but he foon gained the affections of his flock by his good fenfe, his acknowledged worth, and his unwearied attention to all their wants, which he was ever ready to relieve to the utmoft extent of his abilities. So deeply rooted indeed was their regard for him at laft, that, though it is now almoft half a century fince his relation to the parifh of New Machar ceafed, his memory continues to be revered in that parifh even at the prefent day; and the following anecdote evinces that it is not revered without reafon.

A man who, from being in decent circumftances, and a member of the kirk-feffion (See PRESBYTERIANS, *Encycl.*), when Dr Reid was minifter, had become, in his old age, poor and infirm, obferved to the then minifter of the parifh, that if he were able to go to Glafgow, and make his cafe known to his old friend and paftor, he was fure that he would get fomething done for him. This obfervation was reported to the Doctor, who inftantly recollected the man, though, in all probability, he had not thought of him for thirty years; and he fettled upon him an annual penfion of ten pounds, which was punctually paid as long as they both lived. The pride of fcience had not from the mind of this great man eradicated the amiable fympathies of humanity, nor had his philofophic fame made him overlook the unafpiring duties of the Chriftian paftor.

In the year 1751, about the beginning of the feffion or annual term, one of the profeffors of philofophy in King's College, Aberdeen, died; and his death being unexpected, prefented to the other members of that learned body fome difficulty in carrying on the ufual courfe of education for that year. At this our readers will not be furprifed, when they reflect on the mode in which fcience was taught in that univerfity; for he who could with propriety be placed in the vacant chair, muft 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 fuch a place as Aberdeen, it is hardly to be fuppofed that there was a fingle man unemployed, fo completely mafter of all thefe branches of fcience, as to take up the clafs where it was dropt by the deceafed profeffor, and carry it fuccefsfully through that fcience, whatever it might be, in which at his death, he chanced to be lecturing. It occurred, however, to the principal, and fome of the profeffors, that the minifter of New Machar was fully equal to the tafk; and the late Dr John Gregory, then profeffor of medicine, and the Rev. Dr Macleod, the prefent fubprincipal of King's College, were deputed to vifit Mr Reid, and requeft his immediate acceptance of the vacant profefforfhip. He yielded to the requeft not without fome hefitation, and was admitted profeffor of philofophy on the 22d of November.

He was now in the very fituation for which Nature feemed to have intended him. He had not only an opportunity, but it was his duty to cultivate the fcience to which his attachment was fo ftrong; and the duties of his office made him turn his attention more clofely than he had hitherto done to another fcience, in which he was deftined to make a more confpicuous figure than he ever made even in his favourite mathematics.

It was during his profefforfhip in the univerfity of Aberdeen that he wrote his "Effay on Quantity," which was publifhed in the 45th volume of the Philofophical Tranfactions, and is perhaps the fineft fpecimen of metaphyfical mathematics, if we may ufe fuch an expreffion, that is extant in our own or in any other language (See QUANTITY, *Encycl.*). It was during the fame period that he publifhed his "Inquiry into the Human Mind on the principles of Common Senfe;" a work of unqueftionable merit, which has contributed more than any other work whatever to give a rational turn to metaphyfical fpeculations. It was about this

Reid. 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. Reid.

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 eid, ‖ ſke. 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 Abulſeda 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*.

Reiſke, ‖ Remonſtrants.

* *Biog. Dict.* new edit.

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*,

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 *Renſelaerwick*, 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, $\frac{x^{\frac{m}{n}} - v^{\frac{m}{n}}}{x - v}$
$= x$

ual, ula.

Revel's, ‖ Revivification.

$$= x^{\frac{m}{n}-1} \times \frac{1 + \frac{v}{x} + \frac{v^2}{x^2} + \frac{v^3}{x^3} + \cdots (m)}{1 + \left(\frac{v}{x}\right)^{\frac{m}{n}} + \left(\frac{v}{x}\right)^{\frac{2m}{n}} + \left(\frac{v}{x}\right)^{\frac{3m}{n}} \cdots (n)}$$

where m and n are any integer numbers.

This theorem is the bafis of the calculus; and from the expreffions $x^{\frac{m}{n}} - v^{\frac{m}{n}}$, and $x - v$ having the form of what algebraifts call *refiduals*, the ingenious inventor gave to his whole method the name of the *refidual analyfis*.

The firft account of this method was publifhed by Mr Landen in 1758, under the title of a *Difcourfe concerning the Refidual Analyfis*. The firft book of the Refidual Analyfis itfelf was publifhed in 1764; and contained an explanation of the principles of the new calculus, with its application to feveral of the moft confiderable problems belonging to the direct method of fluxions. The fecond book was intended to give the folution of many of the moft difficult problems that belong to the inverfe method of fluxions, or to the integral calculus; but it has never been publifhed: a circumftance which every one, who has taken the trouble to ftudy the firft part of the work, will very much regret.

If we eftimate the value of the refidual analyfis from the genius, profound knowledge, and extenfive views required to the difcovery of it, it will rank high among works of invention: but if, on the other hand, we eftimate its value by its real practical utility, as an inftrument of inveftigation, we muft rate it much lower. When compared with the fluxionary calculus, which it was intended to fuperfede, its principles, though in appearance more rigorous, are much lefs eafily apprehended, much lefs luminous, and lefs direct in their application; and therefore, as a means of extending the bounds of mathematical fcience, it muft ever be regarded as vaftly inferior to the latter (A).

RESOLUTION *Bay*, or *Madre de Dios*, is under the higheft land on the W. fide of St Chriftina, one of the Marquefas Iflands. S. lat. 9 52, W. long. 139 9. —*Morse*.

RESOLUTION *Ifland*, a fmall ifland, one of the Society Ifles; fo called from the fhip Refolution. S. lat. 17 24, W. long. 141 15.—*ib.*

RETICULA, or RETICULE, in aftronomy, a contrivance for meafuring very nicely the quantity of eclipfes, &c. This inftrument, introduced fome years fince by the Paris Academy of Sciences, is a little frame, confifting of 13 fine filken threads, parallel to, and equidiftant from each other, placed in the focus of object-glaffes of telefcopes; that is, in the place where the image of the luminary is painted in its full extent. Confequently the diameter of the fun or moon is thus feen divided into 12 equal parts or digits: fo that, to find the quantity of the eclipfe, there is nothing to do but to number the parts that are dark, or that are luminous. As a fquare reticule is only proper for the diameter of the luminary, not for the circumference of it, it is fometimes made circular, by drawing fix concentric equidiftant circles, which reprefents the phafes of the eclipfe perfectly. But it is evident that the reticule, whether fquare or circular, ought to be perfectly equal to the diameter or circumference of the fun or ftar, fuch as it appears in the focus of the glafs; otherwife the divifion cannot be juft. Now this is no eafy matter to effect, becaufe the apparent diameter of the fun and moon differs in each eclipfe; nay, that of the moon differs from itfelf in the progrefs of the fame eclipfe. Another imperfection in the reticule is, that its magnitude is determined by that of the image in the focus; and of confequence it will only fit one certain magnitude. See MICROMETER, *Encycl.*

REVEL'S, a fmall ifland in the Atlantic Ocean, clofe to the eaft coaft of Northampton county, Virginia.—*Morse.*

REVETEMENT, in fortification, a ftrong wall built on the outfide of the rampart and parapet, to fupport the earth, and prevent its rolling into the ditch.

REVIVIFICATION, in phyfiology, the recalling to life of animals apparently dead. There are many kinds of infects which may be revivified, after all the powers of animation have been fufpended for a confiderable time. Common flies, fmall beetles, fpiders, moths, bugs, &c. after being drowned in fpirit of wine, and continuing apparently dead for more than a quarter of an hour, have been reftored to life merely by being thrown among wood-afhes flightly warm.

While Dr Franklin refided in France, he received from America a quantity of Madeira wine which had been bottled in Virginia. In fome of the bottles he found a few dead flies, which he expofed to the warm fun, it being then in the month of July; and in lefs than three hours thefe apparently dead animals recovered life which had been fo long fufpended. At firft they appeared as if convulfed; they then raifed themfelves on their legs, wafhed their eyes with their fore feet, dreffed their wings with thofe behind, and began in a little time to fly about.

But the moft extraordinary inftance of revivification that we ever heard of, is the following: In the warmer parts of France there is an infect very deftructive to rye, which feems 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 infect is in the root or ftem, the animal is irrecoverably killed; but after it has reached the grain, the cafe is very different. There have been inftances, which are noticed in the Academy of Sciences, of thefe infects 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 metaphyfician to think of thefe phænomena, or what conclufion is he to draw from them with refpect to the mind or fentient principle? If he be a fober man, he will draw no conclufion; and for this very good reafon, that of the fentient principle of infects, and indeed of every animal but man, he knows nothing.

(A) For this view of the *Refidual Analyfis*, we are obliged to Mr Playfair profeffor of Mathematics in the Univerfity of Edinburgh.

French Revolution 1795.

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 Pyrennees, 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 Hagenau 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.

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 218 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.

And discredit of the Jacobins,

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.

In consequence of this report, a committee of twenty- 219 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

Whose leaders were accused,

ench olution 795. 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.

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.

220 [...]d de-[...]ed by [i]nsurrec-[tion]; 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 [wh]ich is [que]lled by [Pic]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.

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. A-

222 [Vic]tory of [the] Con-[ven]tion. mong 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.

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. 223 Proposal for a new constitution.

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.

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. 224 New insurrection of the Jacobins,

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
225 Who murder ſome of the Convention, and drive it from its
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.

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.

226 Meanneſs of the Convention.

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.

227 Its victory over the Jacobins;

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

228 to ſtill ...in their ...it;

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.

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.

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New conſtitution, conſiſting of 230

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 231

Two Councils and an

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.

The executive power was intruſted to five perſons of 232 Executive Directory

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

French Revolution 1795. 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, 235 The Convention courts the Jacobins. 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.

When the sections of Paris beheld the Convention surrounded

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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.

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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.

236 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 Mountain 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

237 Mountain party, or the most violent Jacobins, again at the head of the state.

ary government. This project, however, was oppofed in the Convention with fo much vehemence and ability by Thibaudeau, that it was renounced. Indeed it was become unneceffary to the fafety or afcendency of the men who propofed it, as the decrees for the re-election of two-thirds of the Convention enabled them to retain the full poffeffion of their power. A few members of the moderate party, fuch as Boiffy D'Anglas, Languinais, and Le Sage, were elected by almoft every place in France, though they could only fit for one place. Hence the Convention itfelf 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 legiflature with its own leaders.

238
First fitting of the new legiflature.

On the 27th of October the Convention terminated its fittings, and was fucceeded by the new legiflature as appointed by the Conftitution. By its laft decrees, a general amnefty was granted for all revolutionary crimes and proceedings. From this amnefty, however, were excepted the emigrants, the tranfported priefts, and all perfons concerned in the laft infurrection; fo that in fact it was merely a pardon granted by the Mountain party to its own friends for all the exceffes they had committed. The members of the Convention, who had been imprifoned in the caftle of Ham fince the Jacobin infurrection in May, were now fet at liberty. The members of the revolutionary committees, and other agents of Robefpierre in Paris and the departments, were all difmiffed from their prifons, and advanced to the moft important offices under the new government.

239
The Council of Five Hundred outwits the Council of Ancients.

As foon as the new legiflature had divided itfelf into two councils, it proceeded to the election of an Executive Directory. Here the genius of the French nation for intrigue inftantly difplayed itfelf. The Council of Five Hundred was bound to prefent to the Council of Two Hundred and Fifty a lift of ten times the number of candidates neceffary for the office. It fulfilled this duty in the following manner. The majority of the Council of Five Hundred made out a lift, confifting of the five following perfons, upon whom they wifhed the election ultimately to fall: Sieyes, Barras, Rewbell, La Reveillere Lepaux, and Letourneur de la Manche. To complete the lift, they added the names of 45 obfcure perfons, country juftices, farmers, and even peafants. 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 neceffity of nominating to the office of directors the five perfons at the head of the lift prefented by the Council of Five Hundred. The crafty Sieyes, however, who had been the adviser of all parties, but the oftenfible agent of none, did not yet think fit to venture upon the poffeffion of power. He had difapproved of the conftitution which was now put in force, and had even framed one of his own in oppofition to it, which, however, was rejected by the Convention. The moft remarkable circumftance in his plan of government was a national jury, upon which he propofed to confer the power of difmiffing from their offices, without a caufe being affigned, any of the public functionaries whom they might account dangerous to the ftate. Sieyes having refufed to accept the office of director, Carnot was elected in his ftead. But on this occafion 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 confiderable eminence, appeared along with that of Carnot in the lift of candidates voted by the Council of Five Hundred.

240
New government not popular.

The republican government that was now attempted to be eftablifhed promifed little tranquillity to the nation. This great misfortune attended it, that the chief offices in the ftate were intrufted to men who were difliked by the people. The members of the Executive Directory, with the exception of Reveillere Lepaux, had always belonged to the Mountain or moft violent Jacobin party. As they now owed their power to that party, they employed its members in almoft every official department. The government was therefore neceffarily unpopular. Things might have been gradually altered, indeed, by fucceffive elections, which would in time bring other men into power: But, by the forms of the conftitution, the executive power was more permanent than the legiflative body, without poffeffing any influence over it. Hence it was to be feared that a conteft for power might fpeedily occur between a directory nominated by the Jacobin party and the new legiflators appointed by the people, in which the Conftitution might fuffer fhipwreck; an event which actually occurred.

241
Treatment of the Republic by foreign powers.

While the poffeffion of power continued to fluctuate in the manner we have already ftated, between the Moderate and the Jacobin or Mountain parties, the armies of the ftate were fuffered to languifh; but upon the credit of its former military fuccefs, the Republic was treated with refpect by fome of the neighbouring powers. On the 10th of April, a treaty of peace with Pruffia, which had been negociated by the committees through the medium of Barthelemi the French refident at Bafle, was prefented to the Convention for ratification. By this treaty, it was ftipulated, that the French troops fhould immediately evacuate the Pruffian territory on the right bank of the Rhine, but fhould retain the territory belonging to that power on the left bank till a general peace. Prifoners of war were to be mutually reftored, and the commerce of the two countries was to be placed on its ancient footing. Meafures were alfo to be taken to remove the theatre of war from the north of Germany by treaties between France and thofe princes for whom the king of Pruffia might interpofe.

During the fame month of April, the French Republic was acknowledged by the king of Sweden; and Baron Stael his ambaffador was received at Paris with great folemnity. In the month of May a fecond treaty with Pruffia was concluded. It chiefly regarded the line of neutrality. It is worthy of remark, that thefe treaties contained fecret articles which were to be revealed only to a felect committee. By authorifing this mode of procedure, the Convention fufficiently demonftrated its refolution, that no form of popular government to be adopted in France fhould ftand in the way of the national aggrandifement. The Swifs cantons now followed the example of Sweden, and acknowledged the French Republic. A treaty of peace with Spain was alfo concluded at Bafle on the 22d of July. France, on this occafion, relinquifhed all the conquefts fhe had made in the territory of that country, and reftored the ancient frontier. She received in return all the Spanifh part of the ifland of St Domingo. The Dutch Republic was included in this treaty; and France agreed

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agreed to accept of the king of Spain's mediation in favour of Portugal and the Italian princes.

242 Death of his II. 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.

243 Naval superiority of Britain. 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.

244 Expedition to Quiberon Bay. 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.

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.

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 245 Its failure.

put

French Revolution 1795. 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 Noirmontier. 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
246 occupied.

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
247 They receive a check. immediately took possession. 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 par-
248 ties entered into an armistice for three months.

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. French Revolution 1796.

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 spec- 249
tacles the air called *Le Reveil du Peuple*. 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

Ridiculous conduct of the Directory.

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,

Measures taken against the Jacobins.

French Revolution 1796. 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.

251 Moderate party. 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.

252 Distressed state of the finances. 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.

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. 253 Reasons of the flourishing state of agriculture.

Their

Their country was accordingly well cultivated; 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.

* See Institute, *Suppl.*

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 Stofflet, were taken, and put to death on the 29th of March, and the insurgents were suppressed in all quarters. 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.

257 French armies.

258 Bonaparte.

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

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 Beauharnois, a beautiful French woman whom Barras had taken under his protection.

259 Takes the command of the army of Italy.

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.

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

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.

262 A formal treaty.

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.

263 Armiſtice with the Duke of Parma.

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, Dupar, 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

264 Victory at Lodi.

on its left (A). Theſe places opened their gates without reſiſtance, though the citadel of Milan held out for a ſhort time.

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
65 onſe- ces. 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.

:66 eſſes of French erma- 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

(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 throughout 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 of the houſe of Auſtria.* 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 of 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 the

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.

70 cal ſi- on of eau.

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

71 kilful at.

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 reſiſted 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.

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 272

272 Reflections on the different orders of battle.

(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!

French Revolution 1796.

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*."

Fren[ch] Revolu[tion] 179[6].

27[4] The or[der] adopte[d by] Bonap[arte].

27[5] His po[mp]ous pro[cla]mation.

27[6] Marsha[l] Wurms[er] attacke[d].

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 rench olution 796. 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.

276 ntua eged. 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

277 tial ſuc- es of rmſer. 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

278 is defeated. 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. French Revolution 1796.

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.

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. 279 Again defeated.

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. 280
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 theſe His maſterly conduct after a third defeat.

French Revolution 1796. 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.

280 He enters Mantua.

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.

281 Corsica revolts from Britain, and unites with France.

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.

282 Partial successes of the Austrians.

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.

283 They are defeated.

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 Britain 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

Austrian

rench volution 1796. 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,
285 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!

ldenly ke off the Directory.

286 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.

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287 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.

ſucceſs- attempt the nch on and.

1797. 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. 288

French Revolution 1797.

Succeſſes of the Auſtrians.

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. 289

They divide their army;

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 Aus-
290 trians laid down their arms in a panic, and surrendered
And are defeated. themselves prisoners of war. 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, seized 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
291 on his refusal, endeavoured to carry the position by as-
Mantua sault. Having failed in this attempt, he turned his at-
surrenders. tention 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

In the meanwhile, the Pope, who of all the Euro- The Pope perseveres in hostilities; pean 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 pri- 293
soners. Urbino, Ancona, and Loretto, successively fell But is conquered.
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

(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.

294 Bonaparte reinforced. 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.

295 Error of the court of Vienna. 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.

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. 296 Progress of the French army. 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.

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. 297 The Austrians defeated. 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. 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.

298 Wonderful success of Bonaparte.

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 Hunsmark, 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.

299 Partial successes of the Austrians.

300 The Austrian cabinet treats for peace.

301 Unjust and cruel conduct of Bonaparte.

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 Dierstheim, 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[2] Success of the French on the Rhine.

30[3] Peace concluded.

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[4] Power of France at this period.

30[5] Britain continues the war.

tugal, attached to her caufe; but on land, fuch was the terrible energy of France, that, with this exception, which feemed only to exift by tolerance, the Britifh trading veffels were excluded, by her influence, from all approach to the continent, from the Elbe to the Adriatic; and the Britifh government was once more induced, in thefe circumftances, to try the effect of a new negociation. All thefe external advantages, however, were fpeedily loft by the French nation; and it feemed the unhappy deftiny of this people to be conftantly deprived of the fruits of all their fufferings, and their courage, by the turbulence of their domeftic factions, and the profligacy and unprincipled conduct of their rulers.

6 A ferious conteft between the executive power and the legiflature was now approaching. We already remarked, that the Directory was originally felected by thofe men who had been the affociates of Robefpierre; and though deferted of late by fome of the more violent fpirits, who were termed *Anarchifts*, it was ftill confidered as the head of the Mountain party. By the victory obtained over the fections of Paris on the 5th of October, all oppofition had been fet at defiance for a time; but the nation at large had never been reconciled to thefe men. The period now arrived when a third of the legiflative 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 feats in the Councils, a third of their predeceffors having evacuated their feats by lot; and on the following day, Barthelemi, the ambaffador to Switzerland, was chofen to fucceed Letourneur in the Directory. The election of the members of the new third had almoft entirely fallen upon men who were underftood to be hoftile to the directory. Many Generals out of employment were chofen; fuch as Pichegru, Jourdan, and Willot, and many reprefentatives of the families of the ancient nobility who had not emigrated (among whom was the prince of Conti) were now elected into the legiflature. The moderate or oppofition party in the two Councils now poffeffed a complete majority. Carnot and Barthelemi were underftood to be favourable to them in the Directory; the former having made his peace with them, and the latter being eftablifhed by themfelves. The effect of this change in the ftate of the Councils fpeedily appeared in their adopting every meafure that could embarrafs the Directory, or caft odium upon the Mountain party, and alter the ftate of things which it had eftablifhed.

On the 14th of June, Gilbert Defmolieres brought forward a report from a committee upon the ftate of the finances; in which he exhibited and reprobated in the ftrongeft terms the prodigality of the Directory, and the profufion and rapacity of its agents. On the 18th the fame committee propofed a new plan of finance, the object of which was to deprive the Directory of any fhare in the adminiftration of the public money. In the mean time, on the 17th of the fame month, Camille Jourdan had prefented a long report on the fubject of religion; in which he endeavoured to demonftrate the impropriety of prohibiting the public difplay of its ceremonies, and the injuftice of the perfecution which its minifters had undergone for refufing to take oaths prefcribed by the legiflature. This report was afterwards, on the 15th of July, followed up in the Council of Five Hundred, by a decree repealing all the laws againft refractory priefts, or which affimilated them to emigrants. On the following day, another decree, requiring from them a declaration of fidelity to the conftitution, could only be carried by a majority of 210 againft 204. A propofal was now 307
brought forward in the Council of Five Hundred by Emery, a new member, to repeal the laws which confifcated the property of emigrants, and to allow their relations to fucceed to them as if they had died at the period of their emigration. Thofe who had fled into foreign countries from Toulon and other places, during the reign of terror, were alfo encouraged to return, and allowed to expect that their names would be erazed from the lift of emigrants. The conduct of the Directory towards foreign powers was attacked on different occafions; and Dumoullard propofed the appointment of a committee to enquire into the external relations of the republic. This was a delicate fubject; as it involved the character of the armies and their leaders, and as it might fubvert the interefts of the Directory with fome of their friends of the Mountain party. The Venetian republic, though a neutral ftate, had been overturned by Bonaparte on account of a popular infurrection, for which the government apologifed. Little account had been given of the immenfe fums of money that had been levied in Italy. The armies in the preceding year had entered Germany in the character of plunderers; which had difgufted all thofe in that country who had once been friendly to their caufe, and longed for their arrival. The Directory, at the fame time, inftead of encouraging the progrefs of revolution, which the Jacobins eagerly defired, had fuddenly made peace with the German princes, upon receiving pecuniary contributions, which were left to be exacted according to the ancient laws of the different ftates (which exempt the nobles and the clergy), and thus fell heavieft upon thofe very perfons who had cherifhed the new republican principles.

Mild meafure of the Councils.

The difcuffion of thefe fubjects brought the majority of the Directory and of the Councils into a ftate of complete hoftility. Both parties refolved to violate the conftitution, under the pretence of preferving it. The one wifhed to change the Directory before the time prefcribed by law, and the other to deprive of their feats a great number of the new legiflators elected by the people. Barras was the moft obnoxious of the directors; and an attempt was made to deprive him of his office, upon the footing that he was lefs than 40 years of age. But his colleagues afferted that he was born in the year 1755; and as no proof to the contrary could be brought, this abortive attempt ferved only ftill farther to irritate the contending parties, and they began to prepare for more effectual meafures. Had not force been fpeedily ufed on the fide of the Directory, the Councils muft naturally have prevailed. 308
The majority of the people confided in them. The national purfe was in their hands; and they hoped to fubdue the Directory, as the conftituent affembly had done the king, by avoiding to vote the neceffary fupplies. They could enact what laws they pleafed. They had not indeed the command of the armies; but to remedy their weaknefs in this refpect, General Pichegru, on the 20th of July, prefented a plan for reorganifing the national guard, and placing it more at the difpofal of

Their popularity.

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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.

309 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, Angereau 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. 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.

310 Pretend[ed] conspir[acy].

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. 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

311 Emplo[yed] by the [Di]rectory [to] justify [their] conduc[t].

ch ition 7. 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 Corfu, 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.

French Revolution 1797.

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 if

313 Violent meaſures 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.

314 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.

315 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.

316 And of Admiral Duncan over the Dutch

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.

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 produc-

1798

317 Decline of public spirit in France.

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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

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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.

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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 im-

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priſoned 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.

French Revolution 1798.

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 Ca-

pitol

French Revolution 1798.

pitol was the anniverfary of his election to the fovereignty. Whilft he was, according to cuftom, in the Siftine chapel celebrating his acceffion to the papal chair, and receiving the congratulations of the cardinals, Citizen Haller, the commiffary general, and Cervoni, who then commanded the French troops within the city, gratified themfelves in a peculiar triumph over this unfortunate potentate. During that ceremony they both entered the chapel, and Haller announced to the fovereign Pontiff on his throne, that his reign was at an end.

323 Cruel treatment of the Pope.

"The poor old man feemed fhocked at the abruptnefs of this unexpected notice, but foon recovered himfelf with becoming fortitude; and when General Cervoni, adding ridicule to oppreffion, prefented him the national cockade, he rejected it with a dignity that fhewed he was ftill fuperior to his misfortunes. At the fame time that his Holinefs received this notice of the diffolution of his power, his Swifs guards were difmiffed, and republican foldiers put in their place."

He was himfelf removed to the territory of Tufcany, where he refided in much obfcurity, till his enemies, driven from Rome in their turn, thought fit to carry him ftill farther from his capital, to end his days beyond the Alps.

324 Roman republic.

In the mean time, the Roman ftates were converted into a republic after the French model; excepting that the ancient appellations of *confuls*, *fenators*, and *tribunes* were adopted, inftead of the new names of a *Directory* and *two Councils* (D). But this oftentatious grant of freedom was rendered completely illufory, by a condition annexed to it, that for ten years the French General

(D) The character of a nation, like that of an individual, will not perhaps admit of a fudden and total change. This remark is exemplified in the French; who, even when they affect to affume the ftern manners of Republicans, cannot diveft themfelves of their frivolous and fantaftical turn, and of that fondnefs for pomp and fhow by which they were always diftinguifhed. The following account of the re-eftablifhment of the Roman Republic, by an author of refpectability, who witneffed the folemn farce, will amply confirm the truth of our affertion.

"That the regenerated Roman people might be conftitutionally confirmed in their newly-acquired rights, a day was fet apart folemnly to renounce their old government, and fwear fidelity to the new. For the celebration of this folemnity, which took place on the 20th of March, an altar was erected, in the middle of the piazza of St Peter's, with three ftatues upon it, reprefenting the French, Cifalpine, and Roman Republics. Behind the altar was a large tent, covered and decorated with filk of the Roman colours, furmounted with a red cap, to receive the deputies from the departments who had been fummoned to affift. Before the altar was placed an open orcheftra, filled with the fame 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 defign of that of Conftantine, in the Campo Vacino, on the top of which was alfo placed three coloffal figures, reprefenting the three republics. As a fubftitute for bafs-reliefs, it was painted in compartments in *chiaro fcura*, reprefenting the moft diftinguifhed actions of Bonaparte in Italy. Before this arch was another orcheftra.

"The ceremony in the piazza began by the marching in of the Roman legion, which was drawn up clofe to the colonnade, forming a femicircular line; then came French infantry, and then cavalry, one regiment after another alternately, drawn up in feparate detachments round the piazza. When all was thus in order, the confuls made their entrance, on foot, from the Vatican palace, where they had robed themfelves, preceded by a company of national troops and a band of mufic; and if the weather had permitted, a proceffion of citizens, felected and dreffed in *gala* for the occafion, from the age of five years to fifty, were to have walked two and two carrying olive branches; but an exceffively heavy rain prevented this part of the ceremony.

"Before the high altar, on which were placed the ftatues, there was another fmaller one with fire upon it. Over this fire the confuls, ftretching out their hands, fwore eternal hatred to monarchies, and fidelity to the republic; and at the conclufion, one of them committed to the flames a fcroll of paper he held in his hand, containing a reprefentation of all the infignia of royalty, as a crown, a fceptre, a tiara, &c.; after which the French troops fired a round of mufketry; and, at a fignal given, the Roman legion raifed their hats in the air upon the points of their bayonets, as a demonftration of attachment to the new government; but there was no fhouting—no voluntary figns of approbation; nor do I believe that there ever was a fhow, in which the people were intended to act fo principal a part, where fo decided a tacit difapprobation was given as on this occafion.

"After the ceremony was concluded, the French officers, with the confuls 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 numeroufly attended, yet with an exception to the houfes Borghefe, Santacroce, Altempt, and Cefarini: I believe not one diftinguifhed family was prefent from defire or inclination: but it was now no longer time to accumulate additional caufes for oppreffion; and he who hoped to fave a remnant of his property, avoided giving occafion for perfonal refentment. At night the dome of St Peter's was illuminated, with the fame fplendour as was cuftomary on the anniverfary of St Peter's day. This was the fecond time of its illumination fince the arrival of the French, having been before difplayed on the evening of the folemn fete to honour the manes of Duphot, which, though not quite fo opportune, was done to gratify the officers that were to leave Rome on the morrow.

"The day after this federation, the French publifhed the Roman conftitution in form, which was only a repetition of the one given to the unfortunate Venetians, confifting of 372 articles, and which I think unneceffary to tranfcribe, as it would only be giving what we have already had from time to time in tranflations made from their own."—*Duppa's Journal of the moft remarkable Occurrences that took place in Rome*, upon the Subverfion of the Ecclefiaftical Government in 1798.

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.

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

325 [perſeded military ſpotiſm.] 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.

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

326 [ethods ployed corrupt Roman uth.] 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.

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.

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 327 [Monuments of ancient art expoſed to ſale.]

(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.

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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. 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. 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. 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.

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329 Undecided conduct of the magistrates of Berne.

330 Consternation of the government, and capitulation of Berne.

331 Switzerland treated as a conquered country.

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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.

332 e Directory violates the ſtitution.

333 ns an edition Egypt l India.

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.

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.

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334 Preparations for it conducted with ſecrecy.

335 Conqueſt of Malta.

336 Admiral Nelſon ſails 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 vigorous 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 Ireland.

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 ſupported by the Directory.

342 Whoſe efforts are defeated by the Britiſh 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.

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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. Championnet finding himſelf unable to reſiſt the force now brought againſt him, actually evacuated 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.

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345
The Neapolitans
take poſſeſſion of
Rome.

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. 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.

346
Hard fate
of the king
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. 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.

347
Naples conquered by
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-

French Revolution 1798.

ed by the refult of the battles which it fought, and by defertion, to 12,000 men, he found it neceffary to advife the king and royal family of Naples to take refuge on board the Britifh fleet. They did fo; and arrived at Palermo, in Sicily, on the 27th of December, in the Britifh Admiral Lord Nelfon's fhip. General Mack, in the mean time, requefted an armiftice, to afford an opportunity for making peace; but this was refufed. Being driven from Capua, which is the laft military poft of any ftrength in the Neapolitan territory, and his life being in no fmall danger from the difaffection of his own troops, he at laft found it neceffary to feek for fafety, by furrendering himfelf, along with the officers of his ftaff, 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 confent 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 poffeffion of that place. So far as the efforts of regular armies are to be confidered, the war might now therefore be regarded as brought to a termination; but the French had fpeedily a new and unufual enemy to contend againft.

1799. From the mildnefs of the climate, and the fertility of the foil, human life can be fuftained in the fouthern parts of Italy with fewer efforts of induftry than in almoft any other country in Europe. Hence arifes a general propenfity to idlenefs, which is increafed by the numerous charitable inftitutions to which the Roman Catholic religion gives rife. In the city of Naples there had long exifted a body of perfons under the denomination of *Lazzaroni* or Beggars, amounting to the incredible number of from thirty to forty thoufand men, who did nothing, and fubfifted merely by charity, or by fuch fhifts as occafionally occurred to them. One of thefe frequently was the menacing the ftate with an infurrection, in cafe their wants were not inftantly fupplied; which ufually drew from a feeble adminiftration very liberal diftributions of money and provifions. On the prefent occafion they demonftrated abundance of loyalty; but the king had thought fit to avoid entrufting his fafety to fuch defenders. During the confufion which followed the flight of the court and the approach of the French army, the Lazzaroni became mutinous. They heard that the French abolifhed, whereever they came, all thofe monafteries and other religious eftablifhments which are the great fources of public charity. The Lazzaroni, therefore, conceived the moft violent hatred againft them, and againft all who were fufpected of favouring opinions hoftile to royal government. In the beginning of January they began to fhew fymptoms of difcontent, and in a few days broke out into open infurrection. The members of the government left by the king, overcome by habitual terror of the Lazzaroni, confulted merely their own perfonal fafety, and made no effort to preferve the public tranquillity. Prince Militorni had gained confiderable applaufe on account of his vigorous defence of Capua againft the French. The Lazzaroni therefore elected him their commander in chief; but he attempted in vain to reftrain their violence and love of plunder. They declared hoftility againft the French and all the advifers of the armiftice. They broke open the prifons, and put to death all thofe who were confined on account of political offences againft the royal government. They next fpread themfelves over the city in fearch of thofe perfons whom they confidered as favourable to the invaders, and committed murder and robbery in all quarters, concluding by burning the houfes of thofe accounted difaffected. An attempt was made by a confiderable body of the inhabitants, who thought themfelves in the greateft danger, to refift their fury, by fortifying the convent of the Celeftins, and retiring thither; but the Lazzaroni, after encountering the fire of cannon and of mufketry, fucceeded in ftorming the place, and deftroyed all who had taken refuge there. Their power and their fury were now equally boundlefs, and the city became in many quarters a fcene of maffacre and pillage. Prince Militorni, therefore, went to Capua, and requefted Championnet to refcue Naples from utter ruin by occupying it with his army. For this purpofe it was arranged, that a column of French troops fhould fecretly advance by a circuitous march, and fuddenly enter the city from the oppofite quarter. Before this plan could be fully executed, the Lazzaroni had adopted the daring refolution of attacking the French within the fortifications of Capua. Accordingly two thirds of them marched out upon this enterprife, and fpent the 19th and 20th of January in attempting to take Capua by affault. Multitudes of thefe men here perifhed by the artillery of the place; for the French, to favour the capture of Naples by the party that had been fent eaftward for that purpofe, avoided making any fally, and remained upon the defenfive. The Lazzaroni at Capua, however, having learned on the 21ft that a French column had marched to Naples, and approached the gates, fuddenly returned to the affiftance of their brethren in the capital. They were clofely purfued by the French; but they had leifure, neverthelefs, to barricade the ftreets, and to form themfelves into parties for the defence of different quarters. A dreadful and fanguinary conteft now enfued, which lafted from the morning of the 22d to the evening of the 23d of January. The Lazzaroni, with fome peafants who had joined them, difputed obftinately every fpot of ground; and by the energy which they difplayed, caft a fevere reproach upon the feeble and unfkilful government, which had not been able to direct in a better manner the courage of fuch men. At length, after having been gradually driven from ftreet to ftreet, the Lazzaroni rallied for the laft time at one of the gates of the city, where they were nearly exterminated. The inhabitants rejoiced on account of their own efcape from immediate ruin; and while the French armies found themfelves become odious in all the other countries which they had entered, they here found themfelves, from the peculiar circumftances of the cafe, received with unfeigned welcome, in a city which holds the third place in population and fplendour among the capitals of Europe.

348 The Lazzaroni rife againft the French.

349 Their outrages.

350 They are nearly exterminated.

This may be regarded as the laft triumph enjoyed by the Directory. The confequences of their conduct were now gathering faft around them. They were defervedly unpopular at home; not only from the violations they had offered to the conftitution of their country, but alfo from the manner in which they conducted public affairs in detail. They fet no bounds to their profufion, or to the exactions with which their agents vexed

French Revolution 1799. 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

351 Rapacity of the Directory. 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.

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

352 War renewed on the Rhine. 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 (G), 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 353
deſperate reſiſtance under the walls of *Coire*. The reduction of the Griſons was the conſequence of this victory. And in Switzerland.

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

I 2 Nellenburg,

(G) 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!*

Nellenburg, and his left near Wallenweis. On the 25th, at day-break, the French army began the attack. They directed their chief efforts againft the right wing of the Auftrians commanded by General Meerfeldt. The battle was long and obftinate. From five o'clock in the morning till paft one of the afternoon, its termination remained extremely doubtful. The French fucceeded in their attempt againft General Meerfeldt. His pofition was forced, and he retreated into a wood between Liptingen and Stockach. Here he renewed the combat
354 The French are defeated in Swabia, without fuccefs. He was gradually driven to the extremity of the wood, though it is a German mile in breadth. The left wing of the Auftrians, however, had in the mean time maintained its ground, and reinforcements were fent from it to General Meerfeldt. With the affiftance of thefe he at laft fucceeded in making a ftand, and even obliged the French to retire in their turn. At length, about two o'clock, the French found it neceffary 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 prifoners whom they had taken during the various movements of the day. The refult of the battle, upon the whole, however, was fatal to their affairs. Their lofs was fo great, and the fuperiority of the Auftrians fo manifeft, 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 offenfive operations, he fent back one part of it to cover Kehl and Strafburg, while he withdrew with the other towards Switzerland. This event compelled Maffena, who was preffing upon Tyrol and the Engadine, to return to the defence of Switzerland. He was immediately intrufted with the chief command of the troops in this quarter, in the room of Jourdan, who was removed. The Auftrians continued to advance in every direction, and immediately occupied the whole of the right, or German fide, of the Rhine, from the lake of Conftance to Mentz.

355 And in Italy. In Italy the fuccefs of the Auftrians was equally confpicuous, notwithftanding the treachery of the French in attacking them before the expiration of the truce. The attempt of the latter to force the advanced pofts of the former, on the 26th of March, at Santa Lucia and Buffelango, was rendered abortive; and at Legnago, the Auftrian general, Kray, obtained a complete victory, and compelled them to feek protection under the walls of Mantua. On the 5th of April, the Auftrians again attacked them in their pofition at Memiruolo, which lies on the road from Mantua to Pefchiera, and compelled them, after an obftinate conflict, once more to retreat. The lofs of the French in thefe different actions was undoubtedly great; but it is probably overrated at 30,000 men killed, wounded, and taken.

The fuccefs of the Auftrians, however, was not cheaply purchafed. Scherer, who commanded the French army, gained over them, at firft, fome advantages, which, had he known how to improve them, might have given a different turn to the tide of affairs. One divifion of his army had actually forced the Auftrian pofts on the 26th of March, and taken 4000 prifoners; but the other divifion being repulfed, he withdrew his troops from their advanced pofition, and thus relinquifhed the advantage which he had gained. Even on the 5th of April, Moreau's divifion performed prodigies of valour, and took, it has been faid, 3000 prifoners; but from the injudicious difpofitions which had been made by Scherer, that general was not fupported, and the victory of the Auftrians was complete. Kray now quickly drove the French from the Mantuan, and compelled them, after having fuftained new loffes, to relinquifh their ftrong holds on the Mincio and the Adige, and to retreat to the Adda.

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. 356 Moreau fortifies his camp. The military talents of this man had been rendered unqueftionable by his celebrated retreat through a hoftile country, and before a victorious army ably commanded. On the prefent occafion 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 confidered as paffable; and a fituation, remarkably ftrong by Nature, was ftrengthened by every means which art could fupply.

Before this period, a confiderable body of Ruffians had joined the Imperialifts; and the chief command of the allied army was now affumed by Field Marfhal Suwarrow Rimnifki. This celebrated leader, whofe character every democrate labours to mifreprefent, had entered into the army at the age of twelve, and rifen from the ranks to the ftation which he now held, of Generaliffimo of the Ruffian armies. 357 Marfhal Suwarrow. Poffeffed of ftrong natural talents, he had likewife the benefit of an excellent education, and is faid, by thofe who are perfonally known to him, as well as acquainted with the ftate of literature in Ruffia, to be one of the beft claffical fcholars of all the natives of that great empire. He had ftudied, in early life, mathematics and natural philofophy, as branches of fcience abfolutely neceffary to the man whofe higheft ambition is to become a great commander; and his knowledge of the learned, as well as of the fafhionable languages, had enabled him to avail himfelf 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 ftudy from his youth; it had been at once his bufinefs and his amufement.

Poffeffed with his countrymen, in general, of the moft undaunted courage, and formed by Nature to endure the greateft fatigue, it is not furprifing, that with all thefe advantages Suwarrow fhould have long ago acquired the character of one of the ableft generals of his time. It is indeed true, that, till the opening of the campaign of 1799, he had diftinguifhed himfelf only againft the Turks, whom we are too apt to defpife, and againft the Poles when divided among themfelves; but let it be remembered, that the enthufiaftic courage of thofe fame Turks had found employment for the talents of fome of the ableft generals in Europe, a Laudohn and a Cobourg; and that the Polifh armies which Suwarrow fubdued were united by the ftrongeft of all ties—the knowledge that they muft conquer or perifh. All this was fo well known to Frederic the Great, that he held the military talents of the Ruffian hero in the higheft efteem; and the attention of all Europe was now turned towards the quarter where thofe talents

were

nch ution 99. 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.

;8 ks n his ch- 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.

;9 le. im great ter.

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 proweſs 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.

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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

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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.

361 Junction of the French and Spanish fleets.

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.

362 Partial successes of Macdonald.

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.

363 He is completely defeated by Suwarrow.

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.

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.

3[64] Mut[ual] comp[laints] of Su[war]row a[nd] the A[ulic] Coun[cil].

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 Mussulmans, 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

367 Assassination of the French envoys.

carriages

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carriages to Raftadt, Jean Debry wandered about the woods all night, and returned alfo Raftadt on the following day. He claimed the papers belonging to the legation from the Auftrian commander, but they were refufed to be reftored.

During the whole of the long period that the Congrefs had fat, Raftadt and its vicinity had been occupied by French troops, and it was only a few days fince the Auftrians had obtained poffeffion of it. This event therefore caft, at leaft, a fevere reproach upon the difcipline of the Auftrian army. It did more; it made every honeft man regret, that troops, engaged in the fupport of a good caufe, fhould think to promote that caufe by the murder even of the greateft villains. The Archduke Charles made hafte to difclaim all knowledge of it in a letter to Maffena; but the French Directory, regarding it as a fortunate occurrence, from its tendency to roufe the refentment of the nation, addreffed to the two Councils, on the 5th of May, a meffage, in which they afcribed it to a deliberate purpofe on the part of the Auftrian government to infult France by the affaffination of her ambaffadors. They thus converted the private act of a few defperate individuals into a meafure of public policy; as if the death of thofe wretched mifcreants could have been of confequence to the enemies of the *great* nation. The unpopularity of the Directory, however, and the obvious inutility of fo grofs a crime, prevented this accufation 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 affured that the murder of the envoys "*fait plus de bruit que de fenfation*;" and that the general opinion was, that the Directory itfelf knew more of the authors of that crime than the Archduke or the Auftrian government.

368 Turned by the Directory to its own advantage.

369 Diffenfions in France.

Upon the introduction of the new third of this year into the Councils, a violent oppofition to the Directory commenced. Sieyes, who was ambaffador at Berlin, and who had enjoyed, during the whole progrefs of the revolution, a very confiderable influence over all the parties that had fucceffively enjoyed the fupreme authority, was elected into the Directory. At the firft eftablifhment of the conftitution he had refufed to occupy this ftation, and it excited much furprife when he readily accepted the office in the prefent calamitous ftate of the Republic. His admiffion into the Directory, however, did not reconcile the public or the two Councils to that body. A violent conteft for power betwixt the Moderate and the Jacobin parties feemed to approach; but they foon came to a compromife. Treilhard was removed from the Directory, under the pretence that he had held an office in the ftate within lefs than a year previous to his nomination. Merlin and Reveillere were compelled to refign, to avoid an impeachment with which they were threatened; but Barras ftill contrived to retain his ftation. Moulins, Gohier, and Ducos, men little known, and by no means leaders of the contending parties, were appointed Directors. The power was underftood to be divided, and that neither party greatly predominated. An attempt was made to revive public fpirit, by encouraging anew the inftitution of clubs, which had been fuppreffed by the Directory. The violent Jacobins were the firft to take advantage of this licence. They refumed their ancient ftyle, their propofals for violent meafures, and their practice of denouncing the members and the meafures of government. But the Directory becoming alarmed by their intemperance, obtained leave from the Councils to fupprefs their meetings before they were able to intereft the public in their favour.

3[70] Warl[ike ef]forts [of the] Direc[tory.]

Confiderable efforts were now made by the French government to recruit their armies; but the deranged ftate of the finances, which the votes of the Councils could not immediately remedy, prevented the poffibility of their gaining a fuperiority during the prefent campaign. The difficulty was alfo increafed by the neceffity of refifting immenfe armies in different quarters at the fame time, France being affailed at once on the fide of Holland, Switzerland, and Italy. Such, however, were the exertions of the Directory, that they feemed not deftitute of the hope of being able fpeedily to affume, on the frontier, a formidable, and even menacing pofture. In the beginning of Auguft, their Italian army amounted to 45,000 men. The different bodies of troops of which it confifted had been drawn together, and concentrated nearly in the fame pofitions which Bonaparte had occupied before his battles of Montenotte and Millefimo. The command of the whole was given to Joubert, a young man, who had been much diftinguifhed under Bonaparte; and who, in the ftyle of gafconade employed by that general, affured his government of victory, declaring, that he and Suwarrow fhould not both furvive the firft battle. In this boafting declaration he feems to have been in earneft; for, on taking the command, he prevailed with Moreau to remain in the army as a volunteer till the firft battle fhould be fought. The allies had now taken Turin, Aleffandria, Milan, Pefchiera, and Ferrara, with a rapidity which would lead one to fuppofe that fome new mode had been invented of materially abridging the duration of fieges. The ftrong citadel of Turin opened its gates, to the aftonifhment of Europe, after a bombardment of only *three days*; the citadel of Aleffandria furrendered to the Auftrian General Bellegarde, on the 22d of July, after a fiege of *feven days*; and the ftill more important fortrefs of Mantua furrendered to the brave General Kray, on the 29th of the fame month, after a fiege of only *fourteen days*. The garrifon of Aleffandria amounted to 2400 men; that of Mantua to 13,000. The former were detained prifoners 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 reafonably expect to be kept. This has given rife to a fufpicion, that the fortrefs was voluntarily furrendered to the Auftrians, in order that the Directory might recruit its armies with the garrifon.

3[71] Joub[ert] affum[es the] comm[and] in Ita[ly.]

3[72] Succe[sses of] the a[llies.]

The allies next began to befiege Tortona, and Joubert refolved to attempt its relief. He hoped to accomplifh this object, and to gain fome advantage over their army, before General Kray could arrive to the affiftance of Suwarrow with the troops that had been occupied in the fiege of Mantua. On the 13th of Auguft, the French drove in the whole of the Auftrian pofts, and took poffeffion of Novi. Here they encamped on a long and fteep, but not high, ridge of hills, with their centre at Novi, their right towards Seravalle, and their left towards Bafaluzzo. On the 14th they remained quiet; and on the 15th they were attacked by Suwarrow, whofe army was now reinforced by 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.

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 375
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.

Thinking it degrading to a Prince of the Imperial 376
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.

Is deserted, if not betrayed, by the Austrians.

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

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ten 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.

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
377 march towards Switzerland by Mount St Gothard.
The allies defeated in Switzerland.
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.

378
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.

379
His admirable conduct.

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.

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 380
His indignation at the court of Vienna.
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. 380

Invasion of Holland.

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 381
Capture of 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 establishing ench lution 799. 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.

82 cefs of iva- 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 Carſpel.* French Revolution 1799.

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. 383 Stopped by the enemy and the inclemency of the weather.

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. 384 Coalition againſt France ready to be diſſolved.

French Revolution 1799.

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 his principal officers in 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.

387 And seizes the reins of government.

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 members

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.

8 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.

French Revolution 1799.

389 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

390 His conduct watched by the British.

fure fhould appear neceffary. Before that period, however, the government in India had been alarmed, by the fame means, and was making preparations for war. This, however, was no eafy matter. It is the nature of European power, in thefe countries, gradually to decline. The nature of the climate, the view of returning home, and the diftance from the feat of government, fpeedily 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 fhort time, or negligently attended to, they become unable to protect the extenfive territories fuch as Britain now poffeffed in India. When Lord Mornington, the governor-general, enquired into the ftate of the Britifh army at Madras, and whether he might hazard an offenfive war againft Tippoo; he was informed, that three, if not fix months would be neceffary to affemble the fcattered divifions of the army, and to prepare them to defend their own territory. It was added, that fuch was the feeble ftate of the Britifh forces in that quarter, that it might even be unfafe to excite fufpicion in Tippoo by military preparations, as he might, in that cafe, ruin them by a fudden attack. Lord Mornington, however, refolved to encounter every hazard, and ordered immediate and active preparations in every quarter.

In the meanwhile, Tippoo did not truft for fuccefs to the aid of France alone. He endeavoured to bring an attack upon the Britifh and their allies, or fubjects, in India, from the north-weft, 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 Perfia and India. It was founded about fixty years ago by Ahmed Khaun Abdalla, an Affghan chief, who followed Nadir Shah on his invafion of India in 1739. He himfelf afterwards invaded India no lefs than feven times; and, in particular, he overthrew, with dreadful flaughter, the united forces of the Mahratta empire, in the year 1761, on the plains of Panipat. He was fucceeded, in 1773 by his fon Timmur Shah, who died, and was fucceeded by his own fon, the prefent prince. The dominions of Zemaun Shah extend from the left bank of the river Indus, on the feacoaft, as far northward as the latitude of Cafhmeer; and from eaft to weft they are 650 Englifh miles in length, comprehending the provinces of Cabal, Candahar, Peifhere, Ghizni, Gaur, Sigiftan, and Korafun. He ufually keeps in pay an army of 150,000 horfe, befides infantry to garrifon his fortreffes. In expectation of direct aid from France, by Bonaparte's expedition to Egypt, and of an important diverfion to be made by Zemaun Shah, Tippoo endeavoured to remain quiet, and to temporife with the Britifh.

Since the firft victories of Lawrence and of Clive, the native princes of India have been eager to introduce the European art of war among their fubjects. For this purpofe they retain European adventurers to command and difcipline a part of their troops, and even endeavour to form a guard for their perfons of European foldiers. The Nizam, a prince in alliance with the Britifh, though in a great meafure under their influence, had long retained around his perfon a confiderable body of French, and of troops under their management. Thefe, under the command of one Perou, now poffeffed great influence at Hydrabad, the capital of the Nizam. It was of much importance that thefe fhould be removed out of the way, to enable the Britifh to obtain the aid of this prince as an ally in the approaching conteft with Tippoo. Lord Mornington procured this object to be accomplifhed with fo much fuccefs, that, on the 22d of October 1798, the French corps under Perou was furrounded and difarmed without bloodfhed, and a Britifh force was fubftituted as a guard to the Nizam in its ftead. The military preparations being in a confiderable ftate of forwardnefs, Lord Mornington next warned Tippoo Sultan, in a letter dated the 8th of November 1798, of his having a knowledge of his hoftile defigns and connection with the French. He alfo propofed to fend an ambaffador to treat about the means of reftoring a good underftanding between the ftates. Tippoo avoided returning an anfwer till the 18th of December, and then merely denied the accufation, and refufed to receive the ambaffador. On the 9th of January 1799, the Britifh governor again urged in writing that the ambaffador fhould be received. No anfwer was returned for a month; and, in the mean time, an army of 5000 men having arrived from England, orders were iffued to General Harris to advance at the head of the Madras army againft the kingdom of Myfore. Tippoo now offered to receive the ambaffador, providing he came without an attendance; but this conceffion was not accounted fufficient, and the army advanced. An army from Bombay was, at the fame inftant, advancing on the oppofite fide 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 reft of his army was defeated by General Harris.

391 General Harris advances againft him.

When an European army in India is tolerably numerous, the detail of its military operations againft the natives is by no means interefting; for the inhabitants of thefe enfeebling and fertile regions can never be made, by any kind or degree of difcipline, to poffefs that moral energy which enables men to encounter danger with coolnefs and felf-command. They can rufh on death under the influence of rage or defpair, but they cannot meet the hazard of it with calmnefs and recollection. It is fufficient to remark that, on the 7th of April, General Harris fat down before Seringapatam. On the 9th, Tippoo fent a letter to this officer, alleging his own adherence to treaties, and enquiring into the caufe of the war. He was anfwered by a reference to Lord Mornington's letters. On the 20th he made another attempt to negociate, by writing to General Harris, requefting him to nominate commiffioners to treat of a peace. In anfwer to this propofal, certain articles were fent to him as the only conditions that would be granted. By thefe he was required to furrender half his dominions, to pay a large fum of money, to admit refident ambaffadors from the Britifh and their allies, to renounce all connection with the French, and to give hoftages for the fulfilment of thefe ftipulations.

On the 28th of April Tippoo again wrote to General Harris, requefting leave to treat by ambaffadors; but his propofal was refufed, upon the footing that he was already in poffeffion 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 muft have retreated. The rainy feafon was about

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 wherever 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.

But to return to the domestic history of France, which has now become only an history of the usurpation of Bonaparte.

French Revolution 1799. 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 with

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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.

397 Army of Egypt.

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.

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.

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.

399 Errors in the former part of this article corrected.

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.

* *Old Annual Register.*

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.* n° 8. and 9. 400

First error.

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 part nch ution 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 *droits 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.*

Diſ- Letter Earl der- led. 1 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.

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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.

† *De l'Eſprit des Loix*, liv. 20. c. 20.

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."

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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.

405 Blunders of 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.

406 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 n° 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,

* 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:

"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. French Revolution 408 Conduct of the Prince de Lambeſc vindicated.

"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.

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 409 True account of the taking of the Baſtile;

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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 conſcioufneſs 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.*

* *Bertrand's Annals*, vol. ii. ch. 13.

412 M. Memmay vindicated.

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 The powers of the aſſembly in danger of being recalled by its conſtituents.

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 ench olution

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 those ministers were themselves nothing more than the humble and docile agents of the Assembly.

414 e account of the book,

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 fisty men. The troops immediately returned the fire; and a great number of the rebellinus 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*,

(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 Prefeln, Gautier de Biauzat, Treilhard, Champeaux-Palasuc, 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 French the aggreſſors in the war with Britain.

In our account of the origin of the war between Great Britain and France (n° 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

French volution 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.*"

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.

ıtroduc-ı to the *nals of French volution.*

421 ·trand's w of the : and ›grefs of : revolu-ı.

"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.

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"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 corresp ndence 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.

"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.

422 Constitution of 1791 completes the first revolution.

"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

French Revolution 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.

423 The ſecond revolution. "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.

"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. 424 The third revolution.

"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

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 conſtitution 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.

These

French Revolution. 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 The fifth revolution. "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." 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, ‖ Rhode-Island.

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, New-

Rhode-Island.

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 north-weſtern 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 fame object is attained alfo by paffing the grain between two flat ftones of a circular form, the upper of which turns round upon the other, but at fuch a diftance from it as not to break the intermediate grain. The operation is performed on a larger fcale in mills turned by water; the axis of the wheel carrying feveral arms, which, by ftriking upon the ends of levers, raife them in the fame manner as is done by treading on them. Sometimes twenty of thefe levers are worked at once. The ftraw from which the grain has been difengaged is cut chiefly into chaff, to ferve as provender for the very few cattle employed in Chinefe hufbandry.

"The labour of the firft crop being finifhed, the ground is immediately prepared for the reception of frefh feeds. The firft operation undertaken is that of pulling up the ftubble, collecting it into fmall heaps, which are burnt, and the afhes fcattered upon the field. The former proceffes are afterwards renewed. The fecond crop is generally ripe late in October or early in November. The grain is treated as before; but the ftubble is no longer burnt. It is turned under with the plough, and left to putrefy in the earth. This, with the flime brought upon the ground by inundation, are the only manures ufually employed in the culture of rice."

RICH, *Cape*, on the W. fide of the ifland of Newfoundland, towards the N. end, and in the N. E. part of the gulph of St Lawrence, having the ifle of St John and other fmall ifles to the north. This cape or point ufed to be omitted in the French maps, feemingly becaufe it was the bounds of their privilege of fifhing, which extended from hence northward, and round to Cape Bonavifta.—*Morfe.*

RICHARDSON's *Bay*, on the S. E. part of the ifland of Jamaica. The anchorage within it is between Morant river and Two Mile Wood.—*ib.*

RICHFIELD, a townfhip of New York, fituated in Otfego county, taken from Otfego townfhip, and incorporated in 1792; 229 of its inhabitants are electors.—*ib.*

RICHFORD, the north eafternmoft townfhip of Franklin county Vermont; on Miffifconi river.—*ib.*

RICHLAND, a county of S. Carolina, Camden diftrict; bounded S. and S. W. by Congaree and Broad rivers, and eaft by Wateree river, which divides it from Kerfhaw and Clermont counties. It contains 3,930 inhabitants; of whom 2,479 are white, and 1,437 flaves.—*ib.*

RICHLAND, a townfhip of Pennfylvania, in Buck's county.—*ib.*

RICHLIEU *Iflands*, a clufter of fmall iflands 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 fmall fortification built by the French, on the north bank of the river Sorel, at its junction with the river St Lawrence, oppofite the iflands of Richlieu.—*ib.*

RICHMAN's *Ifland*, on the coaft of Cumberland county, Diftrict of Maine, about northerly, four leagues from Wood Ifland, and a league weft of Portland. Few veffels put in here, except coafters. There is a funken ledge S. E. half a mile from the north-eaft end of the ifland, which only fhews itfelf when the wind blows frefh: But you need not go fo near the ifland. Wood Ifland is in lat. 43 50 N. and long. 69 57 W.—*ib.*

RICHMOND, a townfhip on the weft line of the State of Maffachufetts, in Berkfhire county, 17 miles W. by S. of Lenox, and 150 weft of Bofton. Iron ore of the firft quality is found here, but as it lies deep it is raifed at a great expenfe. Ore of indifferent quality is found in many places. It abounds with lime-ftone, coarfe, white, and clouded marble. The town was incorporated in 1775, and contains an iron-work, 3 grift-mills, a fulling-mill, 2 faw-mills, and 1255 inhabitants.—*ib.*

RICHMOND, a townfhip of Chefhire county, New-Hampfhire; fituated on the Maffachufetts line, about 11 miles eaft of Connecticut river, and 97 W. by S. of Portfmouth. It was incorporated in 1752, and contains 1380 inhabitants.—*ib.*

RICHMOND, a townfhip in Wafhington county, Rhode-Ifland, feparated from Hopkinton on the weft by Ward's river a branch of Paucatuck river. It is about 19 miles weft of Newport, and contains 1760 inhabitants.—*ib.*

RICHMOND, a county of New-York, comprehending all Staten-Ifland, Shooters-Ifland, and the Iflands of Meadow, on the weft fide thereof. It is divided into the townfhips of Caftletown, Northfield, Southfield, and Weftfield. It contains 3,835 inhabitants; of whom 488 are electors, and 759 flaves.—*ib.*

RICHMOND, a county of N. Carolina, fituated in Fayette diftrict, bounded fouth, by the State of S. Carolina, and north, by Moore county. It contains 5055 inhabitants, including 583 flaves. Chief town, Rockingham. The court-houfe, at which a poft-office is kept, is 20 miles from Anfon court-houfe, 56 from Fayetteville, and 563 from Philadelphia.—*ib.*

RICHMOND, a county of Virginia, bounded N. and N. E. by Weftmoreland, and S. and S. W. by Rappahannock river, which feparates it from Effex county. It contains 6,985 inhabitants, of whom 3,984 are flaves. The court-houfe, where a poft-office is kept, is 273 miles from Philadelphia.—*ib.*

RICHMOND, the prefent feat of government of the State of Virginia, is fituated in Henrico county, on the north fide of James's river, juft at the foot of the falls, and contains between 400 and 500 houfes, and nearly 4,000 inhabitants. Part of the houfes are built on the margin of the river, convenient for bufinefs; the reft are upon a hill which overlooks the lower part of the town, and commands an extenfive profpect of the river and adjacent country. The new houfes are well built. A large ftate-houfe, or capitol, has lately been erected on the hill. This city likewife boafts of an elegant ftatue of the illuftrious Wafhington, 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 acrofs James's river, at the foot of the fall, by Col. Mayo. That part from Manchefter to the ifland is built on 15 boats. From the ifland to the rocks was formerly a floating bridge of rafts; but the enterprifing proprietor has now built it of framed log piers, filled with ftones. From the rocks to the landing at Richmond, the bridge is continued on framed piers filled with ftones. This bridge connects the city with Manchefter; and as the paffengers pay toll, it produces a handfome revenue

nue to Col. Mayo, who is the fole proprietor. The public buildings, befides the ftate-houfe, are an Epifcopal church, a court-houfe, gaol, a theatre, and 3 tobacco ware-houfes. The falls above the bridge are 7 miles in length. A noble canal is cutting, and nearly completed on the north fide of the river, which is to terminate in a bafon of about two acres, in the town of Richmond. From this bafon to the wharves in the river, will be a land carriage of about a mile. The expenfe is eftimated at £30,000 Virginia currency. The opening of this canal promifes the addition of much wealth to Richmond. Veffels of burden lie at City Point, 20 miles below, to which the goods from Richmond are fent down in boats. It is 626 miles from Bofton, 374 from N. York, 176 from Baltimore, 278 from Philadelphia, 247 from Fayetteville, 497 from Charlefton, and 662 from Savannah. N. lat. 37 40, W. long. 77 50.—*ib.*

Richmond, a county of the Upper diftrict of Georgia, in which is fituated the city of Augufta. It is feparated from S. Carolina, on the E. by Savannah river, and contains 11,317 inhabitants, of whom 4,116 are flaves.—*ib.*

Richmond, a town of the ifland of St Vincent's, in the Weft-Indies. It is feated at the head of a deep bay, on the weftern fide of the ifland. Chateaubelair river runs on the fouth fide of the town, which gives name to the bay. Another river empties into the bay on the north fide of the town.—*ib.*

RIDEAU, in fortification, a fmall elevation of earth, extending itfelf lengthwife on a plain; ferving to cover a camp, or give an advantage to a poft.

Rideau is fometimes alfo ufed for a trench, the earth of which is thrown up on its fide, to ferve as a parapet for covering the men.

RIDGEFIELD, a poft-town of Connecticut, in Fairfield county, 10 miles fouth-weftward of Danbury, 78 fouth weft of Hartford, 51 north-eaft of Kingfbridge, in the State of New-York, and 161 north-eaft of Philadelphia. The townfhip of Ridgefield was called by the Indians *Caudotowa*, or high land. It well anfwers the name, for though it is 14 miles from the Sound, it affords a good profpect of it, and of Long-Ifland. Of the latter, 40 miles in length is vifible, and veffels may be feen as they pafs up the Sound. It was fettled in 1709.—*Morse.*

RIDLEY (Dr Glofter), was of the fame family with Dr Nicolas Ridley, Bifhop of London, and Martyr to the Reformation. (See Ridley, *Encycl.*) He was born at fea, in 1702, on board the Gloucefter Eaft Indiaman; to which circumftance he was indebted for his Chriftian name. He received his education at Winchefter fchool, and thence was elected to a fellowfhip at New college, Oxford, where he proceeded B. C. L. April 29. 1729. In thofe two feminaries he cultivated an early acquaintance with the mufes, and laid the foundation of thofe elegant and folid acquirements for which he was afterwards fo eminently diftinguifhed as a poet, an hiftorian, and a divine. During a vacancy in 1728, he joined with four friends, viz. Mr Thomas Fletcher (afterwards Bifhop of Kildare), Mr (afterwards Dr) Eyre, Mr Morrifon, and Mr Jennens, in writing a tragedy called "The Fruitlefs Redrefs," each undertaking an act on a plan previoufly concerted. When they delivered in their feveral proportions at their meeting in the winter, few readers would have known that the whole was not the production of a fingle hand. This tragedy, which was offered to Mr Wilks, but never acted, is ftill in MS. with another called "Jugurtha." Dr Ridley in his youth was much addicted to theatrical performances. Midhurft, in Suffex, was the place where they were exhibited; and the company of gentlemen actors to which he belonged confifted chiefly of his coadjutors in the tragedy already mentioned. He is faid to have performed the characters of Marc Antony, Jaffier, Horatio, and Monefes, with diftinguifhed applaufe; a circumftance that will be readily believed by thofe who are no ftrangers to his judicious and graceful manner of fpeaking in the pulpit.

For great part of his life he had no other preferment than the fmall college living of Weftow in Norfolk, and the donative of Poplar in Middlefex, where he refided. To thefe his college added, fome years after, the donative of Romford in Effex. "Between thefe two places the curricle of his life had (as he expreffed it) rolled for fome time almoft perpetually upon poftchaife wheels, and left him not time for even the proper ftudies of economy, or the neceffary ones of his profeffion." Yet in this obfcure fituation he remained in poffeffion of, and content with, domeftic happinefs; and was honoured with the intimate friendfhip of fome who were not lefs diftinguifhed for learning than for worth.

In 1740 and 1741 he preached "Eight Sermons at Lady Moyer's Lecture," which were publifhed in 1742, 8vo. In 1756 he declined an offer of going to Ireland as firft chaplain to the Duke of Bedford; in return for which he was to have had the choice of promotion, either at Chrift-church, Canterbury, Weftminfter, or Windfor. His modefty inducing him to leave the choice of thefe to his patron, the confequence was, that he obtained none of them. In 1763, he publifhed the "Life of Bifhop Ridley," in 4to, by fubfcription, 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 lofe both his fons, each of them a youth of abilities. The elder, James, was author of "The Tales of the Genii," and fome other literary performances. Thomas, the younger, was fent by the Eaft India Company as a writer to Madras, where he was no fooner fettled than he died of the fmall-pox. In 1765, Dr Ridley publifhed his "Review of Philips's Life of Cardinal Pole;" and in 1768, in reward for his labours in this controverfy, and in another which "The Confeffional" produced, he was prefented by Archbifhop Secker to a golden prebend in the cathedral church of Salifbury (an option), the only reward he received from the great during a long, ufeful, 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 Bifhop Lowth with his ufual elegance, informs us, that for his merits the univerfity of Oxford conferred upon him the degree of D. D. by diploma, which is the higheft literary honour which that learned body has to beftow.

RIDLEY, a townfhip in Delaware county, Pennfylvania.—*Morse.*

RIENZI (Nicolas Gabrini de), one of the moft extraordinary men of the 14th century, was born at Rome, we know not in what year. His father, Law-

rence

Rienzi. rence Gabrini, was a mean vintner, or, as others fay, a miller, and his mother a laundrefs. Thefe perfons, however, found the means of giving their fon a liberal education; and to a good natural underftanding he joined an uncommon affiduity, and made great proficiency in ancient literature. Every thing which he read he compared with fimilar paffages that occurred within his own obfervation; whence he made reflections, by which he regulated his conduct. To this he added a great knowledge in the laws and cuftoms of nations. He had a vaft memory: he retained much of Cicero, Valerius Maximus, Livy, the two Senecas, and Cæfar's Commentaries efpecially, which he read continually, and often quoted by application to the events of his own times. This fund of learning proved the bafis and foundation of his rife. The defire he had to diftinguifh himfelf in the knowledge of monumental hiftory, drew him to another fort of fcience, in which few men at that time exerted themfelves. He paffed whole days among the infcriptions which are to be found at Rome, and acquired foon the reputation of a great antiquary. Having hence formed within himfelf the moft exalted notions of the juftice, liberty, and ancient grandeur of the old Romans, words he was perpetually repeating to the people, he at length perfuaded not only himfelf, but the giddy mob his followers, that he fhould one day become the reftorer of the Roman republic. His advantageous ftature, his countenance, and that air of importance which he well knew how to affume, deeply imprinted all that he faid in the minds of his audience.

Nor was it only by the populace that he was admired; he alfo found means to infinuate himfelf into the favour of thofe who partook of the adminiftration. Rienzi's talents procured him to be nominated one of the deputies fent by the Romans to Pope Clement VI. who refided at Avignon. The intention of this deputation was to make his Holinefs fenfible, how prejudicial his abfence was, as well to himfelf as to the intereft of Rome. At his firft audience, our hero charmed the court of Avignon by his eloquence and the fprightlinefs of his converfation. Encouraged by fuccefs, he one day took the liberty to tell the Pope, that the grandees of Rome were avowed robbers, public thieves, infamous adulterers, and illuftrious profligates; who, by their example, authorifed the moft horrid crimes. To them he attributed the defolation of Rome; of which he drew fo lively a picture, that the Holy Father was moved, and exceedingly incenfed againft the Roman nobility. Cardinal Colonna, in other refpects a lover of real merit, could not help confidering thefe reproaches as reflecting upon fome of his family; and therefore found means of difgracing Rienzi, fo that he fell into extreme mifery, vexation, and ficknefs, which, joined with indigence, brought him to an hofpital. Neverthelefs, the fame hand that threw him down, raifed him up again. The cardinal, who was all compaffion, caufed him to appear before the Pope, in affurance of his being a good man, and a great partizan for juftice and equity. The Pope approved of him more than ever; and, to give him proofs of his efteem and confidence, made him apoftolic notary, and fent him back loaded with favours.

Being returned to Rome, he began to execute the functions of his office; and by affability, candour, affiduity, and impartiality, in the adminiftration of juftice, he arrived at a fuperior degree of popularity; which he ftill improved by continued invectives againft the vices of the great, whom he took care to render as odious as poffible; till at laft, for fome ill-timed freedoms of fpeech, he was not only feverely reprimanded, but difplaced. From this time it was his conftant endeavour to infpire the people with a fondnefs for their ancient liberties; to which purpofe he caufed to be hung up in the moft public places emblematic pictures, expreffive of the former fplendour and prefent decline of Rome. To thefe he added frequent harangues and predictions upon the fame fubject. In this manner he proceeded till one party looked on him only as a madman, while others careffed him as their protector. At length he ventured to open himfelf to fuch as he believed male contents. At firft he took them feparately; afterwards, when he thought he had firmly attached a fufficient number to his intereft, he affembled them together, and reprefented to them the deplorable ftate of the city, over-run with debaucheries, and the incapacities of their governors to correct or amend them. As a neceffary foundation for the enterprife, he gave them an infight into the immenfe revenues of the apoftolic chamber: He demonftrated, that the Pope could, only at the rate of fourpence, raife a hundred thoufand florins by firing, as much by falt, and as much more by the cuftoms and other duties. As for the reft, faid he, I would not have you imagine that it is without the Pope's confent 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 fo animated his auditors, that they declared they would make no fcruple of fecuring thefe treafures for whatever end might be moft convenient; and that they were devoted to the will of him their chief. Having obtained fo much, to fecure his adherents from a revolt, he tendered them a paper, fuperfcribed, "an *oath* to procure the good eftablifhment;" and made them fubfcribe and fwear to it before he difmiffed them. By what means he prevailed on the Pope's vicar to give a tacit fanction to his project, is not certainly known; that he did procure that fanction, and that it was looked on as a mafterpiece of policy, is generally admitted. "The 20th of May, being Whitfunday, he fixed upon to fanctify in fome fort his enterprife; and pretended, that all he acted was by particular infpiration of the Holy Ghoft. About nine, he came out of the church bare headed, accompanied by the Pope's vicar, furrounded by an hundred armed men. A vaft crowd followed him with fhouts and acclamations." The gentlemen confpirators carried three ftandards before him, on which were wrought devices, infinuating, that his defign was to re-eftablifh liberty, juftice, and peace. In this manner he proceeded directly to the Capitol, where he mounted the roftrum; and, with more boldnefs and energy than ever, expatiated on the miferies to which the Romans were reduced: at the fame time telling them, without hefitation, "that the happy hour of their deliverance was at length come, and that he was to be their deliverer, regardlefs of the dangers he was expofed to for the fervice of the Holy Father and the people's fafety." After which, he ordered the laws of what he called the good eftablifhment to be read: "affured that the Romans would refolve

Rienzi. to obferve thefe laws, he engaged in a fhort time to re-eftablifh them in their ancient grandeur."

The laws of the good eftablifhment promifed plenty and fecurity, which were greatly wanted; and the humiliation of the nobility, who were deemed common oppreffors. Such laws could not fail of being agreeable to a people who found in them thefe double advantages; wherefore, "enraptured with the pleafing ideas of a liberty to which they were at prefent ftrangers, and the hope of gain, they came moft zealoufly into the fanaticifm of Rienzi. They refumed the pretended authority of the Romans; they declared him fovereign of Rome; and granted him the power of life and death, of rewards and punifhments, of enacting and repealing the laws, of treating with foreign powers; in a word, they gave him the full and fupreme authority over all the extenfive territories of the Romans.

Rienzi, arrived at the fummit of his wifhes, kept at a great diftance his artifice: he pretended to be very unwilling to accept of their offers, but upon two conditions; the firft, that they fhould nominate the Pope's vicar (the Bifhop of Orvieto) his copartner; the fecond, that the Pope's confent fhould be granted him, which (he told them) he flattered himfelf he fhould 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 Bifhop of Orvieto would carry a title only, and no authority. The people granted his requeft, but paid all the honours to him: he poffeffed the authority without reftriction; the good Bifhop appeared a mere fhadow and veil to his enterprifes. Rienzi was feated in his triumphal chariot, like an idol, to triumph with the greater fplendour. He difmiffed the people replete with joy and hope. He feized upon the palace, where he continued after he had turned out the fenate; and, the fame day, he began to dictate his laws in the Capitol." This election, though not very pleafing to the Pope, was ratified by him; neverthelefs, Rienzi meditated the obtaining of a title, exclufive of the papal prerogative. Well verfed in the Roman hiftory, he was no ftranger to the extent of the tribunitial authority; and as he owed his elevation to the people, he chofe to have the title of their magiftrate. He afked 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 firft fuch as commanded efteem and refpect, not only from the Romans, but from all the neighbouring ftates. But it is difficult for a perfon of mean birth, elevated at once, by the caprice of fortune, to the moft exalted ftation, to move rightly in a fphere wherein he muft breathe an air he has been unaccuftomed to. Rienzi afcended by degrees the fummit of his fortune. Riches foftened, power dazzled, the pomp of his cavalcades animated, and formed in his mind ideas adequate to thofe of princes born to empire. Hence luxury invaded his table, and tyranny took poffeffion of his heart. The pope conceived his defigns to be contrary to the interefts of the holy fee; and the nobles, whofe power it had been his conftant endeavours to deprefs, confpired againft him: they fucceeded; and Rienzi was forced to quit an authority he had poffeffed little more than fix months. It was to a precipitate flight that he was indebted, at this juncture, for his life; and to different difguifes for his fubfequent prefervation.

Having made an ineffectual effort at Rome, and "not knowing where to find a new refource to carry on his defigns, he took a moft bold ftep, conformable to that rafhnefs which had fo often affifted him in his former exploits. He determined to go to Prague, to Charles king of the Romans, whom the year before he had fummoned to his tribunal," and who, he forefaw, would deliver him up to a Pope highly incenfed againft him. He was accordingly foon after fent to Avignon, and there thrown into a prifon, where he continued three years. The divifions and difturbances in Italy, occafioned by the number of petty tyrants that had eftablifhed themfelves in the ecclefiaftical territories, and even at Rome, occafioned his enlargement. Innocent VI. who fucceeded Clement in the papacy, fenfible that the Romans ftill entertained an affection for our hero, and believing that his chaftifement 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 preferve an inviolable attachment to the holy fee (by whofe favour he fhould be re-eftablifhed)," thought him a proper inftrument to affift his defign of reducing thofe other tyrants; and therefore, not only gave him his liberty, but alfo appointed him governor and fenator of Rome. He met with many obftacles to the affumption of this newly-granted authority; all which, by cunning and refolution, he at length overcame. But giving way to his paffions, which were immoderately warm, and inclined him to cruelty, he excited fo general a refentment againft him, that he was murdered October 8, 1354.

"Such was the end of Nicholas Rienzi, one of the moft renowned men of the age; who, after forming a confpiracy full of extravagance, and executing it in the fight of almoft the whole world, with fuch fuccefs that he became fovereign of Rome; after caufing plenty, juftice, and liberty, to flourifh among the Romans; after protecting potentates, and terrifying fovereign princes; after being arbiter of crowned heads; after re-eftablifhing the ancient majefty and power of the Roman republic, and filling all Europe with his fame during the feven months of his firft reign; after having compelled his mafters themfelves to confirm him in the authority he had ufurped againft their interefts—fell at length at the end of his fecond, which lafted not four months, a facrifice to the nobility, whofe ruin he had vowed, and to thofe vaft projects which his death prevented him from putting into execution."*

* *Biog. Dict.* new edit.

If the reader perceive any thing fimilar at prefent to the rife of this wonderful man to fovereign authority, he may perhaps confole himfelf with the hope that the modern conful will in all probability fall like the modern tribune. Both rofe by difplays of the moft daring courage; the affociates of both were priefts, who in the actual exercife of government were cyphers; both promifed liberty and plenty to the people whom they ruled with abfolute fway; and both have trampled upon the order of nobility.

Rienzi, ‖ Rindge.

RIGO *Ifland*, near the north-weft part of the ifland of Porto Rico, in the Weft-Indies, behind which is the principal harbour of the main ifland.—*Morse.*

RIMAC, a river of Peru, which paffes through the city of Lima, and falls into the fea 6 miles below that city.—*ib.*

RINDGE, or *Ringe*, a town in the county of Chefhire, 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 largeft fleet with fuch convenience, that the fhips may ride near enough the fhore to reach it with a plank. It is about 2 leagues in depth, and is formed by the Point of the Galleons on the weft, and Point Rofe on the eaft.—*ib.*

ROBERVALLIAN LINES, a name given to certain lines ufed for the transformation of figures; thus called from their inventor Roberval, an eminent French mathematician, who died in 1675, aged 76 years. Thefe lines bound fpaces that are infinitely extended in length, which are neverthelefs equal to other fpaces that are terminated on all fides.

The Abbot Gallois, in the memoirs of the Royal Academy, anno 1693, obferves, that the method of transforming figures, explained at the latter end of Roberval's Treatife of Indivifibles, was the fame with that afterwards publifhed by James Gregory, in his *Geometria Univerfalis*, and alfo 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 firft learned the method in the journey he made to Padua in 1668, the method itfelf having been known in Italy from the year 1646, though the book was not publifhed till the year 1692.

This account has been, we think, completely refuted by David Gregory in his vindication of his uncle, publifhed in the Philofophical Tranfactions of 1694. The Abbot, however, rejoined in the Memoirs of the French Academy of 1703; and it is but fair to obferve, that Dr Hutton, fpeaking of the controverfy, expreffes himfelf as if he thought it undecided.

ROBESON, a county of N. Carolina, fituated in Fayette diftrict, and bounded fouth-weft by the State of S. Carolina. It contains 5326 inhabitants including 533 flaves. Chief town, Lumberton.—*Morse.*

ROBIN HOOD's *Bay*, on the eaft coaft of Newfoundland, is frequented by fmall veffels, as they can fifh here to advantage. It is not far from Trinity Harbour, and near to Fox Iflands.—*ib.*

ROCA *Iflands*, a clufter of uninhabited iflands off the north coaft of Venezuela, in Terra Firma, about 40 leagues north-weft by weft of Tortugas.—*ib.*

ROCA PARTIDO, a fmall ifland in the North Pacific Ocean, S. E. from La Mefa, and W. from the ifle La Nublada; and in about lat. 16 35 N. and long. 128 W.—*ib.*

ROCHE, *Cape de la*, on the N. fide of the ifland of St Domingo, is about five leagues weft of Old Cape Francois.—*ib.*

ROCH, *Riviere a la*, a river of the N. W. Territory, which runs a S. W. courfe, and empties into the Miffiffippi 95 miles above the Iowa Rapids.—*ib.*

ROCHER, *la praire du*, or *Rock Meadows*, on Miffiffippi river, 3 miles below the fpot where Fort Chartres ftood.—*ib.*

ROCHESTER, the north-wefternmoft townfhip of Windfor county, Vermont, and contains 215 inhabitants.—*ib.*

ROCHESTER, a townfhip of Maffachufetts, Plymouth county, 53 miles fouthward of Bofton. It was incorporated in 1686, and contains 2,644 inhabitants.—*ib.*

ROCHESTER, a confiderable townfhip in Strafford county, New-Hampfhire, on the W. fide of the northern branch of Pifcataqua river, 22 miles north-wefterly of Portfmouth, and 40 S. by E. of Middleton. It was incorporated in 1722, and contains 2,857 inhabitants.—*ib.*

ROCHESTER, a townfhip in Ulfter county, New-York, extending W. to Delaware river. It is about 12 miles S. W. of Efopus, and contains 1628 inhabitants, of whom 228 are electors, and 281 flaves.—*ib.*

ROCKAWAY, a fmall poft-town in Morris county, New-Jerfey, on the S. fide of the river of its name, 15 miles N. by W. of Morriftown, 21 S. E. of Newton, and 123 N. E. by N. of Philadelphia.—*ib.*

ROCKBRIDGE, a mountainous county of Virginia; bounded N. by Augufta, and S. by James river, which divides it from Botetourt county. It contains 6,548 inhabitants, of which 682 are flaves. The Natural Bridge, fo elegantly defcribed by Mr Jefferfon, in his Notes on Virginia, is in this county.—*ib.*

ROCK FISH, a north-weftern branch of James river, in Virginia, at the mouth of which is fome 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 poft-town of N. Carolina, 573 miles from Philadelphia.—*ib.*

ROCKHILL, a townfhip of Buck's county, Pennfylvania.—*ib.*

ROCKINGHAM, one of the five counties into which the ftate of New-Hampfhire is divided. It lies on the S. E. part of the ftate; having the Atlantic Ocean on the S. E. the county of Hillfborough on the W. Strafford on the N. and the ftate of Maffachufetts on the S. It is about 60 miles long and 30 broad. It embraces the only fea-port, and moft of the commercial towns in the ftate. It contains 46 townfhips, and 43,169 inhabitants. Chief towns, Portfmouth, Exeter, and Concord.—*ib.*

ROCKINGHAM, the north-eafternmoft townfhip in Windham county, Vermont, is fituated on the weft bank of Connecticut river, which feparates it from Walpole in New-Hampfhire. It contains 1235 inhabitants.—*ib.*

ROCKINGHAM, a county of Salifbury diftrict, N. Carolina, bounded eaft by Cafwell and weft 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 Troublefome Creek. Iron ore is found in many parts of the county. It contains 6,187 inhabitants, including 1,100 flaves.—*ib.*

ROCKINGHAM, the chief town of Richmond county, North Carolina. It is feated on an eminence, about 6 miles eaft of Great Pedee river, and contains a court-houfe, gaol, and a few dwelling-houfes. It is 74 miles from Hillfborough, 40 from Bethania, and 536 from Philadelphia.—*ib.*

ROCKINGHAM, a mountainous county of Virginia, bounded north by Shenandoah, and fouth by Augufta. It contains 7,449 inhabitants, including 772 flaves.—*ib.*

ROCKINGHAM, a poft-town and the feat of the courts of the above county, is fituated on a branch of Shenandoah river, and contains a court-houfe, gaol, and about 30 houfes. It is 108 miles eaft 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 *Rockomesso*, 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."

Rodney, *Point*, on the N. W. coast of N. America, is the N. point of Norton Sound. Sledge Island is S. E. ¼ 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. ¼ 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

Roebuck.

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, als , 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 iron-stone, 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

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

Roebuck. 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 to bring the works at Carron to their present ftate of perfection; or, that great alterations and improvements have taken place, during the courfe of forty years, in a great and progreffive eftablifhment. In all works of that kind, the expenfe exceeds the calculation. The undertakers, even of the lateft iron works which have been erected, notwithftanding all the advantages obtained from recent experience, will be ready to acknowledge, that, in thefe refpects, there is little room to blame the original projector of the firft eftablifhment of that kind in Scotland. But the beft, and moft infallible proof of Dr Roebuck's merit, and of the found principles on which thefe works were eftablifhed, is the prefent profperous ftate of that eftablifhment, the great perfection of many branches of their manufactures, and particularly the many extenfive and flourifhing iron-works which have fince been erected upon the model of Carron in different parts of Scotland, at Cleugh, Clyde, Muirkirk, and Devon. It cannot be denied that all thefe works have fprung from the eftablifhment at Carron, and are ultimately founded upon the knowledge and experience which have been obtained from them; for fome of the partners, or overfeers of thefe 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 eftablifhment at Carron, that Scotland is, at this moment, benefited to the amount of many hundred thoufand pounds, in working up the raw materials of that manufacture found in the country itfelf, and which, previous to that eftablifhment, was of no value whatever. Such are the *prefent*, but fcarcely any idea can be formed of the *future*, advantages to this country, which may be derived from the extenfion of the iron manufacture. About 60,000 tons of iron have been annually imported into Great Britain for more than twenty years paft; and though there has been for fome time about 20,000 tons of bar iron made in Britain by pitcoal, yet the foreign imported iron has fuffered little or no diminution in quantity. This great confumption of iron, no doubt, is owing to the various improvements of late years, and the general extenfion throughout all Europe of commerce and the arts. The manufacture of iron muft therefore continue to increafe; and Scotland, abounding everywhere in ironftone, pitcoal, and in command of water for machinery, has the profpect of obtaining the largeft fhare of it.

To the eftablifhment of the Carron works, and to the confequences of that eftablifhment, may be afcribed alfo the exiftence 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 fubject of converfation in Scotland, but nothing in fact had been attempted. The eftablifhment of the iron-works at Carron foon called forth fufficient intereft and enterprife to bring about the execution of this grand defign. Some of the partners of the Carron company, forefeeing the advantages they would derive from fuch a communication, propofed, at their own expence, to execute a fmall canal; and, after taking the preparatory fteps, actually applied to Parliament to obtain authority for that purpofe. But the project of the fmall canal not meeting with the approbation of fome noblemen and gentlemen in that part of Scotland, they oppofed the bill, and obliged themfelves to execute a greater canal, which has now been many years finifhed, and is found to be of the greateft advantage to the trade and commerce of Scotland. The merit of this undertaking is not meant to be afcribed to Dr Roebuck, excepting in fo far as it neceffarily arofe from the eftablifhment of the Carron company, of which he was the original projector; and it may reafonably be doubted whether, without that eftablifhment, it would have yet taken place. Several other canals have, fince that time, been executed in different parts of Scotland, and other very important ones are at prefent projected.

The different eftablifhments which Dr Roebuck made at Borrowftounnefs in carrying on the coal and falt works there, though ultimately of no advantage to himfelf, were attended, during the courfe of thirty years, with the moft beneficial effects upon the trade, population, and induftry of that part of Scotland. They were the means alfo of adding very confiderably to the public revenue. Previous to the time thefe 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 extenfive plan, by opening up new feams of coal, and of better quality, he was enabled to export a very confiderable quantity, to increafe the quantity of falt, and of courfe the revenue arifing from thefe articles. In thefe works, and in the management of a large farm, Dr Roebuck gave employment to near a thoufand perfons at Borrowftounnefs and in the neighbourhood.

Nor was it folely by the different eftablifhments which he projected and executed, but by many other things neceffarily connected with them, that Dr Roebuck's labours were beneficial to Scotland. Along with them he may be faid to have introduced a fpirit of enterprife and induftry, before that time little known in Scotland, which foon pervaded many other departments of labour, and gave birth to many other ufeful projects. He brought from England, then much farther advanced in arts and induftry, many ingenious and induftrious workmen, at great expenfe, who, by their inftructions and example, communicated and diffufed fkill and knowledge to others. At all times Dr Roebuck held out liberal encouragement to rifing genius and induftrious merit; and fpared no expenfe in making trials of improvements and difcoveries which were connected with the different projects and works which he was carrying on.

Such was the active and ufeful life of Dr Roebuck, a man of no common caft, who united, in a very high degree, a great number of folid and brilliant talents, which, even feparately, fall to the lot of but few individuals. Diftinguifhed by an ardent and inventive mind, delighting in purfuit and inveftigation, always afpiring at fomething beyond the prefent ftate of fcience and art, and eagerly preffing forward to fomething better or more perfect, he thus united energies the moft powerful with the moft unwearied and perfevering induftry. To that peculiarity of imagination, fo fitted for fcientific purfuit, which readily combines and unites, which fteadily preferves its combinations before the eye of the mind, and quickly difcovers relations, refults, and confequences, was added, in his character, great promptitude and firmnefs in decifion. Strongly and early impreffed with the great importance of applying chemical and phyfical knowledge to the ufeful arts, to the melioration of civil life, he never loft fight of that favourite view, and difcovered great boldnefs and refource in the means and expedients which he adopted to promote it. He was certainly mafter of the beft philofophy of chemiftry known in the earlier parts of his life; and though in every ftage of that fcience he marked and underftood the progrefs of the difcoveries, yet his numerous avocations did not permit him to follow them out by experimental proceffes of his own. Upon that, and indeed almoft upon every fubject, his mind readily grafped the moft ufeful and fubftantial points, and enabled him to throw out fuch hints and hypothefes as marked him the man of genius.

During the courfe of a regular education, both at Edinburgh and at Leyden, Dr Roebuck ftudied the claffic authors with great attention, particularly the hiftorical and political parts of their works. Upon thefe fubjects he had read much, felected with judgment, and was well acquainted with the facts and philofophy of ancient governments. This tafte he carried with him, and improved in every period of his life, and in every fituation. It abundantly rewarded him for the earneftnefs and diligence with which it had been acquired. It became his favourite refource, and indeed one of the chief enjoyments of his life. Poffeffing the happy talent of turning his mind from ferious and fatiguing, to elegant and recreating purfuits, it was no uncommon thing with him to return from the laboratory or the coalpit, and draw relaxation or relief from fome one or other of the various ftores of claffical learning.

No man was better acquainted with the hiftory of his country than Dr Roebuck, or more admired and revered the conftitution of its government. By temper and education he was a Whig, and at all times entered with great warmth into the political difputes and controverfies which agitated parties in the different periods of his life. If the natural warmth of his temper, and his enthufiafm on thefe fubjects, led him, on fome occafions, beyond the bounds of candid argumentation, his quick fenfe of decorum, and his perfect habits of good manners, produced an immediate atonement, and reftored the rights of elegant and polifhed converfation.

The general acquaintance which Dr Roebuck had acquired with natural and experimental philofophy, together with his claffical and political knowledge, rendered him an agreeable companion to the learned almoft of every department, and procured him the attachment and friendfhip of many of the firft literary characters in Britain. With his friend Dr Black he lived till his death in clofe habits of intimacy; and he often acknowledged, with much franknefs, the advantages which he derived, in his various purfuits, from a free and unreferved communication with that eminent chemift.

The amiable difpofitions of fenfibility, humanity, and generofity, which ftrongly marked his character, in the general intercourfe of fociety, were peculiarly preferved and exercifed in the bofom of his family, and in the circle of his friends. In the various relations of hufband, father, friend, or mafter, and in the difcharge of the refpective duties arifing from them, it would not be eafy to do juftice to his character, or to determine in which of them he moft excelled; nor muft 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 mafter, but many of them, when their circumftances required it, a fkilful and compaffionate phyfician, who cheerfully vifited the humbleft receffes of poverty, and who attached them to his fervice by multiplied acts of generofity and kindnefs.

ROEBUCK *Ifland*, at the eaftern extremity of Lake Ontario.—*Morse*.

ROEMER (Olaus), a noted Danifh aftronomer and mathematician, was born at Arhufen in Jutland, 1644; and at 18 years of age was fent to the univerfity of Copenhagen. He applied affiduoufly to the ftudy of the mathematics and aftronomy, and became fo expert in thofe fciences, that when Picard was fent by Louis the XIV. in 1671, to make obfervations in the north, he was greatly furprifed and pleafed with him. He engaged him to return with him to France, and had him prefented to the king, who honoured him with the dauphin as a pupil in mathematics, and fettled a penfion upon him. He was joined with Picard and Caffini, in making aftronomical obfervations; and in 1672 he was admitted a member of the Academy of Sciences.

During the ten years he refided at Paris, he gained great reputation by his difcoveries; yet it is faid he complained afterwards, that his coadjutors ran away with the honour of many things which belonged to him. Here it was that Roemer, firft of any one, found out the velocity with which light moves, by means of the eclipfes of Jupiter's fatellites. He had obferved for many years, that when Jupiter was at his greateft diftance from the earth where he could be obferved, the emerfions of his firft fatellite happened conftantly 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 excefs of diftance; and confequently 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 fun to us, provided its velocity was nearly uniform. This difcovery had at firft many oppofers; but it was afterwards confirmed by Dr Bradley in the moft ingenious and beautiful manner.

In 1681 Roemer was recalled to his native country by Chriftian the Vth King of Denmark, who made him profeffor of aftronomy at Copenhagen. The king employed him alfo in reforming the coin and the architecture, in regulating the weights and meafures, and in meafuring and laying out the high roads throughout the kingdom; offices which he difcharged with the greateft credit and fatisfaction. In confequence he was honoured by the king with the appointment of chancellor of the exchequer and other dignities. Finally, he became counfellor of ftate, and burgomafter of Copenhagen, under Frederic the IV. the fucceffor of Chriftian. Roemer was preparing to publifh the refult of his obfervations, when he died the 19th of September 1710, at 66 years of age: but this lofs was fupplied by Horrebow, his difciple, then profeffor of aftronomy at Copenhagen, who publifhed, in 4to, 1753, various obfervations of Roemer, with his method of obferving, under the title of *Bafis Aftronomiæ*.—He had alfo printed various aftronomical obfervations and pieces, in feveral volumes of the Memoirs of the Royal Academy of Sciences at Paris, of the inftitution of 1666, particularly vol. 1. and 10. of that collection.

ROGERS *Road*, fo called from the perfon under whofe 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).

 Though

(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 works, 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 Rolloce, extincto, Urbs mæsta, Academia mæsta est;
Et tota exequiis Scotia mæsta 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 Orua, 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 Alleghany 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

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) of. 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, 56¼ 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

on Mufconecunk river, 25 miles from its confluence with the Delaware, and 45 miles north of Trenton. Near it is a mineral fpring.—*ib.*

ROXO, a cape near the S. W. part of Porto Rico Ifland, and due fouth of Cape Rincon. N. lat. 18 11, W. long. 67 53.—*ib.*

ROYAL *Bay*, is a fhort diftance to the eaft, foutherly of Boon's Point, at the north part of the ifland of Antigua in the Weft-Indies.—*ib.*

ROYAL *Ifle*, a fmall fertile ifland in the river St Lawrence; 60 miles below Lake Ontario. The French fort on it was taken by Gen. Amherft, in 1760.—*ib.*

ROYAL's *River*, in Cumberland county, Maine, empties into Cafco Bay, in the townfhip of North-Yarmouth.—*ib.*

ROYALTON, a townfhip in Windfor county, Vermont, north-weft of Hartford, on White river, and contains 748 inhabitants.—*ib.*

ROYALSTON, a townfhip of Maffachufetts, Worcefter county, 40 miles north-weft by north of Worcefter, and 70 north-weft of Bofton. It was incorporated in 1665, and contains 1,130 inhabitants. Miller's river runs through this town from the eaft.—*ib.*

ROY ROYAN, in Bengal, the chief officer in the revenue department, next to the Dewan under the native government.

RUATAN, or *Rattan*, an ifland in the Bay of Honduras, 8 leagues from the Mofquito fhore, and about 200 weft by fouth of the ifland of Jamaica. It is 30 miles long and 13 broad, naturally fortified with rocks and fhoals, except the entrance into the harbour, which is fo narrow that only one fhip can pafs it at a time; the harbour is one of the fineft in the world, and can afford fafe anchorage for 500 fail of fhips. It was totally uninhabited until 1742, when the Britifh, under the command of Major Crawford, began a fettlement, in order to protect the log-wood cutters, and fecure a trade with the Spaniards of Guatimala, for cochineal, indigo, &c. but it was foon 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 wefternmoft branch of Lynche's Creek. Here Gen. Green retreated, in May, 1781, to wait for reinforcements, after his repulfe at Camden, and to prevent fupplies reaching it.—*ib.*

RUISSEAU, *Grand*, a fettlement on the eaftern fide of the river Miffiffippi, 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 Iflands. N. lat. 23 52, W. long. 74 17.—*ib.*

RUMNEY, or *Romney*, a townfhip of New-Hampfhire, fituated in Grafton county, on a north branch of Baker's river, about 7 or 8 miles north-weft of Plymouth on the weft fide of the Pemigewaffet. It was incorporated in 1767, and contains 411 inhabitants.—*ib.*

RUNAWAY *Bay*, on the north-weft coaft of the ifland of Antigua; fituated between the fort on Corbizon's point to the north, and Fort Hamilton to the fouth. Off it lie rocks and fhoals.—*ib.*

RUNAWAY *Bay*, on the north coaft of the ifland of Jamaica, weftward of Great Laughlands river and Mumby Bay, and 9 or 10 miles eaftward of Rio Baeno.—*ib.*

RUPERT, the north-wefternmoft townfhip of Bennington county, Vermont. It contains 1,033 inhabitants.—*ib.*

RUPERT's *Bay*, at the north-weft end of the ifland of Dominica, in the Weft-Indies, affords good fhelter from the winds, and is deep, capacious and fandy. It is the principal bay of the ifland, and on it is erected the town of Portfmouth.—*ib.*

RUPERT's *Fort*, at the bottom of Hudfon's Bay, in N. America, is fituated on a river of the fame name, on the E. fide of James's Bay; between Slade river on the north, and Nodway river on the fouth. N. lat. 51 50, W. long. 80 5.—*ib.*

RUPERT's *Ifland*, the moft wefterly of the 4 iflands in the ftraits of Magellan, which form the S. fide of Royal Reach.—*ib.*

RUSSELL, a county of Virginia, bounded north by Greenbrier, and fouth by Lee county. Before Lee was erected out of this county, it contained 3,338 inbitants, including 190 flaves.—*ib.*

RUSSELL, a townfhip in Hampfhire county, Maffachufetts, 15 miles weft of Springfield, and 108 weft by fouth of Bofton. It was incorporated in 1792.—*ib.*

RUTHERFORD (John, M. D.), one of the illuftrious founders of the medical fchool in the univerfity of Edinburgh, was the fon of the Rev. Mr Rutherford minifter of Yarrow, in the county of Selkirk, North Britain. He was born on the 1ft Auguft 1695, and received the rudiments of his education at the parifh fchool of Selkirk; where, from his future proficiency, there is every reafon to believe that he made a rapid progrefs 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 univerfity, he applied himfelf to the ftudy of claffical literature, mathematics, and natural philofophy. The celebrated Dr Pitcairn was then fo highly refpected for his medical fkill, that it is not improbable but that a laudable defire of obtaining a portion of fimilar fame may have turned the attention of young Rutherford to the ftudy of medicine. Be that as it may, he engaged himfelf apprentice to Mr Alexander Nefbit, at that time an eminent furgeon in Edinburgh, with whom he remained till 1716, when he went to London. There he attended fome hofpitals, and the lectures read on anatomy by Dr Douglas, on furgery by André, and on materia medica by Strother.

After a year's refidence in London, he returned to Edinburgh; and having fettled his affairs in that city, he went to Leyden, which, from the lectures of Boerhaave, was then the moft celebrated medical fchool 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 univerfity of Rheims. He paffed the following winter in Paris, chiefly for the fake of Winflow's private demonftrations in anatomy; and in 1720 he returned to Britain.

In 1721 he fettled as a phyfician in Edinburgh; and foon afterwards Drs Rutherford, Sinclair, Plummer, and Innes, purchafed a laboratory, where they

prepared

Rutherford.

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.

Rutherford || Rye.

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 Tuckahoe Creek, 6 miles S. E. of Centerville, and 7½ N. W. of Greensborough.—*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 seacoast of Rockingham county, opposite the Isle of Shoals, and

Rye. 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.* Rye, ‖ Ryegate.

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, ‖ Saccharometer.

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.

Saccharometer, ‖ Saco.

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

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 Porpoiſe. 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 *Sacramento 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 furthest 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 Paiſlow, 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 Weſtmoreland.—*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 Malteli, 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 ſubl me 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 Bonjour.

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

Saltpetre. of boiling water. When the folution is made, it will mark between 66 and 68 degrees of the hydrometer. (Sp. gr. 1.844. and 1.898.)

The folution is to be poured into a proper veffel, where it depofits by cooling about two thirds of the faltpetre originally taken. The precipitation begins in about half an hour, and terminates in between four and fix hours. But as it is of importance to obtain the faltpetre in fmall needles, becaufe in this form it is more eafily dried, it is neceffary to agitate the fluid during the whole time of the cryftallization. A flight motion is communicated to this liquid mafs by a kind of rake; in confequence of which the cryftals are depofited in very flender needles.

In proportion as the cryftals fall down, they are fcraped to the borders of the veffel, whence they are taken with a fkimmer, and thrown to drain in bafkets placed on treffels, in fuch a manner that the water which paffes through may either fall into the cryftallizing veffel, or be received in bafons placed underneath.

The faltpetre is afterwards put into wooden veffels 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 fmall perforations through which water may pafs to the lower bottom, which likewife affords a paffage by one fingle aperture. A refervoir is placed beneath. The cryftallized faltpetre is wafhed in thefe veffels with 5 *per cent.* of water; which water is afterwards employed in the folution of faltpetre in fubfequent operations.

The faltpetre, after fufficient draining, and being dried by expofure to the air upon tables for feveral hours, may then be employed in the manufacture of gunpowder.

But when it is required to ufe the faltpetre in the fpeedy and immediate manufacture of gunpowder, it muft be dried much more ftrongly. This may be effected in a ftove, or more fimply by heating it in a flat metallic veffel. For this purpofe the faltpetre is to be put into the veffel to the depth of five or fix inches, and heated to 40 or 50 degrees of the thermometer (or about 135° of Farenheit). The faltpetre is to be ftirred for two or three hours, and dried fo much that, when ftrongly preffed in the hand, it fhall acquire no confiftence, nor adhere together, but refemble a very fine dry fand. This degree of drynefs is not required when the powder is made by pounding.

From thefe circumftances, we find that two faline liquids remain after the operation; (1) the water from the wafhing; and (2) that from the cryftallizing veffels.

We have already remarked, that the wafhing of the faltpetre is performed in three fucceffive operations, in which, upon the whole, the quantity of fluid made ufe of amounts to 35 *per cent* of the weight of the crude faltpetre. Thefe wafhings are eftablifhed on the principle that cold water diffolves the muriats of foda, and the earthy nitrats and muriats, together with the colouring principle, but fcarcely attacks the nitrat of potafh.

The water of thefe three wafhings therefore contains the muriat of foda, the earthy falts, the colouring principle, and a fmall quantity of nitrat of potafh; the amount of which is in proportion to that of the muriat of foda, which determines its folution.

The water of the cryftallizing veffels contains a portion of the muriats of foda, and of the earthy falts which efcaped the operation of wafhing, and a quantity of nitrat of potafh, which is more confiderable than that of the former folution.

The waters made ufe of at the end of the operation, to whiten and wafh the cryftals depofited in the pyramidal veffel, contain nothing but a fmall quantity of nitrat of potafh.

Thefe waters are therefore very different in their nature. The water of the wafhings is really a mother water. It muft be collected in veffels, and treated with potafh by the known proceffes. It muft be evaporated to 66 degrees (or 1,848 fp. gr.), taking out the muriat of foda as it falls. This folution is to be faturated with 2 or 3 *per cent.* of potafh, then fuffered to fettle, decanted, and poured into cryftallizing veffels, where 20 *per cent.* of water is to be added to keep the whole of the muriat of foda fufpended.

The waters which are thus obtained by treatment of the mother water may be mixed with the water of the firft cryftallization. From thefe the marine falt may be feparated by fimple evaporation; and the nitrat of potafh, which they hold in folution, may be afterwards obtained by cooling.

The fmall quantity of water made ufe of to wafh and whiten the refined faltpetre, contains nothing but the nitrat of potafh: it may therefore be ufed in the folution of the faltpetre when taken from the tubs.

From this defcription it follows, that a manufactory for the fpeedy refining of faltpetre ought to be provided with (1) mallets or rammers for pounding the faltpetre; (2) tubs for wafhing; (3) a boiler for folution; (4) a cryftallizing veffel of copper or lead, in which the faltpetre is to be obtained by cooling; (5) bafkets to drain the cryftals; (6) a wooden cafe or hopper for the laft wafhing and draining the faltpetre; (7) fcales and weights for weighing; (8) hydrometers and thermometers, to afcertain denfities and temperatures; (9) rakes to agitate the liquor in the cryftallizing veffel; (10) fkimmers to take out the cryftals, and convey them to the bafkets; (11) fyphons or hand-pumps to empty the boilers.

The number and dimenfions of thefe feveral articles muft vary according to the quantity of faltpetre intended to be refined.

Salt Petre Creek. Salt *Petre Creek*, in Baltimore county, Maryland, falls into Gunpowder river on the weftern fide; 14 miles E. N. E. of Baltimore, in north lat. 39 20; and nearly 2 miles north-wefterly from the weftern point of Gunpowder Neck.—*Morse.*

Salt *Pond Bay*, on the fouth coaft of the ifland of Jamaica, eaftward of Port Royal.—*ib.*

Salt *River*, in Kentucky, is formed by three principal branches, and empties through the fouth-eaft 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 fide is level and poor, and abounds with ponds. Between Salt and Green rivers there are two fprings of bitumen, which, when analyzed, is found to be amber.—*ib.*

Salt *River*, on the north fhore of the ifland of Jamaica, is nearly due fouth from Point Galina.—*ib.*

Salt

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 Chebucto 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

Samilitam, ‖ Gum-Sandarac.

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, $2\frac{1}{2}$ 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 $13\frac{1}{2}$ 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.

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. ½ 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 Maticaloe. 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, jurifdiction, fituated at the foot of a mountain, on the banks of the fmall river Guapay, about 56 miles north-eaft of La Plata, and near the borders of Paraguay. It is thinly inhabited; the houfes are of ftone, thatched with palm leaves. The valley, in which the city ftands, produces all kinds of grain and fruits, and the woods and uncultivated mountains afford great quantities of honey and wax. S. lat. 19 25, weft long. 62 30.—*ib.*

SANTA FE, a town of New Mexico, in N. America. N. lat. 35 32, weft long. 106 35—*ib.*

SANTA FE *Bay*, on the north coaft of S. America, weftward of Comana Gulf.—*ib.*

SANTA *Ifland*, or *Holy Ifland*, on the coaft of Peru, is oppofite to the port of Ferol. It is 3 miles from the port and city of Santa, and as far from Ferol, which is eaftward of it.—*ib.*

SANTA *Maria*, a river of the Ifthmus of Darien, which is navigable 8 or 9 leagues, and fo 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 confiderable 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, weft long. 82 20.—*ib.*

SANTA *Port*, on the coaft of Peru, is north-eaft of Santa Ifland, in the mouth of a river of the fame name. —*ib.*

SANTA MARTHA, a province of Terra Firma, S. America, bounded eaft by Rio de la Hacha, and weft by Carthagena.—*ib.*

SANTA MARTHA, the capital of the above province, and the fee of a bifhop, was formerly very populous, but is now much decayed, occafioned by the Spanifh fleets not touching there, as they anciently ufed to do. There are large falt ponds four and an half miles from the town, from which good falt is extracted and fent to the neighbouring provinces. It ftands near the fea, at the foot of a prodigious mountain, whofe fummit is generally hid in the clouds; but in clear weather, when the top appears, it is covered with fnow. In fome places in the vicinity are gold mines, and in others precious ftones of great value.—*ib.*

SANTEE, a navigable river of S. Carolina, the largeft and longeft in that ftate. It empties into the ocean by two mouths, a little fouth of Georgetown, which laft 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, paffes the Catabaw nation of Indians, and bears the name of Catabaw river, from this fettlement to its fource.—*ib.*

SANTO ESPIRITU, a captainfhip of Brazil, bounded N. by the captainfhip of Seguro, and S. by that of Rio Janeiro, from which laft the river Paraybo feparates it, and after a long courfe from W. to E. empties into the ocean, in lat. 21 30 S. This government is the moft fertile, and beft furnifhed with all forts of provifions of any in Brazil; having alfo an incredible quantity of fifh and game. Its low lands being interfected by a great number of rivers, are very fruitful; and the high grounds are covered with forefts 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 captainfhip already defcribed; the fecond 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 captainfhip, and indeed the only town in it, is fituated on the fouth fide of a large bay on the eaftern coaft of Brazil, about 9 miles from the fea. It has a caftle in ruins, but no fortifications, and contains about 900 inhabitants. Here are two monafteries and a college. The port is a fmall bay, opening to the eaft, interfected with many fmall iflands. On the top of a mountain, at fome diftance from the town, is a large white tower, called, by the Portuguefe, Noftra Senhora de Pena, and near it a fmall church, furrounded with a wall. At the foot of the mountain, are ftill to be feen 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 captainfhip of St Vincent, in Brazil, feated on a river 9 miles from the fea, which is there a mile broad, and five fathoms deep. It is defended by a rampart on the fide next the river. It is alfo guarded by two caftles, one on the fouth fide, and the other in the middle of the town, which contains 250 inhabitants. It has a parifh church, a monaftery, and a college. S. lat. 24 26, W. long. 42 30.—*ib.*

SAONA, or *Saone*, a fmall ifland near the S. E. part of the ifland of St Domingo. It is about 8 leagues from E. to W. and 2 from N. to S. which becomes ftill lefs in the narroweft part. Its circumference is nearly 25 leagues. It lies eaft of St Catherine Ifland; 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 fouthern fide. Thefe mountains at once fhelter and water it, and temper the air. The Indians called this ifland *Adamanoy*, and had a particular cacique, who was fovereign of the ifland, independent of thofe of St Domingo. His fubjects devoted themfelves to commerce with the Spaniards, to agriculture, to cultivation of grain and fruits. They furnifhed enough for the confumption of the city of St Domingo, and for provifioning feveral expeditions, going from that port. Some Caftilians having caufed the cacique to be eaten by a dog, this act of cruelty became the caufe of a quarrel, and the Spaniards having exterminated the unfortunate inhabitants, formed fettlements on their little ifland. It is furrounded with banks and breakers, except at the weftern part; but there is a paffage for fmall barks, between its north fide, and the main of the ifland of St Domingo. The ifland and its port are a fhelter for the mariners failing in this part, who here find water, wood, and wild cattle, all which are in abundance. It is impoffible to have an idea of the vaft quantities of birds, and particularly of wood pigeons, that are feen here. The eaftern point of the ifland lies in lat. 18 9 N. and long. 71 11 W. of Paris.—*ib.*

SAP, or SAPP, in building, as to fap a wall, &c. is to dig out the ground from beneath it, fo as to bring it down all at once for want of fupport.

SAPA, *St Michael de*, a village in the valley of Arica, in the province of Charcos, in Peru. It is a fmall 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.*

nnah. 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. ½ 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, ‖ Saville.

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 enco-

Saville, ‖ Sauſſure.

miums 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

Sauſ

Sauſſure.

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

 ſome

(A) Abauzit, Cramer, Lhuilier, J. Trembley, &c.

(B) Jalabert, A. Trembley, Bonnet, Leſage, Deluc, Senebier, Prévoſt, Pictet, and De Sauſſure himſelf.

fome ideas on the primitive ftate of the earth; but the more he acquired new facts, and the more he meditated on the fubject, the more uncertain did his opinions become in regard to thofe grand revolutions which preceded the prefent epoch. In general he was a Neptunian; that is to fay, afcribed all the revolutions of our globe to water.' He admitted the poffibility of the mountains having been thrown up by elaftic fluids difengaged from the cavities of the earth.

Though the ftate of his health began gradually to become worfe, he ftill entertained hopes of recovery; and the French government having appointed him profeffor of philofophy at the Special School of Paris, he did not defpair of being one day able to fill that office: but his ftrength was exhaufted, a general langour fucceeded the vigour he had always enjoyed, his flow and embarraffed pronunciation no longer correfponded with the vivacity of his mind, and formed a melancholy contraft with the pleafantnefs by which he had been formerly diftinguifhed. It was a painful fpectacle to fee 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-eftablifhment of his health, all the remedies which medicine, enlightened by the phyfical fciences, could afford—all affiftance was ufelefs. The vital power quitted him with flow and painful fteps. Towards the beginning of autumn 1798 his decay became more vifible, his mind loft 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 townfhip, in Berkfhire county, Maffachufetts, incorporated in 1797.—*Morse.*

SAWYER's *Ferry*, a fmall poft-town of N. Carolina, 14 miles from Nixonton, 10 from Indiantown, and 482 from Philadelphia.—*ib.*

Sawyer's, or *Afferadores, Ifland*, on the weft coaft of Mexico; is of fmall fize, and has on its fouth-eaft fide a fmall 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-weft branch of Cape Fear river, in N. Carolina. It is formed by Aramanche and Deep rivers, and it is faid may be made navigable for boats about 50 miles.—*ib.*

SAXEGOTHA, a village or fettlement in S. Carolina, on the fouthern bank of Congaree river; about 48 miles north-wefterly of Augufta, in Georgia.—*ib.*

SAXTON's *River*, in Vermont, empties into the Connecticut at Weftminfter.—*ib.*

SAYBROOK, a poft-town of Connecticut, Middlefex county, on the weft fide of Connecticut river, acrofs which is a ferry, on the road leading to New-London. It is 36 miles eaft of New-Haven, 18 weft of New-London, and 219 north-eaft of Philadelphia. This is the moft ancient town in the State, having been fettled by Mr Fenwick in 1634, who gave it its prefent 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 ferve as a common meafure to all the parts of the building, or all the diftances and places of the map.

Scales, in mathematics, fee Scales (*Encycl.*), and likewife *Logarithmic Lines*, under which title are mentioned fome improvements by Mr Nicholfon on Gunter's fcale. Thefe improvements are valuable; and the reader will find a fuller account of them in the firft volume of the author's *Philofophical Journal.*

SCANTLING, a meafure, fize, or ftandard, by which the dimenfions, &c. of things are to be determined. The term is particularly applied to the dimenfions of any piece of timber, with regard to its breadth and thicknefs.

SCAPEMENT, in clock-work, a general term for the manner of communicating the impulfe of the wheels to the pendulum. The ordinary fcapements confift of the fwing-wheel and pallets only; but modern improvements have added other levers or detents, chiefly for the purpofes of diminifhing friction, or for detaching the pendulum from the preffure of the wheels during part of the time of its vibration. See *Watch Making*, in this *Suppl.*

SCARBOROUGH, a townfhip of the Diftrict of Maine, fituated in Cumberland county, on the fea coaft, between Pepperelborough and Cape Elizabeth. It was incorporated in 1658; contains 2,235 inhabitants; and lies 113 miles northerly of Bofton.—*Morse.*

Scarborough *Cove*, in the harbour of Chebucto, on the fouthern coaft of Nova-Scotia, is on the middle of the weft fide of Cornwallis Ifland. It is 5 or 6 furlongs broad, and nearly the fame in depth.—*ib.*

Scarborough, a town and fort in the ifland 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 increafe 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. Profeffor Beckmann, in the fecond volume of his Hiftory of Inventions, feems to have eftablifhed the following conclufions:

1ft, Scarlet, or the kermes-dye, was known in the Eaft in the earlieft ages, before Mofes, and was a difcovery of the Phœnicians in Paleftine, but certainly not of the fmall wandering Hebrew tribes. *2d*, *Tola* was the ancient Phœnician name ufed by the Hebrews, and even by the Syrians; for it is employed by the Syrian tranflator, Ifaiah, chap. 1. ver. 18. Among the Jews, after their captivity, the Aramæan word *zehori* was more common. *3d*, This dye was known alfo to the Egyptians in the time of Mofes; for the Ifraelites muft have carried it along with them from Egypt. *4th*, The Arabs received the name kermes, with the dye, from Armenia and Perfia, where it was indigenous, and had been long known; and that name banifhed the old name in the Eaft, as the name fcarlet has in the Weft. For the firft part of this affertion we muft believe the Arabs. *5th*, Kermes were perhaps not known in Arabia; at leaft they were not indigenous, as the Arabs appear to have had no name for them. *6th*, Kermes fignifies always *red dye*; and when pronounced fhort, it becomes *deep red.*

Concerning the origin of the name fcarlet, which was in ufe fo early as the 11th century, our author has many conjectures, which we need not tranfcribe, as he feems 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 $\frac{1}{4}$ 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 ate, 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.*

lick.

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 efflorefcentiam 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 *lectale*, *bride ale*, *clerk-ale*, and *church-ale*. To a *lect 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 of wheat, and in drink ten bufhels of mault, and in cheefe, twenty-pence, to give to poor people for the health of his foull; and he ordered that, after the deceafe of his wife, his executors and feoffees fhould continue the cuftom for evermore."

SCOTCH *Plains*, a village in Effex county, New-Jerfey, on a N. E. branch of Rariton river, between Weftfield and Turky; 11 miles weft of Elizabeth-Town, and as far northward of New-Brunfwick.—*Morse.*

SCOTLAND *Neck*, a village of N. Carolina, where is a poft office, 396 miles from Philadelphia.—*ib.*

SCOTLAND *River*, in the ifland of Barbadoes, is fcarcely deferving notice, otherwife than being almoft the only rivulet in the ifland, except St Jofeph's river, another fmall brook. It rifes in St Andrew's parifh, and falls into Long Bay on the eaftern fide of the ifland, 2½ miles north-weft of St Jofeph's river.—*ib.*

SCOTS *Bay*, on the fouth-weft coaft of the ifland of Dominica, towards the fouthern extremity of the ifland. It lies in St Martin's parifh, having Scots Head on the fouth, and Vaughan's Point on the north. —*ib.*

SCOTS *Cove*, on the fouth-weft part of the ifland of Jamaica.—*ib.*

SCOWHEGAN *Falls*, in Kennebeck river, in the Diftrict of Maine, are near the town of Canaan. Boats cannot pafs this fall.—*ib.*

SCOWRING OF STUFFS, is an art much more generally practifed than underftood. It fuppofes, fays Chaptal, 1ft, a knowledge of the different fubftances capable of ftaining any kind of cloth; 2d, of the fubftances to which recourfe muft be had, in order to make thofe depofited on the ftuff to difappear; 3d, a knowledge of the effects produced on colours by thofe re-agents, which it may be neceffary to employ to deftroy ftains; 4th, a knowledge of the manner in which the cloth is affected by thofe re-agents; 5th, of the art of reftoring a colour changed or faded. Of thofe bodies which occafion fpots on different kinds of cloth, fome are eafily diftinguifhed by their appearance, fuch as greafy fubftances; but others have more complex effects, fuch as acids, alkalies, perfpired matter, fruits, urine, &c. Acids redden black, fawn, violet, and puce-colour, and every fhade communicated with orchilla-weed, iron, aftringents, and every blue except indigo and pruffian 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 yellowifh, make yellow brownifh, and change the yellow produced by arnatto to aurora. Perfpired matter produces the fame effects as alkalies.

When the fpots are produced by fimple bodies on ftuffs, it is eafy to remove them by the means already known. Greafy fubftances are removed by alkalies, foaps, 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 ftuffs may be removed by the fulphureous acid, and ftill better by the oxygenated muriatic acid. But when the fpots are of a complex kind, it will be neceffary to employ feveral means in fucceffion. Thus, to deftroy the ftain of coom from carriage wheels, after the greafe has been diffolved, the oxyd of iron may be removed by the oxalic acid.

As colours are often changed by re-agents, it will be neceffary, in order to reftore them, that the fcowrer fhould poffefs a thorough knowledge of the art of dyeing, and how to modify the means according to circumftances. This becomes the more difficult, when it is neceffary to reproduce a colour fimilar to that of the reft of the ftuff, to apply that colour only in one place, and often to reftore the mordant by which it was fixed, and which has been deftroyed, or even the firft tint which gave the colour its intenfity. It may be readily conceived, that the means to be employed muft depend on the nature of the colour and the ingredients by which it was produced; for it is known that the fame colour may be obtained from very different bodies. Thus, after an alkali has been employed to deftroy an acid fpot on browns, violets, blues, poppies, &c. the yellow fpot which remains may be made to difappear by a folution of tin; a folution of fulphat of iron reftores the colour to brown ftuffs which have been galled; acids reftore to their former fplendour yellows which have been rendered dufky or brown by alkalies; blacks produced by logwood become red by acids; alkalies change thefe red fpots to yellow, and a little of the aftringent principle makes them again become black. A folution of one part of indigo in four parts of fulphuric acid, diluted with a fufficient quantity of water, may be employed with fuccefs to revive the blue colour of cotton or wool which has been changed. Scarlet may be revived by means of cochineal and a folution of the muriat of tin, &c.

The choice of re-agents is not a matter of indifference. Vegetable acids are preferable; the fulphureous acid, however, may be employed for ftains occafioned by fruit; it does not change the blue of filk nor colours produced by aftringents; it does not degrade the yellow of cotton. Ammonia fucceeds better than fixed alkalies in removing fpots produced by acids. It is employed in vapour; its action is fpeedy, and feldom alters the colour.

The means of removing greafy fpots are well known. This effect is produced by alkalies, fullers earth, volatile oils diffolved in alcohol, a heat proper for volatilizing greafe, &c. Spots occafioned by ink, ruft, or iron-mould of any kind, and all thofe produced by the yellow oxyd of iron, are removed by the oxalic acid: the colour may be reftored by alkalies, or a folution of the muriat of tin. Thefe fpots may be removed alfo by the oxygenated muriatic acid, when they are on white ftuffs or paper.

The action of alkalies, and that of perfpired matter, are the fame; their fpots may be effaced by acids, or even by a weak folution of the muriat of tin. When thefe fpots arife from feveral unknown caufes, in order to deftroy them, recourfe muft be had to polychreft compofitions. The following may be confidered as one of the moft efficacious: Diffolve white foap in alcohol, and mix this folution with the yolks of from four to fix eggs; add gradually effence of turpentine; and incorporate with the whole fome fullers earth, in fuch a manner as to form balls of a fuitable confiftence. Moiften the fpot; and having rubbed it with thefe balls, the

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.

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 fouth, the *afcending rema*. The current afcends or defcends at the rifing or fetting of the moon, and continues for fix hours. In the interval between each afcent or defcent, there is a calm which lafts at leaft a quarter of an hour, but not longer than an hour. Afterwards, at the rifing or fetting of the moon, the current enters from the north, making various angles of incidence with the fhore, and at length reaches the Calofaro. This delay fometimes continues two hours; fometimes it immediately falls into the Calofaro; and then experience has taught that it is a certain token of bad weather."

When our author obferved Charybdis from the fhore, it appeared like a group of tumultuous waters; which group, as he approached, became more extenfive and more agitated. He was carried to the edge, where he ftopped fome time to make the requifite obfervations; and was then convinced, beyond the fhadow of a doubt, that what he faw was by no means a vortex or whirlpool.

Hydrologifts teach us, that by a whirlpool in a running water we are to underftand that circular courfe which it takes in certain circumftances; and that this courfe or revolution generates in the middle a hollow inverted cone, of a greater or lefs depth, the internal fides of which have a fpiral motion. But Spallanzani perceived nothing of this kind in the Calofaro. Its revolving motion was circumfcribed to a circle of at moft 100 feet in diameter; within which limits there was no incurvation of any kind, nor vertiginous motion, but an inceffant undulation of agitated waters, which rofe, fell, beat, and dafhed on each other. Yet thefe irregular motions were fo far placid, that nothing was to be feared in paffing over the fpot, which he did; though their little bark rocked very much from the continual agitation, fo that they were obliged conftantly to make ufe of their oars to prevent its being driven out of the Calofaro. Our author threw fubftances of different kinds into the ftream. Such as were fpecifically heavier than the water funk, and appeared no more; thofe which were lighter remained on the furface, but were foon driven out of the revolving circle by the agitation of the water.

Though from thefe obfervations he was convinced that there was no gulph under the Calofaro, as otherwife there would have been a whirlpool, which would have carried down into it the floating fubftances; he determined to found the bottom with the plummet, and found its greateft depth did not exceed 500 feet. He was likewife informed, to his no fmall furprife, that beyond the Calofaro, towards the middle of the ftrait, the depth was double.

When the current and the wind are contrary to each other, and both in their greateft violence, efpecially when the fcilocco, or fouth wind, blows, the fwelling and dafhing of the waves within the Calofaro is much ftronger, more impetuous, and more extenfive. It then contains three or four fmall whirlpools, or even more, according to the greatnefs of its extent and violence. If at this time fmall veffels are driven into the Calofaro by the current or the wind, they are feen to whirl round, rock, and plunge, but are never drawn down into the vortex. They only fink when filled with water, by the waves beating over them. When veffels of a larger fize are forced into it, whatever wind they have they cannot extricate themfelves; their fails are ufelefs; and after having been for fome time toffed about by the waves, if they are not affifted by the pilots of the country, who know how to bring them out of the courfe of the current, they are furioufly driven upon the neighbouring fhore of the Lanterna, where they are wrecked, and the greater part of their crews perifh in the waves.

From thefe facts, the claffical reader will perceive, that the ancient defcriptions of Charybdis are by no means fo accurate as thofe of Scylla. The faying, however, which became proverbial among the ancients, viz. that "he who endeavours to avoid Charybdis, dafhes upon Scylla," is, in a great meafure, true. If a fhip be extricated from the fury of Charybdis, and carried by a ftrong foutherly wind along the ftrait towards the northern entrance, it will indeed pafs out fafely; but fhould it meet with a wind in a nearly oppofite direction, it would become the fport of both thefe winds, and, unable to advance or recede, be driven in a middle courfe between their two directions, that is to fay, full upon the rock of Scylla, if it be not immediately affifted by the pilots. It is likewife obferved, that in thefe hurricanes a land wind frequently rifes, which defcends from a narrow pafs in Calabria, and increafes the force with which the fhip is impelled towards the rock.

SEABROOK, a townfhip of New-Hampfhire, in Rockingham county, on the road from Portfmouth to Newbury-Port; about 16 miles foutherly 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 eaftern fhore which forms the entrance of Narraganfet Bay, in the State of Rhode-Ifland; about 6 miles eaft fouth-eaft of Newport.—*ib.*

SEAL *Ifland*, *Machias*, on the coaft of the Diftrict of Maine. From thence to Grand Manan Ifland the courfe is eaft-north-eaft 2 leagues; and to Matinicus Ifland weft-fouth-weft 26 leagues. N. lat. 44 27, weft long. 66 52.—*ib.*

SEAL *River*, in New North Wales, runs eaft to Hudfon's Bay, into which it empties eaftward of Moofe river.—*ib.*

SEA OTTER *Sound*, on the north-weft coaft of N. America, lies fouth-eafterly of the Hazy Iflands. N. lat. 55 18, weft long. 133 47 30.—*ib.*

SEARSBURGH, a townfhip of Vermont, Bennington county, 12 miles eaft of Bennington.—*ib.*

SEA-SICKNESS is a diforder which has been but little treated of, notwithftanding the frequency of its occurrence, and the irkfomenefs and diftrefs to which the patient is fubjected during its continuance. It has been found to be very beneficial in feveral difeafes, among which the principal are afthmatic and pulmonary complaints; and there are very few inftances of its being attended with fatal confequences. The fea-ficknefs feems to be a fpafmodic affection of the ftomach, produced by the alternate preffure and recefs of the contents of that vifcus againft its lower internal furface, according as the rife and fall of the fhip oppofes or recedes from the action of gravity.

The feas in which this diforder attacks the paffenger with the greateft violence, are thofe where the waves have long uninterrupted freedom of action; of courfe, bays, Sea-sickness.

bays, gulphs and channels, may be navigated with lefs inconvenience, as the waves, meeting with more frequent refiftance, and the repercuffion being confiderably ftronger, the veffel does not experience that gentle uniform vacillation which fickens the ftomach, and renders the head giddy. By the fame argument, a perfon feels lefs inconvenience from the diforder on the wide ocean in a fmall veffel, on which the flighteft motion of the waves makes a ftrong impreffion. He is likewife lefs expofed to it in a very large veffel, as in a fhip of the line, or a large merchantman deeply laden; as the waves, in this cafe, fcarcely affect the veffel. It is in fhips of the middling fize, and which carry but a light cargo, that the paffenger fuffers moft from the fea ficknefs. It has been obferved, that this diforder affects people in years lefs than young perfons; thofe of a dark lefs than thofe of a fair complection, and that it feldom attacks infants. The duration is not limited to any fixed period of time; with fome it lafts only a few days, with others weeks, months, and even during the whole courfe of the voyage. The fooner it takes place after embarkation, the greater probability is there of its continuance. It does not always ceafe immediately on landing, but has been known, in fome cafes, to continue for a confiderable time. Even the oldeft and moft fkilful feamen have experienced a relapfe, efpecially if they have quitted the fea fervice for a long term of years.

There have been many modes recommended for mitigating, if not entirely preventing, this diforder; among which the following feem the moft 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 ftrong exercife, with as little intermiffion as conveniently can be done; for inftance, to affift at the pumps, or any other active employment, as indolent and flothful paffengers always fuffer moft from the diforder.

3. To keep much upon deck, even in ftormy and rainy weather, as the fea breeze is lefs liable to affect the ftomach than the ftagnated air of the cabin, which is frequently rendered infectious for want of fufficient circulation.

4. Not to watch the motion of the waves, efpecially when ftrongly agitated with tempeft.

5. To avoid carefully all employments which harafs the mind, as reading, ftudy, meditation, and gaming; and on the other hand, to feek every opportunity of mirth and mental relaxation.

6. To drink occafionally carbonic acids, as the froth of ftrong fermented beer, or wine mixed with Seltzer water, and fermented with pounded fugar, or a glafs of Champaign.

7. It will be found of great fervice to take the acid of fulphur dulcified, dropped upon lump fugar, or in peppermint-water; or ten drops of fulphureous ether.

With regard to eating, it is advifable to be very fparing, at leaft not to eat much at one meal. The proper diet is bread and frefh meat, which fhould be eaten cold with pepper. All fweet favoured food fhould be carefully avoided; and the paffenger fhould refrain from fat, but efpecially from all meat that is in the leaft degree tainted. Even the odour of flowers is very pernicious; for which reafon, it is not expedient to examine marine productions, as thefe generally have a naufeating fmell. The fumes of vinegar may be inhaled with great benefit. The drink fhould confift of tart wines, lemonade, or Seltzer water, but never of common water. The paffenger would do well to drink little and often. As experience has proved, that an accidental diarrhœa has frequently relieved the patient from the fea-ficknefs, it will be prudent to follow the clue of nature, and take a gentle laxative, or, if circumftances will permit, a clyfter of falt-water and Venice foap, which is the more neceffary, as fea-faring people are liable to obftructions. It will further be found ufeful to apply to the pit of the ftomach a tonic anodyne antifpafmodic emplaftrum, fpread upon leather, and covered with linen.

Sea-ficknefs, ‖ Sebacook.

Where the above preventives have not been employed, or have not fucceeded in fecuring the paffenger from the fea-ficknefs, he may, however, experience confiderable relief from the following remedies:

If fymptoms of vomiting appear, they may frequently be remedied by the patient proftrating himfelf in a horizontal pofition, upon the back or belly, and lying perfectly ftill. We would recommend likewife a gentle compreffion of the abdomen. But if the fits of vomiting are too violent to be repreffed, in that cafe, it is beft to promote them by a ftrong dofe of falt-water; an expedient, however, which muft not be too often repeated, as it tends ftill more to weaken the ftomach. When the emetic takes effect, let the patient bend his body, advancing his knees towards his breaft, and fupport his head againft a firm and folid refting-place. He muft be particularly careful to untie his garters and cravat, as this precaution will fecure him from the rifk of a rupture, and from the ill effects of the blood rufhing violently towards the head and breaft.

After the vomiting has fubfided, its return may be guarded againft by preferving a ftate of repofe, and even keeping the eyes fhut for a confiderable time. Let the patient choofe a cool, ventilated place, remembering to keep himfelf warm and well clothed, as perfpiration is highly falutary. But he muft not indulge in too long fleep during the day-time, as this induces torpidnefs. In the morning he fhould conftantly take a gargle of fugar diffolved in vinegar. Let him eat often, but fparingly: and if he can content himfelf with a difh of chocolate, coffee, or ftrong tea, he will reap ftill greater benefit. He fhould never drink water in its pure elementary ftate, but mix it with brandy, vinegar, or wine. In the morning, inftead of brandy, he may take a glafs of wine, with an infufion of orange peel, gentian root, or peruvian bark (*quinquina*). A glafs of punch taken occafionally will prove of very effential fervice, as it promotes perfpiration.

Perfons in the habit of fmoking, will find a pleafant and falutary companion in the pipe; but thofe who are not accuftomed to it will be fufferers by taking to the practice.

In conclufion, it is proper to add, that warm clothing, flannel fhirts, trowfers, caps, &c. are efficacious remedies againft exceffive expectoration, and all other fymptoms of this terrible diforder.

SEBACO, an ifland on the weft coaft of Mexico, 12 miles north of Point Mariat, and 45 north-eaft of Quicara.—*Morse.*

SEBACOOK, or *Sebago*, a pond or lake of the

 Diftrict

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

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 *ape*, 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 those 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 neighbourhood, 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

(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 Santos. 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

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*.

* *Phil. Tranſ.* 1794, p. 107.

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 *ſagre*, 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 a tub

Shagreen. a tub filled with pure water, and fuffered to remain there for feveral days, till they are thoroughly foaked, and the hair has dropped off. They are then taken from the tub, one by one, extended on boards placed in an oblique direction againft a wall, the corners of them, which reach beyond the edges of the board, being made faft, and the hair with the epidermis is then fcraped off with a blunt iron fcraper called *urak*. The fkins thus cleaned are again put in pure water to foak. When all the fkins have undergone this part of the procefs, they are taken from the water a fecond time, fpread out one after the other as before, and the flefh fide is fcraped with the fame kind of inftrument. They are carefully cleaned alfo on the hair fide, fo that nothing remains but the pure fibrous tiffue, which ferves for making parchment, confifting of coats of white medullary fibres, and which has a refemblance to a fwine's bladder foftened in water.

"After this preparation, the workmen take a certain kind of frames called *pälzi*, made of a ftraight and a femicircular piece of wood, having nearly the fame form as the fkins. On thefe the fkins are extended in as fmooth and even a manner as poffible by means of cords; and during the operation of extending them, they are feveral times befprinkled with water, that no part of them may be dry, and occafion an unequal tenfion. After they have been all extended on the frames, they are again moiftened, and carried into the houfe, where the frames are depofited clofe to each other on the floor with the flefh fide of the fkin next the ground. The upper fide is then thickly beftrewed with the black exceedingly fmooth and hard feeds of a kind of goofe 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 fouth fide of the Volga; and that they may make a ftrong impreffion on the fkins, a piece of felt is fpread over them, and the feeds are trod down with the feet, by which means they are deeply imprinted into the foft fkins. The frames, without fhaking the feeds, are then carried out into the open air, and placed in a reclining pofition againft a wall to dry, the fide covered with the feeds being next the wall, in order that it may be fheltered from the fun. In this ftate the fkins muft be left feveral days to dry in the fun, until no appearance of moifture is obferved in them, when they are fit to be taken from the frames. When the impreffed feeds are beat off from the hair fide, it appears full of indentations or inequalities, and has acquired that impreffion which is to produce the grain of the fhagreen, after the fkins have been fubjected to the laft fmoothing or fcraping, and have been dipped in a ley, which will be mentioned hereafter, before they receive the dye.

"The operation of fmoothing is performed on an inclined bench or board, which is furnifhed with an iron hook, and is covered with thick felt of fheep's wool, on which the dry fkin may gently reft. The fkin is fufpended 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 fkin for extending it in its frame as before mentioned; and a cord, having at its extremity a ftone or a weight, is attached to each end of the fkin, to keep it in its pofition while under the hands of the workman. It is then fubjected to the operation of fmoothing and fcraping by means of two different inftruments. The firft ufed for this purpofe, called by the Tartars *tokar*, is a piece of fharp iron bent like a hook, with which the furface of the fhagreen is pretty clofely fcraped to remove all the projecting inequalities. This operation, on account of the corneous hardnefs of the dry fkin, is attended with fome difficulty; and great caution is at the fame time required that too much of the impreffion of the *alabuta* feed be not deftroyed, which might be the cafe if the iron were kept too fharp. As the iron, however, is pretty blunt, which occafions inequalities on the fhagreen, this inconvenience muft afterwards be remedied by means of a fharp fcraping iron or *urak*, by which the furface acquires a perfect uniformity, and only faint impreffions of the *alabuta* feed then remain, and fuch as the workman wifhes. After all thefe operations, the fhagreen is again put into water, partly to make it pliable, and partly to raife the grain. As the feeds occafion indentations in the furface of the fkin, the intermediate fpaces, by the operations of fmoothing and fcraping, lofe fome part of their projecting fubftance; but the points which have been depreffed, and which have loft none of their fubftance, now fwell up above the fcraped parts, and thus form the grain of the fhagreen. To produce this effect, the fkins are left to foak in water for 24 hours after which they are immerfed feveral times in a ftrong warm ley, obtained, by boiling, from a ftrong alkaline earth named *fchora*, which is found in great abundance in the neighbourhood of Aftracan. When the fkins have been taken from this ley, they are piled up, while warm, on each other, and fuffered to remain in that ftate feveral hours; by which means they fwell, and become foft. They are then left 24 hours in a moderately ftrong pickle of common falt, which renders them exceedingly white and beautiful, and fit for receiving any colour. The colour moft ufual for thefe fkins is a fea-green; but old experienced workmen can dye them blue, red, or black, and even make white fhagreen.

"For the green colour nothing is neceffary but filings of copper and fal ammoniac. Sal ammoniac is diffolved in water till the water is completely faturated; and the fhagreen fkins, ftill moift, after being taken from the pickle, are wafhed over with the folution on the ungrained flefh fide, and when well moiftened a thick layer of copper filings is ftrewed over them: the fkins are then folded double, fo that the fide covered with the filings is innermoft. Each fkin is then rolled up in a piece of felt; the rolls are all ranged together in proper order, and they are preffed down in an uniform manner by fome heavy bodies placed over them, under which they remain 24 hours. During that period, the folution of fal ammoniac diffolves a quantity of the cupreous particles fufficient to penetrate the fkin and to give it a fea-green colour. If the firft application be not fufficient, the procefs is repeated in the fame manner; after which the fkins are fpread out and dried.

"For the blue dye, indigo is ufed. 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 ftirred round till the colour begins to be diffolved. Five pounds of pounded *alakar*, which is a kind of barilla or crude foda, prepared by the Armenians and Calmucs, is then diffolved in it, with two pounds of lime and a pound of pure honey, and the whole is kept feveral days in the fun, 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 feen 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 2307810405, &c. In the fame book of Sherwin's may alfo be feen his ingenious improvements on the making of logarithms, and the conftructing of the natural fines, tangents and fecants.

He alfo calculated the natural and logarithmic fines, tangents, and fecants, to every fecond in the firft minute of the quadrant; the laborious inveftigation of which may probably be feen in the archives of the Royal Society, as they were prefented to Mr Patrick Murdoch for that purpofe; exhibiting his very neat and accurate manner of writing and arranging his figures, not to be equalled perhaps by the beft penman now living.

Mr Sharp kept up a correfpondence by letters with moft of the eminent mathematicians and aftronomers of his time, as Mr Flamfteed, Sir Ifaac Newton, Dr Halley, Dr Wallis, Mr Hodgfon, Mr Sherwin, &c. the anfwers to which letters are all written upon the backs, or empty fpaces, of the letters he received, in a fhort-hand of his own contrivance. From a great variety of letters (of which a large cheftful remain with his friends) from thefe and many other celebrated mathematicians, it is evident that Mr Sharp fpared neither pains nor time to promote real fcience. Indeed, being one of the moft accurate and indefatigable computers that ever exifted, he was for many years the common refource for Mr Flamfteed, Sir Jonas Moore, Dr Halley, and others, in all forts of troublefome and delicate calculations.

Mr Sharp continued all his life a bachelor, and fpent his time as reclufe as a hermit. He was of a middle ftature, but very thin, being of a weakly conftitution. He was remarkably feeble the laft three or four years before he died, which was on the 18th of July 1742, in the 91ft year of his age.

In his retirement at Little Horton, he employed four or five rooms or apartments in his houfe for different purpofes, into which none of his family could poffibly enter at any time without his permiffion. He was feldom vifited by any perfons, except two gentlemen of Bradford, the one a mathematician, and the other an ingenious apothecary; thefe were admitted, when he chofe to be feen by them, by the fignal of rubbing a ftone againft a certain part of the outfide wall of the houfe. He duly attended the diffenting 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 fuffered to be taken fingly 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 afking a fingle queftion.

Mr Sharp was very irregular as to his meals, and remarkably fparing in his diet; which he frequently took in the following manner. A little fquare hole, fomething like a window, made a communication between the room where he was ufually employed in calculations, and another chamber or room in the houfe where a fervant could enter; and before this hole he had contrived a fliding board: the fervant always placed his victuals in this hole, without fpeaking or making any the leaft noife; and when he had a little leifure, he vifited his cupboard to fee what it afforded to fatisfy his hunger or thirft. But it often happened, that the breakfaft, dinner, and fupper, have remained untouched by him when the fervant has gone to remove what was left—fo 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 poft-town of Maryland, Wafhington county, about 2 miles from Patowmack river, and nearly oppofite to Shepherdftown, in Virginia, at the mouth of Shenandoah river. It contains a church, and about 250 houfes. 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 fame as SHASTER; which fee, *Encycl.*

SHAWANEE, and *Shavanon;* the former the Indian, and the latter the French name of Cumberland river, in the State of Tenneffee. It is alfo called *Shawanoe.*—*Morse.*

SHAWANESE, or *Shawanoes*, an Indian nation, great numbers of whom have joined the Creek confederacy. They have 4 towns on the Tallapoofee 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 fum in hand, and 1000 dollars a year forever, in goods. They inhabit alfo on Scioto river, and a branch of the Mufkingum, and have their hunting-grounds between Ohio river and Lake Erie. They are generally of a fmall fize, rather handfome in their features, and are a very cheerful and crafty people. Counfelling among their old people, and dancing among their young men and women, take up a great part of their time.—*ib.*

SHAWANGUNK, a townfhip in Ulfter county, New-York; bounded eafterly by Newburgh and Marlborough, and foutherly by Montgomery and the Platte Kill. It contains 2,128 inhabitants; of whom 323 are electors, and 350 flaves. It is 20 miles from Gofhen, and 12 from New-Paltz.—*ib.*

SHAWSHEEN, a confiderable ftream of Maffachufetts, which rifes in Bedford, in Middlefex county, and, paffing through Billerica, Tewkfbury and Andover, difcharges itfelf 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. Thefe 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 itfelf very much refembles the American oak; and the fruit, from the kernel of which being firft dried in the fun the butter is prepared, by boiling the kernel in water, has fomewhat the appearance of a Spanifh olive. The kernel is enveloped in a fweet pulp, under a thin green rind; and the butter produced from it, befides the advantage of its keeping the whole year without falt, is whiter, firmer, and, Mr Park fays, to his palate, of a richer flavour than the beft butter which he ever tafted made from cows milk. The growth and preparation of this commodity, feem to be among the firft objects of African induftry in this and the neighbouring ftates; and it conftitutes a main article of their inland commerce. In fome places they

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.

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 answerers

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

 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 establshed."

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 hypocrify and bluftering courage are very properly chaftifed. He died on the 1ft of Auguft 1788, leaving, among thofe who knew him beft, the character of a benevolent man; a character which, from the manner in which he fpeaks of his connections, he probably deferved.

SHECATICA, a bay of very irregular fhape and breadth, on the coaft of Labrador, N. America; having an ifland of its name at its mouth. It is fituated between lat. 51 14 and 51 28 N. and between long. 58 16 and 58 22 W.—*Morfe.*

SHECHARY, a lake of New North Wales, formed like a bow. It receives Churchill river from the fouth-weft and at its N. E. end has communication with Berbazon Lake, which lies due N. and fouth. At the fouth end of the latter, the waters of both lakes run eaft under the name of Seal river, which empties into Hudfon's Bay at Churchill Fort, between Button's Bay on the N. and Cape Churchill on the fouth-eaft. Both lakes are long and narrow.—*ib.*

SHEDIAC, a harbour on the eaftern coaft of New-Brunfwick, and on the weft fide of the Gulf of St Lawrence; 53 miles fouth-eaft of Miramichi Bay.—*ib.*

SHEEPSCOT, or *Sheepfcut*, a fmall river of the Diftrict of Maine, which empties into the ocean to the eaft of Kennebeck, and is navigable 20 or 30 miles. On the weft fide of this river is the excellent port called Wifcaffet, in the townfhip of Pownalborough. Newcaftle townfhip is at the head of navigation on this river, and extends from Sheepfcot to Damarifcotta river. The compact part, which is a poft-town, is 10 miles north-eaft of Wifcaffet. Sheepfcot harbour has high water, at full and change, 45 minutes after 10 o'clock; depth, 9 fathoms.—*ib.*

SHEEP's *Cove*, on the eaft coaft of Newfoundland, lies between Bay Robert and Port Grave.—*ib.*

SHEERS, aboard a fhip, an engine ufed to hoift or difplace the lower mafts of a fhip.

SHEFFIELD, a townfhip in the northern part of Caledonia county, Vermont.—*Morfe.*

Sheffield, a poft-town of Maffachufetts, Berkfhire county, 30 miles fouth-eaft of Hudfon in the State of New-York, 145 weft-fouth-weft of Bofton, and 257 north-eaft of Philadelphia. It was incorporated in 1733, and contains 1,899 inhabitants. Houfatonic river, which is nine rods in breadth, paffes through it from north to fouth, which with its branches fupply water for feveral mills and iron-works. South Mountain extends the whole length of the town, along the eaft fide of the river.—*ib.*

SHEIBON, a diftrict in Africa, lying to the fouth-eaft of the kingdom of Dar-Fur (See Soudan in this volume), where much gold is found both in duft and in fmall pieces. The natives, who are idolaters and favages, collect the duft in quills of the oftrich and vulture, and in that condition fell it to the merchants. They have a ceremony on difcovering a large piece of gold, of killing a fheep on it before they remove it. The people, who are all black, have fome form of marriage, *i. e.* of an agreement between man and woman to cohabit. Women of full age wear a piece of platted grafs on their parts. The younger and unmarried are quite naked. The flaves, which are brought in great numbers from this quarter, are fome prifoners of war among themfelves (for their wars are frequent), and fome feduced by treachery, and fold. But it is faid to be a common practice for a father in time of fcarcity to fell his children.

At Sheibon are fome Mohammedans, who live among the idolaters, and wear clothing: it is not faid whether Arabs or not. Mr Browne, from whofe travels we have taken this account of Sheibon, does not give its latitude or longitude.

SHELBURNE, a townfhip of Vermont, Chittenden county, on the eaft fide of Lake Champlain. It has Burlington on the north, and Charlotte on the fouth, and contains 389 inhabitants.—*Morfe.*

Shelburne, an interior townfhip in Grafton county, New-Hampfhire. It was incorporated in 1769, and contains 35 inhabitants.—*ib.*

Shelburne, a townfhip in Hampfhire county, Maffachufetts, adjoining Greenfield.—*ib.*

Shelburne, a town of Nova-Scotia, at the head of a bay which runs up from Port Rofeway, at the fouth-weft part of the province. In 1783, it contained 600 families, but is now lefs populous. It is 18 miles north eaft of Barrington, and 88 fouth-weft by fouth of Halifax.—*ib.*

SHELBY, a new county of Kentucky.—*ib.*

SHELTER *Ifland*, at the eaft end of Long Ifland, in Suffolk county, New-York, lies 3 leagues weft of Gardener's Ifland. It is about 5 miles from eaft to weft, and 7 from north to fouth. It is a fruitful fpot, containing about 8000 acres; was incorporated in 1788, and contains 201 inhabitants, of whom 34 are electors. Confiderable numbers of cattle, fheep and poultry are raifed here. When you leave Shelter Ifland on your larboard hand, and run weft by north about 5 or 6 miles, you will open a large bay where 100 fail of veffels may lie fafe and anchor in 3 or 4 fathoms.—*ib.*

SHENANDOAH, a county of Virginia, bounded north by Frederick, and fouth by Rockingham. It contains 10,510 inhabitants, including 512 flaves. Chief town, Woodftock.—*ib.*

Shenandoah, a river of Virginia, which rifes in Augufta county, and after running a north-eaft courfe of about 200 miles, it joins the Patowmack in about lat. 38 4, juft before the latter burfts through the Blue Ridge. It is navigable about 100 miles; and may be rendered fo nearly its whole courfe at a fmall expenfe. When this is done, it will bear the produce of the richeft part of the ftate.—*ib.*

Shenandoah *Valley*, extends from Winchefter, in Virginia, to Carlifle and the Sufquehannah, in Pennfylvania, and is chiefly inhabited by Germans and Dutch.—*ib.*

SHEPHERDSFIELD, a plantation of the Diftrict of Maine, in Cumberland county, containing 330 inhabitants.—*ib.*

SHEPHERDSTOWN, or *Shepherdfburg*, a poft-town of Virginia, fituated in Berkley county, on the fouth fide of Patowmack river. Its fituation is healthy and agreeable, and the neighbouring country is fertile and well cultivated. It contains about 2000 inhabitants, moftly of German extraction. It lies at the mouth of Shenandoah river, oppofite to Sharpfburg; 10 miles eaft by fouth of Martinfburg, and 178 fouth-weft by weft of Philadelphia.—*ib.*

SHERBURNE, a townfhip of New-York, Herkemer

Shetucket, || Ship.

mer 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 dimenſions.

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

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.

"1*ſt*, 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.

"2*d*, 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.

"3*d*, 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, || Sideling.

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 212 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 *Seara*, 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 Trielle 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.

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 *Kalam 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,

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 plantains;

Siwa.

plantains; and the gardens are remarkably flourifhing. They cultivate a confiderable quantity of rice, which, however, is of a reddifh hue, and different from that of the Delta. The remainder of the cultivable land furnifhes wheat enough for the confumption of the inhabitants. Water, both falt and frefh, abounds, but the fprings which furnifh the latter are moft of them tepid; and fuch is the nature of the water, air, and other circumftances, that ftrangers are often affected with agues and malignant fevers.

The greateft curiofity about Siwa is a ruin of undoubted antiquity, which, according to Mr Browne, refembles too exactly thofe of the Upper Egypt, to leave a doubt that it was erected and adorned by the fame intelligent race of men. The figures of Ifis and Anubis are confpicuous among the fculptures; and the proportions are thofe of the Egyptian temples, though in miniature. What of it remains is a fingle apartment, built of maffy ftones, of the fame kind as thofe of which the pyramids confift; and covered originally with fix large and folid 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, fituated at one extremity, forms the principal entrance; and two doors, alfo near that extremity, open oppofite to each other. The other end is quite ruinous; but, judging from circumftances, 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 lefs fo as there are remains of fculpture on the exterior of the walls. In the interior are three rows of emblematical figures, apparently defigned to reprefent a proceffion; and the fpace between them is filled with hieroglyphic characters, properly fo called. The people of Siwa have no tradition concerning this edifice, nor attribute to it any quality, but that of concealing treafures, and being the haunt of demons. It has, however, been fuppofed, with fome 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 fo; 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 poffible enquiry. "It may (as he obferves) ftill furvive the lapfe of ages, yet remain unknown to the Arabs, who traverfe the wide expanfe of the defert; but fuch a circumftance is fcarcely probable. It may be completely overwhelmed in the fand; but this is hardly within the compafs of belief."

The complexion of the people of Siwa is generally darker than that of the Egyptians. Their dialect is alfo different. They are not in the habitual ufe either of coffee or tobacco. Their fect is that of Malik. The drefs of the lower clafs is very fimple, they being almoft naked: among thofe whofe coftume was difcernible, it approaches nearer to that of the Arabs of the defert than of the Egyptians or Moors. Their clothing confifts of a fhirt of white cotton, with large fleeves, and reaching to the feet: a red Tunifine cap, without a turban; and fhoes of the fame colour. In warm weather they commonly caft on the fhoulder a blue and white cloth, called in Egypt *melayé;* and in winter they are defended from the cold by an *ihhram* or blanket. The lift of their houfehold furniture is very fhort; fome earthen ware made by themfelves, and a few mats, form the chief part of it, none but the richer order being poffeffed of copper utenfils. They occafionally purchafe a few flaves from the Murzouk caravan. The remainder of their wants is fupplied from Cairo or Alexandria, whither their dates are tranfported, both in a dry ftate and beaten into mafh, which when good in fome degree refembles a fweat 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 nourifhment. The remainder confifts of thin fheets of pafte, 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 ftate they drink it, the power of inebriating. Their domeftic animals are, the hairy fheep and goat of Egypt, the afs, and a very fmall 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 falt for many weeks. Siwa is fituated in 29° 12′ N. Lat. and 44° 54′ E. Long.

Six M[en's]

SIX MEN'S *Bay*, on the weft fide of the ifland of Barbadoes, towards the N. end. It lies between Sunderland Fort to the fouth, and Six Men's Fort to the N.—*Morse.*

Six N[ations]

SIX NATIONS, a confederacy of Indian nations fo called by the Britifh and Americans, The French call them Iroquois. Formerly they were called the Five Nations, five only being joined in that alliance; but they now confift of fix nations, and call themfelves *Aganufchioni*, that is, the *United People*. Some call them *Mingos;* others *Maquais*. Thefe fix nations are the *Mohawks*, *Oneidas; Onondagas*, *Senecas*, *Cayugas*, and *Tufcaroras*. 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 Congrefs, and their towns all deftroyed. They now live on grounds called the State Refervations, which are intermediate fpaces fettled on all fides by white people. In their prefent cramped fituation, 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 fouls in all the fix 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 reft 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 refiding with them, on the other part, it was ftipulated that "the fum of 4,500 dollars fhould be expended annually and forever, in purchafing cloathing, domeftic animals, implements of hufbandry, and other utenfils, and in compenfating ufeful artificers who fhall refide among them, and be employed for their benefit." This allowance is under the direction of a fuperintendant, and is not diftributed for any private purpofes. It is apportioned among them according to their numbers, in order to which, there is annually taken an exact cenfus of all thefe 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 seabear 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 M'Kenzie'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 proportinnal, 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, 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 fequently have on vegetation an action different from that of common ice. The experiments of Dr Ingenhoufs on the germination of feeds have taught us, that the prefence and contact of oxygen are abfolutely neceffary for the plant to expand. They have fhewn alfo, that the more abundant the oxygen is, the more rapidly will the feeds grow. Moft plants fuffered to attain to their perfect maturity fhed on the earth a part of their feed. Thefe feeds, thus abandoned and expofed to the action of cold, are preferved by the fnow which covers them, at the fame 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 feeds that would have perifhed to grow, to expand, and to augment the number of the plants that cover the furface of the earth.

A very confiderable number of the plants which are employed in Europe for the nourifhment of men, are fown in the months of September, October, and November. The feeds of feveral of thefe germinate before the cold commences its action upon them, and changes the principle of their life. The fnow which covers the reft, acting on the germ by its oxygenation, obliges them to expand, and to increafe the number of ufeful plants which the farmer and gardener commit to the earth, and confequently to multiply their productions.

Here, then, we have three effects of fnow upon vegetation, all very different, which contribute each feparately to increafe, every year, the number of our plants; to give them more vigour, and confequently to multiply our crops. Thefe effects are: 1. To prevent the plants from being attacked by the cold, and from being changed or perifhing by its force. 2. To furnifh vegetables with continual moifture, which helps them to procure thofe fubftances neceffary for their nutrition, and to preferve them in a ftrong healthy ftate. 3. To caufe a greater number of feeds to germinate, and confequently to increafe the number of our plants.

SNOWHILL, a port of entry and poft-town of Maryland, and the capital of Worcefter county, fituated on the S. E. fide of Pokomoke river, which empties through the eaftern fhore of Chefapeak Bay, about 12 miles to the fouth-weft. Here are about 60 houfes, a court-houfe, 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 fettlement in Lincoln county, Diftrict of Maine; fituated between the Weft Ponds, 7 or 8 miles W. of Sidney, oppofite to Vaffalborough, and N. W. of Hallowell.—*ib.*

SOAP. See Chemistry *Index*, Suppl.

SOCANDAGA, or *Sagendaga*, the W. branch of Hudfon's river, runs a fouth and fouth-eaft courfe, and, about 15 miles from its mouth, takes a north-eaft direction, and joins that river about 12 or 15 miles W. by N. of Fort Edward.—*Morse.*

SOCIETY *Iflands*, a clufter of iflands in the S. Pacific Ocean. To thefe iflands Capt. Cook was directed by Tupia, in 1769; and he gave them this name in honour of the Royal Society. They are fituated 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 Ifland*, which is here included, as being fubject to Huaheine. The foil, the productions, the people, their language, religion, cuftoms, and manners are fo nearly the fame 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 greateft token of friendfhip. Their morais are differently conftructed, though ferving the fame purpofes. It is cuftomary to give their daughters to ftrangers who arrive amongft them; but the pairs muft be five nights lying near each other, without prefuming to take any other liberty. On the fixth evening, the father of the young woman treats his gueft with food, and informs his daughter, that fhe muft that night receive him as her hufband. The ftranger muft not exprefs the leaft diflike, fhould the partner allotted to him be ever fo difagreeable; for this is confidered as an unpardonable affront, and is punifhed with inftant 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 almoft as broad. It does not produce much corn, but great quantities of cocoa and indigo.—*ib.*

Soconusco *Port*, on the W. coaft of New-Mexico, capital of the province of Soconufco, in which are the mountains of this name. N. lat. 15 12, W. long. 98 16.—*ib.*

SOCORA, an ifland on the coaft of South-America.—*ib.*

SODUS, *Great*, a gulf connected with the fouth fide of Lake Ontario, by a fhort and narrow entrance. It is about 8 miles long, and 4 broad, and has an ifland in the eaftern part. The town called Sodus, ftands on the W. fide, near the S. W. part of the bay, or gulf; about 24 miles north of Geneva, 35 fouth weftward of Ofwego Fort, and 100 eaft of Niagara.—*ib.*

SOIL *Cove*, a fettlement on Defert Ifland in the Diftrict of Maine.—*ib.*

SOLANGO, an ifland on the coaft of Peru; 21 miles N. by W. from Colanche river, and 12 fouth of Port Callo.—*ib.*

SOLAR, *Morro*, or *Cape Solar*, on the coaft 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 foldering filver, brafs, and iron: but there are other metals which muft fometimes be foldered; and the following account of different folders, taken from the *Philofophical Magazine*, may be ufeful to many of our readers.

"When lead, tin, and bifmuth, are mixed in a certain proportion, they produce a metal exceedingly fufible, which is known by the name of *foft folder:* but which, from its fingular properties, may be applied with advantage to many other ufeful purpofes. Newton, and after him Kraft and Mufchenbroek, obferved, that five parts of bifmuth, three of tin, and two of lead, alfo five parts of bifmuth, four of tin, and one part of lead, melted with a heat of 220 degrees of Fahrenheit; and

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

them loofe into the market place. Our author tamed two lions, of which one acquired moft of the habits of a dog. He fatiated himfelf twice a week with the offal of the butchers, and then commonly flept for feveral hours fucceffively. 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 faw them difagree, nor fhew any fign of ferocity towards the human race. Even lambs paffed them unmolefted.

Among the birds, the *vultur perenopterus*, or white-headed vulture, is moft worthy of notice. It is of furprifing ftrength, and is faid by the natives to be very long-lived, *fed fides penes auctores*. "I have lodged (fays Mr Browne) a complete charge of large fhot, at about 50 yards diftance, in the body of this bird: it feemed to have no effect on him, as he flew to a confiderable diftance, and continued walking afterwards. I then difcharged the fecond barrel, which was loaded with ball: this broke his wing; but on my advancing to feize him, he fought with great fury with the other. There are many thoufands of them in the inhabited diftrict. 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 fubftance, not unlike the fpur of an old cock. It is ftrong and fharp, and a formidable inftrument of attack. Some fluid exudes from this bird that fmells like mufk; but from what part of him I am uncertain." The ferpents found in Soudan are the fame as in Egypt; but the natives have not the art of charming them, like the Egyptians. The locuft of Arabia is very common, and is frequently roafted and eaten, particularly by the flaves.

In Dar-Fur there feems to be a fcarcity of metals; but in its neighbourhood to the fouth and weft 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 fineft quality, in colour refembling that of China, and appears to contain a portion of zinc, being of the fame pale hue. Iron is found in abundance; but they have not yet learned the art of converting it into fteel. Silver, lead, and tin, our author never heard mentioned in Soudan, but as coming from Egypt; but of gold, in the countries to the eaft and weft, the fupply is abundant. Alabafter, and various kinds of marble, are found within the limits of Fur, as is foffil falt within a certain diftrict; and there is a fufficient fupply of nitre, of which, however, no ufe is made.

The reftraint under which Mr Browne was kept in this inhofpitable country, prevented him from making a full catalogue of its vegetable productions. Of the trees which fhade our forefts or adorn our gardens in Europe, very few exift in Dar-Fur. The characteriftic marks of thofe fpecies which moft abound there, are their fharp thorns, and the folid and unperifhable quality of their fubftance. They feem to be much the fame as thofe which Bruce found in Abyffinia. There is a fmall 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 fingly to the fmaller branches, and interfperfed among the leaves. The internal ftructure of the fruit is not very unlike the grape, which it alfo refembles in fize: but the pulp is of a red hue, and the tafte is ftrongly aftringent. The water-melon *(cucurbita citrullus)* grows wild over almoft all the cultivable lands, and ripens as the corn is removed. In this ftate it does not attain a large fize. The infide is of a pale hue, and has little flavour. As it ripens, the camels, affes, &c. are turned to feed on it, and it is faid to fatten them. The feeds, as they grow blackifh, are collected to make a kind of tar, *kutran*. Thofe plants of the melon which receive artificial culture grow to a large fize, and are of exquifite flavour. Tobacco is produced in abundance; and our author fpeaks of cochineal as found in Dar-Fur, or fome of the neighbouring countries.

The harveft is conducted in a very fimple manner. The women and flaves of the proprietor are employed to break off the ears with their hands, leaving the ftraw ftanding, which is afterwards applied to buildings and various other ufeful purpofes. They then accumulate them in bafkets, and carry them away on their heads. When thrafhed, which is aukwardly and incompletely performed, they expofe the grain to the fun till it become quite dry; after this a hole in the earth is prepared, the bottom and fides 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 preferved tolerably well. In ufing it for food, they grind it, and boil it in the form of polenta, which is eaten either with frefh or four milk, or ftill more frequently with a fauce made of dried meat pounded in a mortar, and boiled with onions, &c. The Furians ufe little butter; with the Egyptians and Arabs it is an article in great requeft. There is alfo another fauce which the poorer people ufe and highly relifh; it is compofed of an herb called *cowel* or *cawel*, of a tafte in part acefcent and in part bitter, and generally difagreeable to ftrangers.

The magiftracy of one, which feems tacitly, if it be not exprefsly, favoured by the difpenfation of Mohammed, as in moft other countries profeffing that religion, prevails in Dar-Fur. The monarch indeed can do nothing contrary to the Koran, but he may do more than the laws eftablifhed thereon will authorife; and as there is no council to controul or even to affift him, his power may well be termed defpotic. He fpeaks in public of the foil and its productions as his perfonal property, and of the people as little elfe than his flaves.

His power in the provinces is delegated to officers, who poffefs an authority equally arbitrary. In thofe diftricts, which have always, or for a long time, formed an integral part of the empire, thefe officers are generally called *Meleks*. In fuch as have been lately conquered, or, perhaps more properly, have been annexed to the dominion of the Sultan under certain ftipulations, the chief is fuffered to retain the title of Sultan, yet is tributary to and receives his appointment from the Sultan of Fur.

Defpotic and arbitrary as he is, the Sultan here does not feem wholly inattentive to that important object, agriculture. Neverthelefs, it may be efteemed rather a blind compliance with ancient cuftom, than individual public fpirit, in which has originated a practice adopted by him, in itfelf fufficiently laudable, fince other of his regulations by no means conduce to the fame end.

At

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.

* Abou century a half a

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

lian beads. 6. Beads of Venice. 7. Agate. 8. Rings, filver and brafs, for the ancles and wrifts. 9. Carpets, fmall. 10. Blue cotton cloths of Egyptian fabric. 11. White cotton ditto. 12. Indian muflins and cottons. 13. Blue and white cloths of Egypt, called *Melayes*. 14. Sword-blades, ftrait (German), from Cairo. 15. Small looking glaffes. 16. Copper face-pieces, or defenfive armour for the horfes heads. 17. Fire arms. 18. Kohhel for the eyes. 19. Rhea, a kind of mofs from European Turkey, for food and a fcent. 20. *She*, a fpecies of abfynthium, for its odour, and as a remedy: both the laft fell to advantage. 21. Coffee. 22. *Mahleb*, *Krumphille*, *Symbille*, *Sandal*, nutmegs. 23. *Dufr*, the fhell of a kind of fifh in the Red Sea, ufed for a perfume. 24. Silk unwrought. 25. Wire, brafs and iron. 26. Coarfe glafs beads, made at Jerufalem, called *herfh* and *munjur*. 27. Copper culinary utenfils, for which the demand is fmall. 28. Old copper for melting and reworking. 29. Small red caps of Barbary. 30. Thread linens of Egypt—fmall confumption. 31. Light French cloths, made into benifhes. 32. Silks of Scio, made up. 33. Silk and cotton pieces of Aleppo, Damafcus, &c. 34. Shoes of red leather. 35. Black pepper. 36. Writing paper *(papier des trois lunes)*, a confiderable article. 37. Soap of Syria.

The goods tranfported to Egypt are, 1. Slaves, male and female. 2. Camels. 3. Ivory. 4. Horns of the rhinoceros. 5. Teeth of the hippopotamus. 6. Oftrich feathers. 7. Whips of the hippopotamus's hide. 8. Gum. 9. Pimento. 10. Tamarinds, made into round cakes. 11. Leather facks for water *(ray)* and dry articles *(geraub)*. 12. Peroquets in abundance, and fome monkeys and Guinea fowls. 13. Copper, white, in fmall quantity.

SOUEYAWAMINECA, a Canadian fettlement, in lat. 47 17 30 N.—*Morse*.

SOUFFRIERE, a fmall town, fituated at the bottom of a bay, towards the leeward extremity of the ifland of St Lucia. There is nothing in the town itfelf which could have entitled it to notice in this work; but the ground about it is very remarkable. It has been defcribed by different authors; and our readers will probably not be ill-pleafed with the following defcription of this wonderful fpot by Dr Rollo.

"Souffriere (fays he) is furrounded by hills covered with trees, the declivities of which, and every part capable of produce, are cultivated, and afford good fugarcane. This place has its marfhes, but not fo extenfive, or fo much to windward as thofe about Carenage.

"The extremity of the fouth fide of Souffriere Bay runs into two fteep hills of a conical figure, which are nearly perpendicular: they are reckoned the higheft on the ifland, and are known by the name of the *Sugar-Loaf Hills*. From their height and ftraitnefs it is impoffible to afcend them: we were told it was once attempted by two negroes, but they never returned. They are covered with trees and fhrubs, and are the fhelter of goats, feveral of which fometimes defcend, and are fhot by the natives.

"After you pafs the hills to windward of Souffriere, a fine clear and level country prefents itfelf. From the back of the Sugar Loaf Hills, and all along the feacoaft, to the diftance, we fuppofe, of from fifteen to twenty miles, this flat or level extends: it is all cultivated and divided into rich eftates, affording fugar-cane equal to any in our iflands. This beautiful fpot is interfected by many rivers of very clear water, and thefe are conducted by art to the purpofe of fugar making. The rains in this part are lefs frequent than on any other part of the ifland; however, they have often a proportion more than fufficient. The wind here blows from the fea, or nearly fo.

"We cannot finifh this defcription without taking notice of a volcano in the neighbourhood of Souffriere. You pafs over one or two fmall hills to the fouthward of the town, and before any mark of the place is perceived you are fenfible of the fmell of fulphur. The firft thing you difcern is a rivulet of black running water, fending forth fteams as if nearly boiling. From the profpect of this you foon open on the volcano, which appears in a hollow, furrounded clofe on every fide by hills. There are only two openings; the one we entered, and another almoft oppofite to it on the north fide. In the hollow there are many pits of a black and thick boiling matter, which feems to work with great force. Lava is flowly thrown out; and in the centre of the hollow there is a large mafs of it, forming a kind of hill. This we afcended; but were foon obliged to return from the exceffive heat. The lava is a fulphur mixed with a calcareous earth and fome faline body. We found fmall quantities of alum in a perfect ftate. In the opening, at the north fide of the hollow, there is a rivulet of very good water. On ftirring the bottom, over which this water runs, we were furprifed with feeling it very hot; and on placing a tumbler filled with fome of the water clofe to the bottom of the rivulet, it foon became fo hot as not to be touched. The liquid which runs from the pits is ftrongly impregnated with fulphur, and refembles a good deal the preparation fold in the fhops, known by the name of *aqua fulphurata*, or *gas fulphuris*."

SOUND BOARD, the principal part of an organ, and that which makes the whole machine play. This foundboard, or fummer, is a refervoir into which the wind, drawn in by the bellows, is conducted by a port-vent, and thence diftributed into the pipes placed over the holes of its upper part. This wind enters them by valves, which open by preffing upon the ftops or keys, after drawing the regifters, which prevent the air from going into any of the other pipes befide thofe it is required in.

Sound Board denotes alfo a thin broad board placed over the head of a public fpeaker, to enlarge and extend or ftrengthen his voice.

Sound-boards, in theatres, are found by experience to be of no fervice; their diftance from the fpeaker being too great to be impreffed with fufficient force. But found-boards immediately over a pulpit have often a good effect, when the cafe is made of a juft thicknefs, and according to certain principles.

Sound-Poft, is a poft placed withinfide of a violin, &c. as a prop between the back and the belly of the inftrument, and nearly under the bridge.

SOUTH, a fhort river of Anne Arundel county, Maryland, which runs eafterly into Chefapeak Bay. Its mouth is about 6 miles fouth of Annapolis city, and is navigable in veffels of burden 10 or 12 miles.—*Morse*.

SOUTH *Amboy*, a townfhip of New-Jerfey, Middlefex county, and contains 2,626 inhabitants, including 183 flaves.—*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 those 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, South-Carolina.

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 draft 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 overflow-ing

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 superb

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 Mississippi 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, Spallanzani.

matics, 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; *Lucchefini*, 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 ſound 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

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.

Spallanzani.

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 thoſe 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 *(rotifère* 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 furface of liquors and moift fubftances, the feeds of which he fhews to float in the air; and he remarks that thefe microfcopic champignons or mufhrooms diftinguifh themfelves from other plants by their tendency to grow in all directions, without conforming to the almoft univerfal law of perpendicularity of ftalk to the ground.

Spallanzani was placed at the head of the univerfity's cabinet of natural hiftory, but he was little more than titular depofitary of a treafure which no longer exifted. He laid the foundations, however, for its renewal, and by his care it is become one of the moft precious and ufeful. He enriched it through his repeated travels by land and fea, in Europe, in Afia, acrofs the Apennines, the Alps, the Krapacks, at the bottom of mines, on the top of volcanoes, at the mouth of craters: fupported by his ardent paffion in the midft of perils, he preferved the *fang froid* of the philofopher to contemplate thefe wonders, and the piercing eye of an obferver to ftudy them. It is thus that he always diftinguifhed the proper objects for improving fcience by favouring inftruction; it is thus that he filled this depofitary with treafures, that all the gold in the world could not have obtained, becaufe gold never fupplies the genius and the difcernment of the enlightened naturalift.

In 1779 Spallanzani ran over Switzerland and the Grifons; he then went to Geneva, where he fpent a month with his friends, who admired him the more in his converfations after having admired him in his writings. He then returned to Pavia, and publifhed, in 1780, two new volumes of his *Differtazione di Fifica Animale e Vegetabile.* He therein reveals the fecrets of the interpretation of two very obfcure phenomena, concerning the vegetable and animal economy.

Some experiments made by Spallanzani upon *digeftion*, for his leffons, engaged him to ftudy this dark operation: he repeated Reaumur's experiments upon the gallinaceous birds; and he obferved that the trituration, which is in this cafe an aid to digeftion, could not, however, be a very powerful means. He faw that the gizzard of thofe birds which pulverife the ftones of fruit to pieces, as if done with needles or other fharp-pointed inftruments, did not digeft the powder fo formed: that it was neceffary it fhould undergo a new operation in the ftomach, before it could become fit chyle for affording the elements of the blood and other humours. He eftablifhed the point, that the digeftion was performed in the ftomach of numerous animals by the powerful action of a juice which diffolves the aliments; and to render his demonftration the more convincing, he had the courage to make feveral experiments on himfelf which might have proved fatal, and had the addrefs to complete his proofs by artificial digeftions, made in glaffes upon the table, by mixing the chewed aliments with the gaftric juice of animals, which he knew how to extract from their ftomachs. But this book, fo original by the multitude of experiments and curious obfervations which it contains, is ftill more worthy of attention by the philofophic fpirit which detected it.

This fubject is one of the moft difficult in phyfiology: the obferver is always compelled to act and to look with darknefs around him; he is obliged to manage the animal with care, to avoid the derangement of his operations; and when he has laborioufly completed his experiments, it is neceffary that he fhould well diftinguifh the confequences, fometimes erroneous, which may be drawn from thofe of obfervation, which never deceive when they are immediate. Spallanzani, in this work, is truly a fine fpectacle; fcrupuloufly analyfing the facts in order to difcover their caufes with certainty; inventing happy refources for furmounting the obftacles which renew themfelves; comparing Nature with his experiments, to judge of them; catching hold in his obfervations of every thing that is effential in them; meafuring their folidity by the augmentation or diminution of fuppofed caufes; drawing the beft-founded conclufions, and rejecting the moft plaufible hypothefes; modeftly expofing the errors of thofe who have gone before him, and employing analogy with that wife circumfpection which infpires confidence in an inftrument at once fo dangerous and fo ufeful. But let it be known, Spallanzani had a capacity in particular for difcovering the truth, while the greater part of obfervators fcarcely ever attain it; and then, after having defcribed around them a circuitous trace, he runs upon it by a ftraight line, and poffeffes himfelf of it fo as that it cannot efcape him.

This work put John Hunter out of humour; and he publifhed, in 1785, *Some Obfervations upon Digeftion*, wherein he threw out fome bitter farcafms againft Spallanzani; who took ample revenge by publifhing this work in Italian, and addreffing to *Caldani*, in 1788, *Una Lettera Apologetica in Rifpofta alle Offervazione del Signor Giovanni Hunter.* He expofes, with moderation, but with an irrefiftible logic, the overfights of the Englifh phyfiologift, and points out his errors in a manner which left him no hope of a reply.

The fecond volume treats of the generation of animals and plants. Spallanzani proves, by experiments as fatisfactory as they are furprifing, the pre-exiftence of germs to fecundation; he fhews the exiftence of tadpoles in the females of five different fpecies of frogs, in toads, and in falamanders, before their fecundation: he recounts the fuccefs of fome artificial fecundations upon the tadpoles of thofe five fpecies, and even upon a quadruped. He in the fame manner fhews the feed in the flowers, before the emiffion of their farina; and by a fubtle anatomy of which one can hardly form an idea, he exhibits to the eye in the flower of the *fpartium junceum*, the filiqua, its feeds, with their lobes, and the embryo plant; he purfues them in their expanfion before and after fecundation, and leaves not a doubt but that the feeds and the pericarpia exifted long before the bloffoming of the buds, and confequently a long time before they could have been fecundated. He has repeated thefe obfervations upon various fpecies of plants with the fame refults; in fhort, he has raifed the individuals of plants with female flowers which have borne fecundated feeds, although they were out of the reach even of fufpicion of a communication with the farina of the male flowers. Such is the feries of furprifing phenomena Spallanzani adds to the hiftory of Nature.

According to cuftom, he availed himfelf of the academical vacation of 1781, to make a journey, the object of which was to add to the cabinet of Pavia. He fet out in the month of July for Marfeilles, where he commenced a new hiftory of the fea, which had prefented him with a crowd of novel and curious facts upon numerous genera of the inhabitants of the ocean. He

Spallanzani.

He went likewife to Finale, to Genoa, to Maffa, and to Carrara, to obferve the quarries of marble fo famous with the ftatuaries; he returned to Spezzia, and thence brought to Pavia an immenfe harveft of fifhes, cruftaceous and teftaceous, which he depofited in that cabinet of which his voyages and travels had rendered him fo worthy to be the guardian. He vifited, in the fame view, and with the fame fuccefs, the coafts of Iftria in 1782; the Apennine Mountains in 1783, where he noticed the terrible hurricanes, and the furprifing vapours which rendered that year fo famous in meteorology. The cabinet of Pavia thus every year faw its riches increafe; and in the fame proportion it became the object of ftrangers admiration; but every one admired ftill more the immenfe labour of Spallanzani, who had collected every part of it.

The Emperor Jofeph knew this when he came into Lombardy: he defired to have a converfation with Spallanzani; and his majefty expreffed his approbation by prefenting him with his medal in gold.

The univerfity of Padua offered to Spallanzani, in 1785, the chair of natural hiftory, which the death of Anthony Vallifneri had left vacant, promifing him more confiderable advantages than thofe which he enjoyed at Pavia; but the archduke doubled his penfion, and allowed him to accompany to Conftantinople the Chevalier Zuliani, who had juft been nominated ambaffador from the republic of Venice.

He left this city the 21ft of Auguft; and during his voyage made feveral obfervations upon the marine productions he met with in thofe climates, as well as upon the meteorological events of every day, among which he had the advantage of beholding a fpecies of water-fpout. He touched at feveral iflands in the Archipelago, which he examined, and went afhore at Troy to vifit the places fung by the poet whom he preferred to all others; and in treading upon that ground fo anciently famous, he made fome geological obfervations truly original. One may judge before hand of the intereft we fhall feel in reading the Voyage of Spallanzani, by fome memoirs which have appeared in the *Memorie della Societa Italiana* upon the water-fpouts at fea, the ftroke of the torpedo, divers marine productions, and the ifland of Cytherea, where he difcovered a mountain compofed of various fpecies of foffils. Spallanzani arrived at Conftantinople the 11th of October, and remained there eleven months: he muft have been greatly out of his element in that country of ignorance and fuperftition, if he had not had Nature to ftudy, and Zuliani to hear him. The phyfical and moral phenomena of this country, quite new to him, fixed his attention; he ftrayed over the borders of the two feas, and climbed up the neighbouring hills; he vifited the ifland of Chalki, where he made known to the Turks a mine of copper, the exiftence of which they never fo much as fufpected. He went to the Principi ifland, a few miles diftant from Conftantinople, where he difcovered an iron mine equally unthought of by the Turks. He returned to Europe loaded with fpoils from the Eaft, compofed of the creatures of the three kingdoms, peculiar to thofe regions: after having been ufeful to the Orientals, who were incapable of appreciating his merit, or rather of imagining he could have any, he fet out on his return for Italy the 16th of Auguft, 1786.

A voyage by fea was in every refpect the moft fafe and the moft commodious; but Spallanzani confidered the dangers and the inconveniencies of the road as nothing when employed in any beneficial purfuit; he braved all the perils of thofe defert regions, where there is no police, no fecurity. When he arrived at Buchareft, he was retained there during nine days by the celebrated and unhappy Mauroceni, hofpodar of Wallachia. This prince, the friend of fcience, received him with diftinction, prefented him with many of the rarities of his country, furnifhed him with horfes for travelling, and alfo gave him an efcort of thirty troopers throughout the whole extent of his dominions. Spallanzani paffed by Hermanftadt in Tranfylvania, and arrived at Vienna the 7th of December, after having viewed the numerous mines of Tranfylvania, of Hungary, and of Germany, which lay in the neighbourhood of his route. Spallanzani remained five days in this capital of Auftria; he had two very long audiences with the Emperor Jofeph II.; was well received by the higheft nobility in that metropolis, and vifited by the men of letters. At length arrived at Pavia; the ftudents came to meet him out of the gates of the city, and accompanied him home, manifefting their joy all the way by repeated fhouts. Their great defire to hear him, drew him almoft immediately to the auditory, where they forced him to afcend the chair from which he had been accuftomed to deliver his lectures to them. Spallanzani, affected by this fcene, teftified with eloquence his gratitude and attachment;—friendly wifhes, cries of joy, clapping of hands, recommenced with more force, and he was obliged to requeft them to defift, and allow him to take in his houfe that repofe which was more neceffary than ever. He had in the courfe of this year above 500 ftudents.

Spallanzani had acquired glory enough to merit the attacks of envy: but his difcoveries were too new, too original, too folid to be difputed; envy itfelf was therefore forced to admire him: but that unworthy paffion, being tired out by the increafing reputation of that great man, watched the moment to prove that it had not forgotten him. Envy and malignity then called in queftion his uprightnefs in the adminiftration 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 fhine with new luftre. The integrity of Spallanzani appeared even more pure after the juridical examination of the tribunals. But let us ftop here; Spallanzani had the fortitude to forget this event which had torn his heart to pieces; the greater part of his enemies acknowledged their miftake, abjured their hatred, and did not defpair of regaining his friendfhip.

The cabinet of Pavia was always the object of Spallanzani's thoughts; amidft the numerous rarities which he had placed there, he only faw thofe that were wanting. Struck with its deficiency in volcanic matters, which had neither feries nor order, and confequently excited little intereft, being a mute article with refpect to inftruction (although Italy was the theatre where the fires of volcanoes had for fo many ages exercifed their defolating powers), he took the refolution, with which his talents, his courage, and his zeal, infpired him. He was defirous to inftruct his pupils, his nation, himfelf, concerning the phenomena fo ftriking, and yet fo little known, and to collect the documents of of their hiftory in the places where they have always been the terror of thofe who furrounded them, and where they have been ufelefsly the fubject of the obfervations of the philofopher. He therefore prepared himfelf for this great enterprife by deep ftudies. He fet out for Naples, in the fummer of 1788, and afcended mount Vefuvius; he looked attentively into its crater, examined and made notes in his books, and embarked for the Lipari iflands. He diffected, as it were, the uninhabited volcanoes, with the exactnefs of a naturalift anatomifing a butterfly, and the intrepidity of a warrior defying the moft imminent dangers. It was then that he had the boldnefs to walk over that fulphurous cruft, cleft with chinks, trembling, fmoking, burning, and fometimes treacheroufly covering the hearth of the volcano. He paffed into Sicily, where he climbed up to Etna, and coafted its immenfe crater. His curiofity not being exhaufted, he would collect around him, and have in his mind, all the fingular phenomena that Sicily contained; he examined the ftones and the mountains, and difcovered many new marine animals; he approached Scylla and Charybdis, and in a boat croffed the frothy billows of thofe deadly rocks, celebrated for fo many fhipwrecks, and fo often fung by the poets; but in the very midft of their frightful waves, he difcovered the caufe of their fury (See Scylla, *Suppl.*) It was thus that, at the age of 60, he picked up thofe numberlefs anecdotes which fill his voyages in the two Sicilies; and that he compared the defcription which Homer, Pindar, Virgil, Diodorus Siculus, and Strabo, have given of thefe ever famous places, with that which he made himfelf. In this manner he fhewed the connection of ancient literature with natural hiftory.

We find in the voyages of Spallanzani a new volcanology. He therein teaches the way to meafure the intenfity of the fire of volcanoes, to glance at the caufes, to touch almoft, in the analyfis which he makes of the lava, that particular gas which, refembling a powerful lever, tears from the bowels of the earth, and raifes up to the top of Etna, thofe torrents of ftone in fufion which it difgorges; to furvey the nature of thofe pumice-ftones, which he has fince explained in his artificial pumice-ftones. He concludes this charming work with fome interefting inquiries into the nature of fwallows, their mild difpofitions, rapid flight; fuggefting that an advantage might be drawn from them in the way of aerial poft; their migrations determined by the temperature of the air, and the birth of infects it occafions: in fhort, he difcuffes 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 thefe birds lethargic. He next fpeaks of a fpecies of owl, hitherto very ill defcribed; and, laftly, of eels and their generation, which is a problem ftill in fome meafure to be folved; but he carries it on by his inquiries to that ftep which alone remains to be made for obtaining a complete folution; or to get over it eafily by a fmall number of obfervations in thofe times and places pointed out, but which the academical occupations of Spallanzani forced him to give up to others.

Spallanzani followed the progrefs of the French chemiftry with much fatisfaction, nor was he long before he adopted it; it was calculated for a juft conception like his, delighting to give an account of every phenomenon he obferved. The folidity of principles in this new doctrine, the precifion in its way of proceeding, the elegance of its interpretation, the generality of its confequences, prefently replaced in his mind the hefitations and the obfcurities of the ancient chemiftry; and his heart anticipated with pleafure the triumphs that it was about to obtain.

In 1791, Spallanzani publifhed a letter addreffed to Profeffor Fortis, upon the Pennet Hydrofcope. He there relates the experiments which he had directed to be made for afcertaining the degree of confidence which might be allowed to the fingular talents of this man; but he ingenuoufly confeffes, that he is not decided upon the reality of the phenomenon.

Spallanzani has often difcovered that which might have been deemed impoffible. In 1795 he made a difcovery of this nature, which he publifhed in his *Lettere fopra il fofpetto d'un nuovo fenfo nei Pipiftrelli.* We therein learn that the bats, if blinded, act in every refpect with the fame precifion as thofe which have their eyes; that they in the fame manner avoid the moft trifling obftacles, and that they know where to fix themfelves on ceafing their flight. Thefe extraordinary experiments were confirmed by feveral natural philofophers, and gave occafion to fufpect a new fenfe in thefe birds, becaufe Spallanzani thought he had evinced by the way of exclufion, that the other fenfes could not fupply the deficiency of that fight which he had deprived them of; but the anatomical details of Profeffor Jurine, upon the organ of hearing in this fingular bird, made him incline afterwards towards the idea, that the fenfe of hearing might in this cafe fupply that of fight, as in all thofe where the bats are in the dark.

Spallanzani concluded his literary career for the public, by a letter addreffed to the celebrated Giobert; *Sopra la piante chiufe ne' vafi dentro l'aqua e l'aria, efpofte a l' immediàta lume folare e a l'ombra.* It is a misfortune for this part of the fcience, that his death has deprived us of the difcoveries he was about to make in it.

Thefe numerous works, printed and applauded, did not however contain all the feries of Spallanzani's labours. He had been occupied a confiderable time upon the phenomena of refpiration; their refemblances and differences in a great number of fpecies of animals; and he was bufily employed in reducing to order his refearches upon this fubject, which will aftonifh by the multitude of unforefeen and unexpected facts. He has left a precious collection of experiments and new obfervations upon animal reproductions, upon fponges, the nature of which he determines, and upon a thoufand interefting phenomena which he knew how to draw out of obfcurity. He had almoft finifhed his voyage to Conftantinople, and had amaffed confiderable materials for a Hiftory of the Sea, when an end was put to his life and his labours.

On the 4th of February 1799, he was feized with a retention of urine, the fame night was unquiet, and in the morning he loft all powers of reafon, which he never recovered but during very fhort intervals. His intimate friends, Tourdes, a French phyfician, and the celebrated Profeffor Scarpa, did every thing which could be expected from genius, experience, and friendfhip, to fave him; but he died the 17th, after having edified thofe around him by his piety. This lamentable event

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

Speculum.

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 *ſandifer*. 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 aſfirms 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 everywhere 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 fame fize, or fomewhat lefs than the hole in the middle of the fpeculum. Mr Edwards fays, that he has always found that fmall mirrors, though without any hole in the middle, polifh much better, and take a more correct figure, for the polifher's having a hole in the middle of it.

The polifher being thus formed, it muft be very gently warmed at the fire, and divided into feveral fquares by the edge of a knife. Thefe, by receiving the fmall portion of metal that works off in polifhing, will caufe the figure of the fpeculum to be more correct than if no fuch fquares had been made. Mr Mudge directs the polifher to be ftrewed over with very fine *putty*; but Mr Edwards prefers Colcothar of vitriol. (See that article, *Encycl.*) Putty (fays he) gives metals a white luftre, or, as workmen call it, a filver hue; but good colcothar of vitriol will polifh with a very fine and high black luftre, fo as to give the metal finifhed with it the complection of polifhed fteel. To know if the colcothar of vitriol is good, put fome of it into your mouth, and if you find it diffolves 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 foft and oily when rubbed between the fingers; bad colcothar of vitriol is of a light red colour, and feels harfh and gritty. The colcothar of vitriol fhould be levigated between two furfaces of polifhed fteel, 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 pleafe. 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 fufficiently fine, to give an exquifite luftre. This levigated colcothar of vitriol muft be put into a fmall phial, and kept with fome water upon it. When it is to be ufed, every part of the pitch-polifher muft be firft brufhed over with a fine camel's hair brufh, which has been dipped in pure water, and rubbed gently over a piece of dry clean foap. The wafhed colcothar of vitriol is then to be put upon the polifher; and Mr Edwards directs a large quantity of it to be put on at once, fo as to faturate the pitch, and form a fine coating. If a fecond or third application of this powder be found neceffary, it muft be ufed very fparingly, or the polifh will be deftroyed which has been already attained. When the metal is nearly polifhed, there will always appear fome black mud upon its furface, as well as upon the tool. Part of this muft be wiped away with fome very foft wafh leather; but if the whole of it be taken away, the polifhing will not be fo well completed.

With refpect to the *parabolic figure* to be given to the mirror, Mr Edwards affures us, that a very little experience in thefe matters will enable any one to give it with certainty, by polifhing the fpeculum in the common manner, only with crofs ftrokes in every direction, upon an elliptical tool of the proper dimenfions.

SPEIGHT's-TOWN, on the W. fhore of the ifland of Barbadoes, towards the N. part; formerly much reforted to by fhips from Briftol, and from thence called Little Briftol; but moft of the trade is now removed to Bridgetown. It is in St Peter's parifh, having Sandy Fort, and Margaret's Fort, about a mile S. and Haywood's Fort on the N. at half the diftance. N. lat. 10 9, W. long. 59 21.—*Morse.*

SPENCER, a flourifhing townfhip in Worcefter county, Maffachufetts, taken from Leicefter, and incorporated in 1753, and contains 1322 inhabitants, and lies 11 miles fouth-weftward of Worcefter, on the poft-road to Springfield, and 58 S. W. of Bofton.—*ib.*

SPESUTIE, a fmall ifland at the head of Chefapeak Bay.—*ib.*

SPINDLE, in geometry, a folid body generated by the revolution of fome curve line about its bafe or double ordinate: in oppofition to a conoid, which is generated by the rotation of the curve about its axis or abfcifs, perpendicular to its ordinate. The fpindle is denominated circular, elliptic, hyperbolic, or parabolic, &c. according to the figure of its generating curve.

Spindle, in mechanics, fometimes 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 philofophers, 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 difpofed to think that thofe very talents were infpired. Their firft inftructors, the poets, gave to Apollo the honour of that power of invention and imagination by which they inftructed and charmed their admiring hearers. The prophetefs dictated her oracles, the poet fung his enraptured ftrain only when infpired. The happy thought of twining a thread, and working it into a blanket, when viewed by that ingenious and acutely fenfible people in all its importance, as the protector of the human race from the feverity of the weather, feemed a prefent from heaven, as the infpiration of a divinity; and the diftaff and the loom were Minerva's firft title to a feat among the great gods on Olympus.

We are much inclined to be of the fame opinion. When we obferve, that in all the countries which have been difcovered by the navigators of the three laft centuries, the diftaff and fpindle, and the needle, have been found, we own ourfelves much difpofed to think that they are the refults of inftinct. Our inftincts are not all fimple and blind, like that which directs the newborn animal to the breaft of its mother without knowing why. We have inftincts of intellect as well as of appetite; and the logic of common converfation is an example of many fuch. We doubt not but that the noble-minded inhabitants of Pelew would have worfhipped as a divinity an Englifh maiden with her fpinning wheel and fly. Surely he who fhould carry them this homely but ingenious machine, and a potter's wheel, would do them more fervice than if he taught them all the fcience of a Newton, with all the philofophy of the 18th century into the bargain. We do not know, except perhaps the fteam engine, any mechanical invention that has made fuch amazing addition to the activity and induftry and opulence of this highly favoured ifland, as the invention of Mr Arkwright for fpinning by water, where dead matter is made to perform all that the niceft finger can do when directed by the neverceafing attention of the intelligent eye. Minerva has the undifputed honours of the diftaff and fpindle. We know not to what benefactor we owe the fly-wheel. Mr Arkwright has the honour of combining them both, and infpiring them with his own fpirit; for we may truly fay of the contrivance which pervades the wonderful machinery of a cotton mill,

Totofque

Totofque infufa per artus
Mens agitat molem et magno fe corpore mifcet.

To give an intelligible and accurate defcription 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 leifure to trace the fteps by which the wool from the bag ultimately affumes the form of a very fine thread. Bewildered by fuch a complication of machinery, all in rapid motion, very few, we imagine, are able to recollect with diftinctnefs and intelligence the effential part of the procefs by which the form of the cotton is fo wonderfully changed. Such readers will not think a page or two mifemployed, if they are thereby able to underftand this particular, to which all the reft of the procefs is fubfervient.

We pafs 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 finifhing 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 flowly turned round by the machine. Another roller lies above the fleece, preffing it down by its weight. By this preffure, a gentle hold is taken of the fleece, and therefore the flow motion of the rollers draws it gently from the card at the fame rate as it is difengaged by the comb; but between the card and the rollers a fet of fmooth pins are placed in two rows, leading from the card to the rollers, and gradually approaching each other as we approach the rollers. By thefe pins the broad fleece is hemmed in on both fides, and gradually contracted to a thick roll; and in this ftate paffes between the rollers, and is compreffed into a pretty firm flat riband, about two inches broad, which falls off from the rollers, and piles up in deep tinplate cans fet below to receive it.

It is upon this ftripe or riband of cotton wool that the operation of fpinning begins. The general effect of the fpinning procefs is to draw out this maffive roll, and to twift 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 neceffary for compofing a thread of the intended finenefs, and continuing this manipulation regularly acrofs the whole end of the riband, and thus, as it were, nibbling the whole of it away. The fingers muft be directed, for this purpofe, by an attentive eye. But in performing this by machinery, the whole riband muft be drawn out together, and twifted as it is drawn. This requires great art, and very delicate management. It cannot be done at once; that is, the cotton roll cannot firft be ftretched or drawn out to the length that is ultimately produced from a tenth of an inch of the roll, and then be twifted. There is not cohefion enough for this purpofe: we fhould only break off a bit of the roll, and could make no farther ufe of it. The fibres of cotton are very little implicated among each other in the roll, becaufe the operation of carding has laid them almoft parallel in the roll; and though compreffed a little by its contraction from a fleece of 20 inches to a riband of only 2, and afterwards compreffed between the difcharging rollers of the carding machine, yet they cohere fo flightly, that a few fibres may be drawn out without bringing many others along with them. For thefe reafons, the whole thicknefs and breadth of two or three inches of the riband is ftretched to a very minute quantity, and then a very flight degree of twift is given it, viz. about three turns in the inch; fo that it fhall now compofe an extremely foft and fpungy cylinder, which cannot be called a thread or cord, becaufe it has fcarcely any firmnefs, and is merely rounder and much flenderer than before, being ftretched to about thrice its former length. It is now called flab, or roove.

Although it be ftill extremely tender, and will not carry a weight of two ounces, it is much more cohefive than before, becaufe the twift given to it makes all the longitudinal fibres bind each other together, and comprefs thofe which lie athwart; therefore it will require more force to pull a fibre from among the reft, but ftill not nearly enough to break it. In drawing out a fingle fibre, others are drawn out along with it; and if we take hold of the whole affemblage, in two places, about an inch or two inches afunder, we fhall find that we may draw it to near twice its length without any rifk of its feparating in any intermediate part, or becoming much fmaller in one part than another. It feems to yield equably over all.

Such is the ftate of the flab or roove of the firft formation. It is ufually called the *preparation*; and the operation of fpinning is confidered as not yet begun. This preparation is the moft tedious, and requires more attendance and hand labour than any fubfequent part of the procefs. For the ftripes or ribands from which it is made are fo light and bulky, that a few yards only can be piled up in the cans fet to receive them. A perfon muft therefore attend each thread of flab, to join frefh ftripes as they are expended. It is alfo the moft important in the manufacture; for as every inch of the flab meets with precifely the fame drawing and the fame twifting in the fubfequent parts of the procefs, therefore every inequality and fault in the flab (indeed in the fleece as it quits the finifhing card) will continue through the whole manufacture. The fpinning of cotton yarn now divides into two branches. The firft, performed by what are called *jennies*, perfectly refembles the ancient fpinning with the diftaff and fpindle; the other, called *fpinning of twift*, is an imitation of the fpinning with the fly-wheel. They differ in the fame manner as the fpinning with the old wool or cotton-wheel differs from the fpinning with the flax-wheel. Mr Arkwright's chief invention, the fubftitution of machinery for the immediate work of the human finger, is feen only in the manufacture of twift. We fhall therefore confine our attention to this.

The reft of the procefs is little more than a repetition of that gone through in making the firft flab or roove. It is formed on bobins. Thefe are fet on the back part of the drawing frame; and the end of the flab is brought forwards toward the attending workman. As it comes forward, it is ftretched or drawn to about $\frac{4}{3}$ of its former length, or lengthened $\frac{1}{3}$; and is then twifted about twice as much as before, and in this ftate wound up on another bobin. In fome mills two rooves, after having been properly drawn, are brought together through one hole, and twifted into one; but we believe that, in the greater number of mills,

mills, this is deferred to the fecond drawing. It is only after the firft drawing that the produce of the operation gets the name of *flab*; before this it is called *preparation*, or *roove*, or by fome other name. The flab is ftill a very feeble, foft, 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 foftnefs; for it is this only which makes it fufceptible of an equable ftretching; all the fibres yielding and feparating alike.

The next operation is the *fecond drawing*, which no way differs from the firft, except in the different proportions of the lengthening, and the proportion between the lengthening and the fubfequent twift. On thefe points we cannot give any very diftinct information. It is different in different mills, and with different fpecies of cotton wool, as may be eafily imagined. The immediate mechanifm or manipulation muft be fkilfully 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 confiderable degree of elafticity which it poffeffes. In this refpect it greatly refembles woollen fibres, and differs exceedingly from thofe of flax: and it is for this reafon that it is fcarcely poffible to fpin flax in this way: its fibres become lank, and take any fhape by the flighteft compreffion, efpecially when damp in the flighteft degree. But befides this, the furface of a cotton fibre has a harfhnefs or roughnefs, which greatly augments their mutual friction. This is probably the reafon why it is fo unfit for tents and other dreffings for wounds, and is refufed by the furgeon even in the meaneft hofpitals. But this harfhnefs and its elafticity fit it admirably for the manufacture of yarn. Even the fhortnefs of the fibre is favourable; and the manufacture would hardly be poffible if the fibre were thrice as long as it generally is. If it be juft fo long that in the finifhed thread a fibre will rather break than come out from among the reft, it is plain that no additional length can make the yarn any ftronger with the fame degree of compreffion by twining. A longer fibre will indeed give the fame firmnefs of adherence with a fmaller compreffion. This would be an advantage in any other yarn; but in cotton yarn the compreffion is already as flight as can be allowed; were it lefs, it would become woolly and rough by the fmalleft ufage, and is already too much difpofed to teazle out. It can hardly be ufed as fewing thread. Now fuppofe the fibres much longer; fome of them may chance to be ftretched along the flab through their whole length. If the flab is pulled in oppofite directions, by pinching it at each end of fuch fibres, it is plain that it will not ftretch till this fibre be broken or drawn out; and that while it is in its extended ftate, it is acting on the other fibres in a very unequable manner, according to their pofitions, and renders the whole apt to feparate more irregularly. This is one great obftacle to the fpinning of flax by fimilar machinery; and it has hitherto prevented (we believe) the working up of any thing but the *fhorts* or tow, which is feparated from the long fine flax in the operation of hatcheling.

A third, and fometimes even a fourth, drawing is given to the flab formed on the bobins of this fecond operation. The flab produced is now a flender, but ftill extremely foft cord, fufceptible of confiderable extenfion, without rifk of feparation, and without the fmalleft chance of breaking a fingle fibre in the attempt. In one or more of the preparatory drawings now defcribed, two, and fometimes three flabs, of a former drawing, are united before the twift is given them. The practice is different in different mills. It is plain, that unlefs great care be taken to preferve the flab extremely foft and compreffible during the whole procefs, the fubfequent drawing becomes more precarious, and we run a rifk of at laft making a bad and loofe thread inftead of a uniform and fimple yarn. Such a thread will have very little lateral connection, and will not bear much handling without feparating into ftrands. The perfection of the yarn depends on having the laft flab as free of all appearance of ftrands as poffible.

The laft operation is the fpinning this flab. This hardly differs from the foregoing drawings in any thing but the twift that is given it after the laft ftretching in its length. This is much greater than any of the preceding, being intended to give the yarn hardnefs and firmnefs, fo that it will now break rather than ftretch any more.

The reader, moderately acquainted with mechanics, cannot but perceive that each of the operations now defcribed, by which the roove is changed into the foft flab, and each of thefe into one flenderer and fomewhat firmer, by alternately teazling out and twining the foft cord, is a fubftitute for a fingle pull of the finger and thumb of the fpinfter, which fhe accommodates precifely to the peculiar condition of the lock of wool which fhe touches at the moment. She can follow this through all its irregularities; and perhaps no two fucceeding plucks are alike. But when we cannot give this momentary attention to every minute portion, we muft be careful to introduce the roove in a ftate of perfect uniformity; and then every inch being treated in the fame manner, the final refult will be equable—the yarn will be uniform.

We are now to defcribe the mechanifm by which all this is effected. But we do not mean to defcribe a cotton mill; we only mean to defcribe what comes into immediate contact with the thread; and in fo doing, to confine ourfelves to what is neceffary for making the reader perceive its ability to perform the required tafk. We fee many cafes where individuals can apply this knowledge to ufeful purpofes. More than this would, we think, be improper, in a national point of view.

Let ABC reprefent the fection of a roller, whofe pivot D does not turn in a pivot hole, but in the bottom of a long narrow notch DE, cut in an iron ftandard. *a b c* is the fection of another iron roller, whofe pivot *d* is in the fame notches at each end, while the roller itfelf lies or refts on the roller ABC below it. The furfaces of thefe rollers are fluted lengthwife like a column: only the flutings are very fmall and fharp, like deep ftrokes of engraving very clofe together. It is plain, that if the roller ABC be made to turn flowly round its axis by machinery, in the direction ABC (as expreffed by the dart), the roughnefs of the flutings will take hold of the fimilar roughnefs of the upper roller *a b c*, and carry it round alfo 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 ftring or riband,

Pl. XI

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 Winnepisengee 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 Rhynbeck 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 ſort 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, ‖ Stapelia.

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 feminiferous 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 increafed as the power of the exhalant or perfpiratory veffels is diminifhed. In thefe plants, a fmall quantity of nourifhment is required. There is no folid part to be formed, no large fruit to be produced. They generally have very fmall leaves, often are entirely naked; fo that taking the whole plant, a fmall furface only is expofed to the action of light and heat, and confequently a much fmaller proportion of water is decompofed than in plants which are much branched and furnifhed with leaves.

Two fpecies of ftapelia only were known at the beginning of the century. The unfortunate Forfkål, the companion of Niebhur, who was fent out by the king of Denmark to explore the interior of Arabia, and who fell a facrifice to the peftilential difeafes of thofe inhofpitable regions, difcovered two new fpecies. Thunberg, in his *Prodromus*, has mentioned five more. Forty new fpecies have been difcovered by Mr Maffon of Kew Gardens, who was fent out by his prefent Majefty for the purpofe of collecting plants round the Cape of Good Hope. Defcriptions of thefe, with elegant and highly finifhed coloured engravings, have lately been publifhed. They are chiefly natives of the extenfive deferts called *Karro*, on the weftern fide of the Cape.

STAR, in fortification, denotes a fmall fort, having five or more points, or faliant and re-entering angles, flanking one another, and their faces 90 or 100 feet long.

STARCH (fee *Encycl.*) is commonly made of wheat, and the very beft ftarch can perhaps be made of nothing elfe. Wheat, however, is too valuable an article of food to be employed as the material of ftarch, when any thing elfe will anfwer the purpofe; and it has long been known that an inferior kind of ftarch may be made of potatoes. Potatoes, however, are themfelves a valuable article of food; and it is therefore an object of importance to try if ftarch may not be made of fomething ftill lefs ufeful.

On the 8th of March 1796, a patent was granted to Lord William Murray for his difcovery of a method by which ftarch may be extracted from horfe-chefnuts. That method is as follows:

Take the horfe-chefnuts out of the outward green prickly hufks; and then, either by hand, with a knife or other tool, or elfe with a mill adapted for that purpofe, very carefully pare off the brown rind, being particular not to leave the fmalleft fpeck, and to entirely eradicate the fprout or growth. Next take the nuts, and rafp, grate, or grind them fine into water, either by hand, or by a mill adapted for that purpofe. Wafh the pulp, which is thereby formed in this water, as clean as poffible, through a coarfe horfe-hair fieve; this again wafh through a finer fieve, and then again through a ftill finer, conftantly adding clean water, to prevent any ftarch from adhering to the pulp. The laft procefs is, to put it with a large quantity of water (about four gallons to a pound of ftarch) through a fine gauze, muflin, or lawn, fo as entirely to clear it of all bran or other impurities. As foon as it fettles, 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 fet it to bake, either in the ufual mode of baking ftarch, or elfe fpread out before a brifk fire; being very attentive to ftir it frequently to prevent its horning, that is to fay, turning to a pafte or jelly, which, on being dried, turns hard like horn. The whole procefs fhould be conducted as quickly as poffible.

Mention is here made of a mill which may be employed to grind the horfe-chefnuts; but none is defcribed as proper for that purpofe. Perhaps the following mill, which was invented by M. Baumé for grinding potatoes, with a view to extract ftarch from them, may anfwer for grinding horfe-chefnuts.

Plate XLII.

He had a grater made of plate iron, in a cylindrical form (fig. 1.) about feven inches in diameter, and about eight inches high; the burs made by ftamping the holes are on the infide. This grater is fupported upon three feet AAA, made of flat iron bars, feven feet high, ftrongly rivetted to the grater; the bottom of each foot is bent horizontally, and has a hole in it which receives a fcrew, as at A, fig. 4. A little below the upper end of the three feet is fixed a crofs piece B (fig. 1. and 4.), divided into three branches, and rivetted to the feet. This crofs piece not only ferves to keep the feet at a proper diftance from each other, and to prevent their bending; but the centre of it having a hole cut in it, ferves to fupport an axis or fpindle of iron, to be prefently defcribed.

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 fecond 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 outfide; it is fixed, with the broad end at the bottom, as in fig. 4. At the upper end of the cone is rivetted a fmall triangle, or crofs piece of iron, confifting of three branches D (fig. 2.), in the middle of which is made a fquare hole, to receive an axis or fpindle; to give more refiftance to this part of the cone, it is ftrengthened by means of a cap of iron E, which is fixed to the grater by means of rivets, and has alfo a fquare hole made in it, to let the axis pafs through.

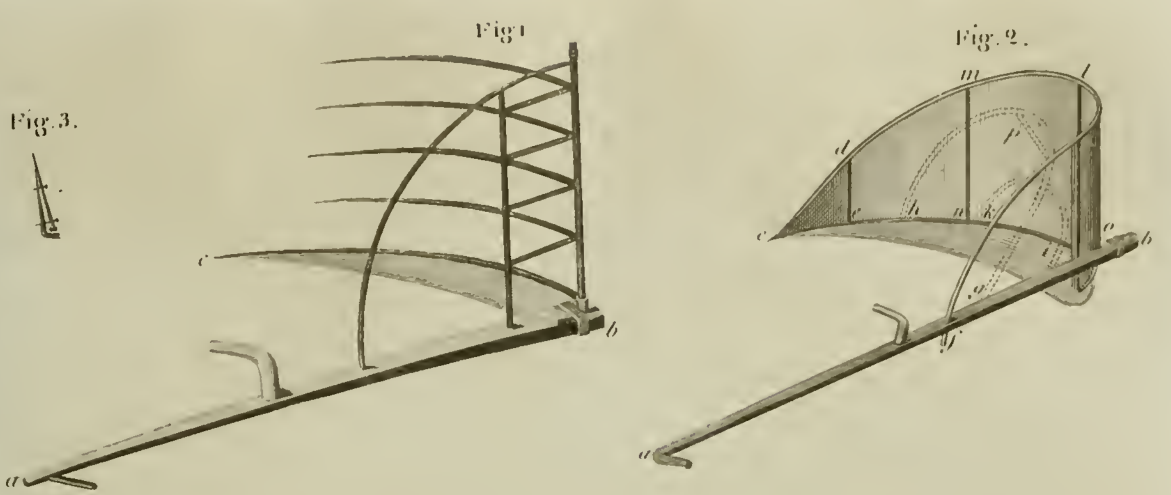
Fig. 3. reprefents the fame cone feen in front; the bafe F has alfo a crofs piece of three branches, rivetted to a hoop of iron, which is fixed to the inner furface of the cone; the centre of this crofs piece has alfo a fquare hole for the paffage of the axis.

Fig. 5. is a fpindle or axis itfelf; it is a fquare bar of iron about 16 inches long, and more than half an inch thick; round at the bottom, and alfo towards the top, where it fits into the crofs piece I, fig. 7. and B, fig. 1. and 4.; in thefe pieces it turns round, and by them it is kept in its place. It muft be fquare 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 fmall 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.

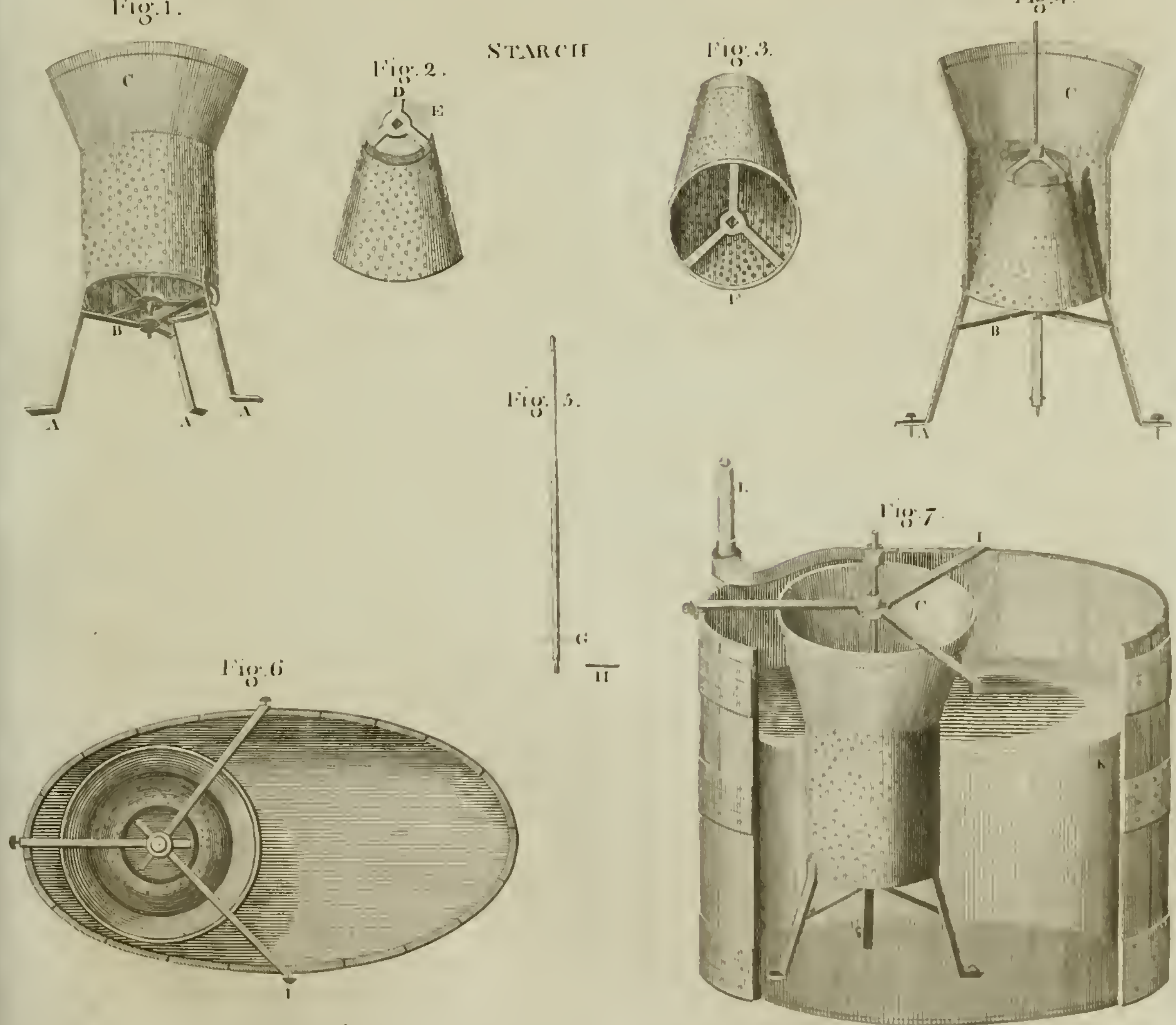
Fig. 6. is a bird's eye view, in which the mill is reprefented placed in an oval tub, like a bathing-tub. I is the fore-mentioned triangular iron crofs, fixed with fcrews to the fide of the tub; the centre of it has a round hole, for the axis of the mill to move in when it is ufed.

Fig. 7. reprefents the mill in the oval tub; it is placed

REAPING SCYTHES PLATE XLII.



STARCH



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 $\frac{6}{7}$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 aftronomy, the ftate of a planet when, to an obferver on the earth, it appears for fome time to ftand ftill, or remain immoveable in the fame place in the heavens. For as the planets, to fuch an obferver, have fometimes a progreffive motion, and fometimes a retrograde one, there muft be fome point between the two where they muft appear ftationary.

STATEN *Ifland*, lies 9 miles S. W. of the city of New-York, and conftitutes Richmond county. The ifland is about 18 miles in length, and at a medium 6 or 7 in breadth, and contains 3,835 inhabitants. On the fouth fide, is a confiderable tract of level, good land; but the ifland in general, is rough and the hills high. Richmond is the only town of any note, and that is an inconfiderable place. The inhabitants are chiefly defcendants of the Dutch and French; and are noted for their hofpitality to ftrangers, and love of their native fpot.—*Morfe*.

STATEN *Land*, an ifland at the extremity of South-America, about 30 miles in length and 12 in breadth. It lies to the eaftward of the E. point of Terra del Fuego, and from which it is feparated by Strait le Maire. The centre of the ifland is in lat. about 54 30 S. and long. 64 30 W.—*ib*.

STATESBURG, a poft-town of S. Carolina, and the capital of Clermont county, fituated on the E. fide of Beech Creek, which unites with Shanks Creek, and empties into the Wateree, a few miles below the town. It contains 10 or 12 houfes, a court-houfe and gaol. It is 20 miles S. by E. of Camden, 100 N. by W. of Charlefton, and 663 S. W. of Philadelphia.—*ib*.

STAUNTON, a poft-town of Virginia, and the capital of Augufta county. It is fituated on the S. E. fide of Middle river, a water of Patowmack, a little to the N. of Maddifon's Cave. It contains about 160 houfes, moftly built of ftone, a court-houfe and gaol. It is 93 miles from the Sweet Springs, 100 miles S. W. by S. of Winchefter, 126 W. N. W. of Richmond, and 287 from Philadelphia —*ib*.

STAUNTON, a fmall river of Virginia, which rifes on the W. fide 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 Iflands, about 100 miles from its fource. It is alfo called Smith's river.—*ib*.

STAUSEE, *Fort*, juft above the Falls of Niagara, and 8 miles above Queens-Town.—*ib*.

STEADMAN's *Creek*, in the ftate of New-York. The main fork of this creek empties into Niagara river, above Fort Schloffer.—*ib*.

STEAM, STEAM-ENGINE. The few following corrections of thefe 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 burft, but in the country in an engine erected by Dr Defaguilliers. See his *Experimental Philofophy*, Vol. II. p. 489.

Page 746. col. 2.—The condenfation requires more cold water than is here allowed, as will appear by and bye; and we alfo fufpect that the rapidity is overrated with which a great volume of fteam is condenfed by the cold furface of a veffel. We are well informed that Mr Watt was much difappointed in his expectations from a conftruction in which this mode of condenfation was adopted. The condenfer employed by Mr Cartwright (fee *Phil. Mag.*) was one of the very firft thought of and tried for this purpofe, and was given up, as well as all others on the fame principle; and the immediate contact of cold water was preferred as incomparably more effective. The great fuperiority of the capacity of water for heat is now well known. It is true, that when we employ an extenfive cold furface of the condenfer, this furface is kept cold by the water round it; and therefore we ftill avail ourfelves of this great avidity of water for heat. But this water muft act through the intervention of the veffel; and the fubftance of the veffel does not convey heat to the furrounding water in an inftant.

Page 749. col. 2.—No diftinct experiment fhews fo great an expanfion of water, when converted into fteam at the temperature 212°; and under the preffure 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 fix 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 neceffary for injection may be determined on principle, at leaft for an engine having a feparate condenfer. Every cubic foot of common fteam produces about an inch of water when condenfed, and contains about as much latent heat as would raife 1100 inches of water one degree. This fteam muft not only be condenfed, but muft be cooled to the temperature of the hot well; therefore as many inches of cold water muft be employed as will require all this heat to raife it to the temperature of the hot well. Therefore let x be the cubic feet of fteam, or capacity of the cylinder, and let y be the inches of cold water expended in condenfing 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 ciftern. 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 fhould never be higher, if we would have a tolerable vacuum in the cylinder), and that of the injection ciftern 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 condenfe the fteam. 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 cafe of a good Newcomen's engine, the cylinder of which contained almoft 30 cubic feet of fteam. And this circumftance fhews the fuperiority of the engine with a feparate condenfer. The injection of Newcomen's engine had been adjufted by experience, fo as to make the beft compenfation for the unavoidable wafte in the cylinder. We prefume that this machine was not loaded above eight pounds per inch, more likely with feven; whereas as Watt's engine, working in the condition now defcribed, bears a load not much below twelve, making at leaft twelve ftrokes per minute.

This is not a matter of mere curiofity; it affords a very exact rule for judging of the good working order of the engine. We can meafure with accuracy the water admitted into the boiler during an hour, without allowing its furface to rife or fall, and the water employed for injection. If the laft be below the proportion now given (adapted to the temperatures 50° and 100°), we are certain that fteam is wafted by leaks, or by condenfation in fome improper place. The rule is not ftrictly conformable to the latent heat of fteam which balances the atmofphere, 1100° being fomewhat too great a value. It is accommodated to the actual performance of Watt's engines, when in their beft working condition.

It is evident that it is of great importance to have the temperature of the hot well as low as poffible; becaufe there always remains a fteam in the cylinder, of the fame, or rather higher temperature, poffeffing, an elafticity which balances part of the preffure on the other fide of the pifton, and thus diminifhes the power of the engine. This is clearly feen by the barometer, which Mr Watt applies to many of his beft engines, and is a moft ufeful addition for the proprietor. It fhews him, in every moment, the ftate 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 firft experiment was not exactly as here related; but much more analogous to the prefent form of his engine. The condenfer was a cylinder of tinplate, fitted with a pifton, which was drawn up from the bottom to the top, before the eduction cock was opened. Without this previous rarefaction in the condenfer, there was no inducement for the fteam to take this courfe, unlefs it were made much ftronger than that of ordinary boiling water.

The defcription of the firft form of the engine is alfo faulty, by the omiffion of a valve immediately below the eduction pipe. This valve is fhut along with the valve I, to prevent the fteam, which fhould then go into the lower part of the cylinder, from alfo going down into the condenfer. This is not abfolutely neceffary, 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 fmall engine at Mr Boulton's works at Soho was erected in 1776; and the engine at Shadwell waterworks, one of the beft yet erected, had been working fome time when we faw it in 1778. We mention this, becaufe we have been told that Mr Hornblower puts in fome 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 refpect profited by the inftruction of fuch intelligent employers. We may alfo obferve, that Mr Watt employed the fame contrivance which we have defcribed with much approbation in p. 772. *Encycl.* for keeping the collar round the pifton rods fteam and air tight. He found them effectual, but that they required more attention for keeping them in fit condition than the ufual mode of packing. He made a fimilar packing for the pifton, and with a fimilar refult.

Page 769. cols. 1. 2.—Mr Boulton eftimates the performance of the engines in the following manner. Seeing that the great expence of the engine is the confumption of fuel, he makes this the ftandard of computation, and eftimates the performance by the work which he *engages* to perform by the confumption of one bufhel of good Newcaftle coal, London meafure, or containing 84lbs without regard to the time in which this bufhel is expended. This depends on the fize of the engine.

The burning one bufhel of coal will,

1. Raife 30 million pounds one foot high.
2. It will grind and drefs 11 bufhels of wheat.
3. It will flit and draw into nail rods 5 cwt. of iron.
4. It will drive 1000 cotton fpindles, with all the preparation machinery, with the proper velocity.
5. It is equivalent to the work of ten horfes.

The general performance of the double ftroke expanfive engines is fomewhat beyond this; and their performance in cotton fpinning, or as compared with horfe work, is much under rated. The firft eftimation is without ambiguity. Suppofe the engine of fuch a fize as to confume a bufhel of coals per hour. This will be found equivalent to raifing 97 wine hogfheads of water ten feet high in a minute, which ten ftout draught horfes cannot do for a quarter of an hour together. They can raife 60 in that time, and work at this rate eight or perhaps ten hours from day to day.

Mr Watt finds that, with the moft judicioufly conftructed furnaces, it requires eight feet of furface of the boiler to be expofed to the action of fire and flame to boil off a cubic foot of water in an hour, and that a bufhel of coals fo applied will boil off from eight to twelve cubic feet.

Boulton and Watt now make fteam-engines equivalent in power to one or two horfes. The cylinder and whole machinery does not occupy more room than a fine lady's working table, ftanding in a fquare of about $2\frac{1}{2}$ feet, and about 5 feet high.

STEEL (fee that article *Encycl.* and CHEMISTRY, n° 114. *Suppl.*) is compofed 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 foft iron into fteel, by ufing the diamond inftead of charcoal in the procefs of cementation. This expenfive experiment, which was fuggefted by M. Clouet, was made, by inclofing within a fmall crucible of very foft iron a diamond, and fhutting up the crucible by a ftopper well adjufted. This crucible of iron, with its contents, was placed, without the addition of any furrounding matter, in a very fmall Heffian crucible, and the latter in a fecond crucible of the fame earth; but the fpace between the two latter crucibles was filled with filiceous fand, free from all ferruginous particles. In the laft place, the large crucible was luted with earth arifing from pounded crucibles and unbaked clay, and the whole was expofed about an hour to a three blaft forge fire. When the whole was cooled, the iron was found in the interior Heffian crucible converted into a folid ingot of caft fteel. Thus the diamond difappeared by the affinity which iron exercifed on it by the help of 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.

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. Plate XLIII.

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 Waushacum 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.*

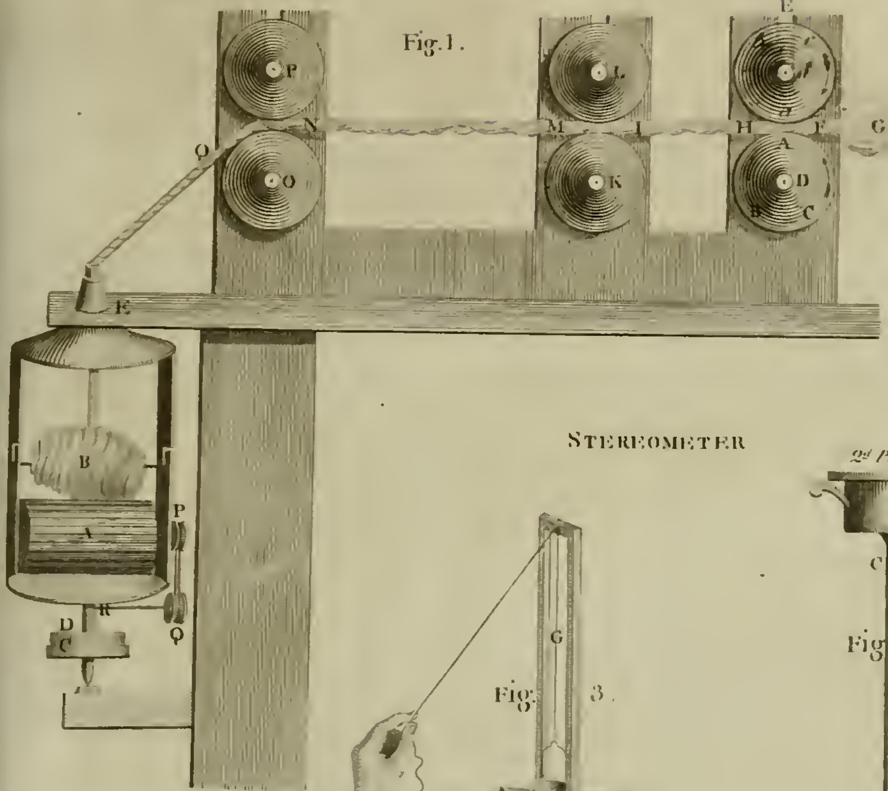
STEVENS, a ſhort navigable river of the Diſtrict of Maine. It riſes within a mile of Merry Meeting Bay, with which it is connected by a canal lately opened.—*ib.*

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.*

STEWART-

Fig. 1.



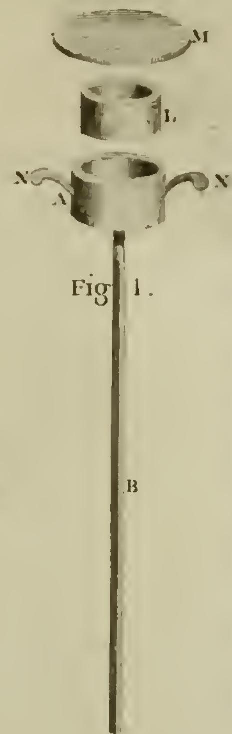


Fig. 1.

STEREOMETER

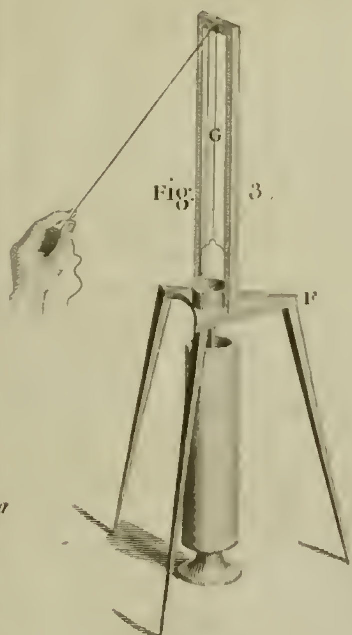


Fig. 3.

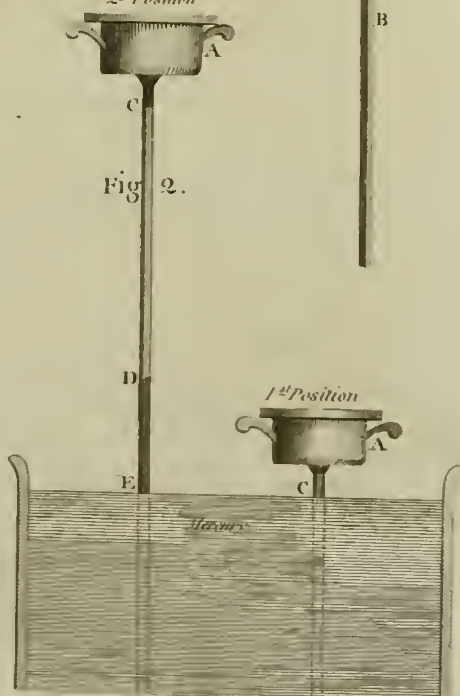


Fig. 2.

VEGETABLE SUBSTANCES

Fig. 1.

Fig. 2.

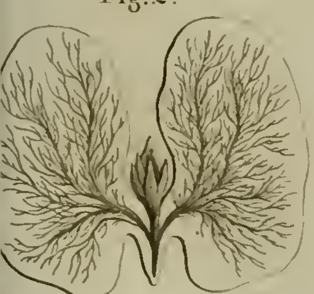
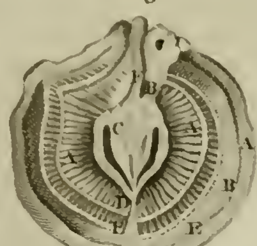


Fig. 1.

TEREBRATULA

Fig. 2.



Law

Stewart-Denham.

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. prefident of the college of juftice.

The firft rudiments of his education he received at the grammar-fchool 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 fcholar, but without any extraordinary advancement in knowledge.

It is remarkable, that many men who have been fingularly ufeful to fociety have not fhewn early fymptoms of the greatnefs of their intellectual powers. A great underftanding muft be the offspring of happy organization in a healthy body, with co-operation of time, of circumftance, and of inftitution, without being forced into prematurity by exceffive cultivation. This holds with refpect to the growth and perfection of every creature; and the truth appears remarkable with refpect to our own fpecies, becaufe we are apt to miftake the flimfy attainments of artificial education for the fteady and permanent foundations of progreffive knowledge.

From the fchool of North-Berwick Sir James was fent to the univerfity of Edinburgh, where he continued until the year 1735, when he paffed advocate before the Court of Seffion, and immediately afterwards went abroad to vifit foreign countries. He was then in the 23d year of his age, had made himfelf well acquainted with the Roman law and hiftory, and the municipal law of Scotland. He had likewife maturely ftudied the elements of jurifprudence; was verfed in the general, as well as the particular, politics of Europe; and was bent upon applying his knowledge to the inveftigation of the ftate of men and of manners in other nations, with a view to promote the benefit of his own, and to confirm himfelf in the love of a free conftitution 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 fplendour in France.

He travelled firft, however, into Holland, with a view to ftudy the conftitution of the empire before he fhould vifit Germany, and to attend fome of the lectures of the moft eminent profeffors at Utrecht and Leyden, on public law and politics. From thence he paffed into Germany, refided about a year in France, travelled thro' fome 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 fea-coaft of the lovely province of Valencia; thence returning, he croffed the Alps, and by Turin made the tour of Italy, where chiefly at Rome and Florence he refided till the beginning of the year 1740; when, having fpent five years on his travels, he returned to Scotland, and married the Lady Frances Wemyfs, eldeft daughter of the Earl of Wemyfs, about two years after his return.

A few months after his marriage the reprefentation 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 Arnifton, one of the fenators of the college of juftice, was chofen prefes of the meeting; and fome how or other omitted to caufe the name of Sir James Stewart to be called on the roll of freeholders. For this illegal ufe of his temporary power, Sir James commenced a fuit againft the prefident; and refuming the gown as an advocate, pleaded his own caufe with great energy and eloquence, and with the applaufe of the bench, the bar, and the public. This called Lord Arnifton from the bench to plead in his own defence at the bar; and Sir James could not have been oppofed to an antagonift better qualified to call forth all his powers; for that judge is talked of at this day in Edinburgh as the profoundeft lawyer and the ableft pleader that ever graced the Scottifh bench or the Scottifh bar.

With the iffue of this conteft 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 muft have rifen rapidly to the head of his profeffion. On his travels, however, he had contracted friendfhips with Lord Marifchal, and other eminent men, attached to the pretenfions of the royal family of Stuart, and had received flattering attentions from the Pretender to the Britifh throne; the impreffion arifing from which, added to the irritations of his controverfy with the powerful party in Scotland attached to the court, led him, unadvifedly, into connections with the movers of the rebellion in 1745.

As he was by far the ableft man of their party, the Jacobites engaged him to write the Prince Regent's manifefto, and to affift in his councils. Information having been given of his participation in thefe affairs, he thought it prudent, on the abortion of this unhappy attempt, to leave Britain; and by the zeal, it is faid, of Arnifton, he was excepted afterwards from the bill of indemnity, and rendered an exile from his country.

He chofe France for his refidence during the ten firft years of his banifhment, and was chiefly at Angoulefme, where he fuperintended the education of his fon; from thence he went to Tubingen in Suabia, for the benefit of its univerfity, in profecution of the fame dutiful and laudable defign; but in the end of the war 1756, having been fufpected by the court of Verfailles of communicating intelligence to the court of London, he was feized at Spa, and kept fome time in confinement; from which being liberated, after the acceffion of the prefent king of Great Britain, he came, by toleration, to England, and refided at London, where he put the laft hand to his Syftem of Political Economy, the copy right of which he fold to Andrew Millar; and being permitted to dedicate this work to the king, he applied for a *noli profequi*, which, after fome malicious objections, he obtained, and had the comfort of returning to his family eftate in Scotland.

Having nothing profeffional to do during his long refidence in France, the active mind of Sir James was occupied in ftudy. His book on the Principles of Political Economy contains moft of the fruits of it. He turned himfelf, in the intervals of leifure, to confider the refources 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 ftudying the language of the finances, without which nobody can afk a proper queftion concerning them, fo as to be underftood, that he attained his great purpofe.

As foon as he could afk queftions properly, he applied in familiar converfation to the intendants and their

 fubftitutes

fubftitutes in the provinces where he refided, whom he found extremely defirous to learn the ftate of the Britifh finances, under the branches of the land-tax, cuftoms, excife, and other inland duties. This led him to compare the ftate of the two nations. The information he gave was an equivalent for the information he received; curiofity balanced curiofity, each was fatisfied and inftructed. The department of the intendants in France was confined to the taxes which compofed the *recettes generales*, namely, the *taille*, the *capitation*, and the *twentieths*, or *vigntiemes*. 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 anfwers he got; and when he came to refide at Paris, he obtained more ample information, both from the gentlemen of the revenue, and from perfons of the parliament of Paris, who to the number of 25 had been for 15 months exiled in the province where he had fo long refided at Angoulefme.

With thefe advantages, with much ftudy and attention to arrangement, he was enabled to compofe the fixth chapter of the fourth part of the fourth book of his Syftem of Political Economy; a portion of that great work well worthy the attention of thofe who wifh to know the ftate of France in refpect of revenue under the old government.

Although Sir James Stewart's leifure, during the firft ten years of his exile, was chiefly employed in focial intercourfe with the moft learned, elegant, and polifhed characters in France, who delighted in the converfation and friendfhip of a man who poffeffed at once immenfe information, on almoft every fubject, important or agreeable to fociety, and the talent of clearly and beautifully expreffing his fentiments in flowing and animated converfation; yet he did not allow the pleafures of the circle and of the table to blunt the fine feelings of a man of genius and fcience. The labour of collecting materials for his great political work was oppreffive, and he relieved himfelf with various enquiries, fuited to the exalted ambition of his cultivated underftanding, while he turned the charms of converfation to the permanent delight of his affociates and of pofterity. The motto of Apelles, "*Nulla dies fine linea*," was the emblem of his employment; and it is amazing what may be done by daily attention for improvement, without appearing to abftract any extraordinary time from the common offices and rational pleafures of fociety.

In the beginning of the year 1755, Sir James wrote his Apology, or Defence of Sir Ifaac Newton's Chronology, which at that time he intended to publifh, but was prevented by other engagements. It was communicated to feveral perfons of eminence in France and Germany in MS. and produced, in the month of December that year in the "*Mercure de France*," an anfwer from M. Defhoulieres, to which Sir James foon after replied.

The great Newton, applying aftronomical and ftatiftical principles to the ancient chronology of Greece, had chaftifed the vanity of nations, and arrefted the progrefs of infidelity in delineating the hiftory of the world. Loft in the confufion of exceffive pretenfions to an antiquity beyond all meafure, and difgufted by the fuperftitious aids that were affumed to fupport thefe pretenfions among ancient nations, the revivers of learning in Europe, during the laft and the preceding century, turmoiled themfelves with controverfies between the comparative merits of the ancients and moderns; and the abettors of the latter, entrenching themfelves behind the falfehoods of the ancients, on the fcope of their remote hiftory, gave the lie to all antiquity, and in defpair plunged themfelves into the ocean of fcepticifm.

Happy had it been for fociety if this fcepticifm had confined itfelf to the hiftory of ancient nations in general; but the fame fpirit, taking difguft at the horrors of Chriftian ambition and bigotry, and contemplating with derifion the ridiculous legends of modern miracles, gave the lie to all religious fcripture of the Jews and Chriftians, and attempted to banifh divine intelligence, the fuperintending providence of Deity, and the true dignity of the human fpecies, from the face of the earth!

It was a noble undertaking, therefore, in Sir James, to attempt to difperfe this mift of error, by difpaffionately and fcientifically explaining and fupporting the chronology of Sir Ifaac Newton. He has done it with great precifion and effect; and it is a book well worth the perufal of thofe who wifh to read ancient hiftory with improvement, or to prevent themfelves 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 Britifh Houfe of Commons took up the confideration of a ftatute to regulate a general uniformity of weights and meafures throughout the united kingdoms, which had been fo often unfuccefsfully attempted.

This called the attention of Sir James, not only to the inveftigation of the particular fubject that engaged that of the Houfe of Commons, but to devife a method of rendering an uniformity of weights and meafures univerfal. He thought the caufe of former difappointments in this ufeful purfuit had been the miftaken notion that one or other of our prefent meafures fhould be adopted for the new ftandard. After the plan had been relinquifhed by the parliament of England, he digefted his notes and obfervations on this important difquifition into the form of an epiftolary differtation, which he tranfmitted to his friend Lord Barrington, and refolved, if there had been a congrefs affembled, as was once propofed, to adjuft the preliminaries of the general peace in 1763, to have laid his plan before the minifters of the different nations, who were to prepare that falutary pacification of the contending powers.

This epiftolary differtation Sir James afterwards reduced at Coltnefs, in the year 1777, into a form more proper for the public eye, and fent a corrected copy to a friend, referving another for the prefs, which was printed 1790 for Stockdale in Piccadilly.

In this tract the author fhews, from the ineffectual attempts that have been made to alter partially, by innovation, the ftandards of meafures or weights, that the effectual plan to be adopted, is to depart entirely from every meafure whatfoever now known, and to take, *ad libitum*, fome new mafs inftead of our pound, fome new length inftead of our ell, fome new fpace inftead of our acre, and fome new folid inftead of our gallon and bufhel.

For this purpofe Sir James propofes as the unit a mafs to be verified with the greateft poffible accuracy, equal

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, *Pokemitt*, or *Poutipog*, 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. ‖ Subduction.

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

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,	10. Camphor,
2. Starch,	11. Reſins,
3. Gluten,	12. Caoutchouc,
4. Albumen,	13. Wax,
5. Gum,	14. Wood,
6. Jelly,	15. Acids,
7. Extract,	16. Alkalies,
8. Tan,	17. Earths,
9. Oils,	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.*

* See *Falconer's Hiſtory of Sugar*, *Mancheſter Memoirs*, iv. 291. and *Mozeley's Hiſtory of Sugar*.

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*.

Suga[r] 5 How o[b]tained.

6 Its prop[er]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[ity] in wat[er].

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[stals].

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.†

† *Gillo[t]*, *Ann. d[e] Chim.* 317.

9 Solubi[lity] in alc[ohol].

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.‖

§ *Enc. Meth.* i. 271

‖ *Sche[ele]* 52. D[e] tranſl.

Sugar abſorbs muriatic acid gas ſlowly, and aſſumes a brown colour and very ſtrong ſmell.‡

‡ *Prie[stley]* ii. 29

1[0] Actio[n of] 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[1] Of p[otash].

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

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.*

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.‡

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.

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.

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.

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.

Starch. 16 Plants containing it.

* *Ruſſ. Tranſ. Philad.* iii. 64.

† *Ann. de Chim.* xxxii. 163.

SECT. II. *Of 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. 17 Method of obtaining ſtarch.

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.

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. 18 Its properties.

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. 19 How acted on by water,

Starch is ſo far from diſſolving in alcohol, even when aſſiſted by heat, that it does not even fall to powder. 20 Alcohol,

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- 21 Acids,

mills,

Gluten. 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 acrid, 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.*

* *Scheele, Crell's Jour.* ii. 14. Engliſh tranſlation.

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 caremel 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.

† *Cruickſhank, Rollo on Diabetes.*

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,	Imperatoria oſtrutheum,
Atropa belladonna,	Hyoſcyamus niger,
Polygonum biſtorta,	Rumex obtuſifolius,
Bryonia alba,	——— acutus,
Colchicum autumnale,	——— aquaticus,
Spiræ filipendula,	Arum maculatum,
Ranunculus bulboſus,	Orchis maſcula,
Scrophularia nodoſa,	Iris pſeudacorus,
Sambucus ebulus,	—— fœtidiſſima,
——— nigra,	Orobus tuberoſus,
Orchis morio,	Bunium bulbocaſtanum.

It is found alſo nearly pure in the following ſeeds:

Oats,	Cheſnut	Acorn,
Rice,	Horſecheſnut,	And alſo in
Maiz,	Peas,	Salop,
Millet,	Beans,	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.†

† *Collect. Acad.* x.

26 Its properties. 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 of 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.§

‡ *Ann. de Chim.* vi. 278.

§ *Ibid.* vi. 135.

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 ‖

‖ *Vauquelin, Ibid.* vi. 278.

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.¶

¶ *Fourcroy*

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. 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.

32 Its compoſition.

33 Subſtances containing 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.

* *Ibid.*

† *Ibid.* vi. 135.

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 lly. it out, has given the name of *albumen* (A), on account of its resemblance to the *white* of an egg.‡

n. de . iii. It is evident, from the method of obtaining it, that albumen, in its natural ftate, is foluble in water, and
34 that heat precipitates it from that fluid in a concrete
erties ftate. While diffolved in water, it has fcarcely any
umen. tafte; but it has the property of changing vegetable blues, efpecially that which is obtained from the flowers
urcroy, of the mallow (*malva fylveftris*), into a green.§ When
257. allowed to remain diffolved in water, it putrefies with-
d. out becoming previoufly acid.||

After it has been precipitated from water in a concrete ftate by boiling, it is no longer foluble in water as before. Alcohol alfo precipitates it from water precifely in the fame ftate as when it is precipitated by heat.

When concrete albumen is dried it becomes fomewhat tranfparent, and very like glue. In that ftate it
d. is foluble in alkalies, efpecially ammonia.*

When diftilled it gives out carbonat of ammonia, a red fetid oil, and carbonated hydrogen gas; and a fpon-
35 gy charcoal remains behind.† From this, it is evident
ompo- n. that albumen, like gluten, is compofed of carbon, azot,
d. hydrogen, and oxygen; but the proportions and combinations of thefe fubftances are altogether unknown.

Mr Fourcroy found albumen in the expreffed juice of fcurvy grafs, creffes, cabbage, and almoft all cruciform plants. He found it too, in a great many young and fucculent plants; but never a particle in thofe parts of vegetables which contain an acid. He obferved alfo that the quantity decreafed conftantly with the age of the plant.

SECT. V. *Of Jelly.*

IF we prefs out the juice of ripe blackberries, currants, and many other fruits, and allow it to remain for fome time in a ftate of reft, it partly coagulates into a tremulous foft fubftance, well known by the name of *jelly*. If we pour off the uncoagulated part, and wafh the coagulum with a fmall quantity of water, we obtain *jelly* approaching to a ftate of purity.

36 In this ftate it is nearly colourlefs, unlefs tinged by
perties the peculiar colouring matter of the fruit; it has a plea-
elly. fant tafte, and a tremulous confiftency. It is fcarcely foluble in cold water, but very foluble in hot water; and, when the folution cools, it again coagulates into
auquelin, the form of a jelly.† When long boiled, it lofes the
. de property of gelatinifing by cooling, and becomes ana-
n. vi. logous to mucilage.‡ This is the reafon that in mak-
. Ibid. ing currant jelly or any other jelly, when the quanti-
00. ty of fugar added is not fufficient to abforb all the watery parts of the fruit, and confequently it is neceffary to concentrate the liquid by long boiling, the mixture often lofes the property of coagulating, and the jelly, of courfe, is fpoiled.§

Gum.

§ *Ann. de Chim.* v. 102.

|| *Ibid.* vi. 282.

¶ *Ibid.* v. 100.

† *Ibid.* vi. 286.

Jelly combines readily with alkalies; nitric acid converts it into oxalic acid, without feparating any azotic gas.|| When dried it becomes tranfparent.¶ When diftilled it affords a great deal of pyromucous acid, a fmall quantity of oil, and fcarcely any ammonia.†

Jelly exifts in all acid fruits, as oranges, lemons, goofeberries, &c. and no albumen is ever found in thofe parts of vegetables which contain an acid. This circumftance has induced Fourcroy to fuppofe that jelly is albumen combined with an acid:* but this conjec-
ture has not been verified by experiment: nor indeed is it probable that it ever fhall; as albumen evidently contains a quantity of azot, and jelly fcarcely any. The products of jelly by diftillation fhew that it approaches nearer than any other vegetable fubftance to the nature of fugar.

* *Ibid.* iii. 261.

SECT. VI. *Of Gum.*

THERE is a thick tranfparent taftelefs fluid which fometimes exfudes from certain fpecies of trees. It is very adhefive, and gradually hardens without lofing its tranfparency; but eafily foftens again when moiftened 37
with water. This exfudation is known by the name of Gum how obtained.
gum. The gum moft commonly ufed is that which exfudes from different fpecies of the *mimofa*, particularly the *nilotica*.† It is known by the name of *gum arabic*. Gum likewife exfudes abundantly from the *prunus avium*, or common wild cherry tree of this country.

† *Schoufboe, Philof. Mag.* v. 241.

Gum is ufually obtained in fmall pieces like tears, moderately hard, and fomewhat brittle while cold, fo that it can be reduced by pounding to a fine powder. Its colour is ufually yellowifh, and it is not deftitute of luftre. It has no fmell; its tafte is infipid.

Gum undergoes no change from being expofed to the atmofphere; but the light of the fun makes it af- 38
fume a white colour. Water diffolves it in large quan Action of
tities. The folution which is known by the name of water.
mucilage (B), is thick and adhefive: it is often ufed as a pafte, and to give ftiffnefs and luftre to linen. When fpread out thin it foon dries, and has the appearance of a varnifh; but it readily attracts moifture, and becomes glutinous. Water wafhes it away entirely. When mucilage is evaporated the gum is obtained unaltered.

Gum is infoluble in alcohol. When alcohol is pour- 39
ed into mucilage, the gum immediately precipitates; Alcohol.
becaufe 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

(A) The exiftence of albumen in vegetables was known to Scheele. He mentions it particularly in his paper on Milk, firft publifhed in the year 1780. See *Scheele's Works*, II. 55. Dijon edition.

(B) Hermftadt ufes this word in a different fenfe. He makes a diftinction between *gum* and *mucilage*. The folution of *gum* in water is tranfparent and glutinous, and can be drawn out into threads; whereas that of *mucilage* is opake, does not feel glutinous, but flippery, and cannot be drawn into threads. Gum may be feparated from mucilage by the following procefs:

Let the gum which is fuppofed to be mixed with mucilage, previoufly reduced to a dry mafs, be diffolved in as fmall a quantity of water as poffible, and into the folution drop at intervals diluted fulphuric acid. The mucilage coagulates while the gum remains diffolved. When no more coagulation takes place, let the mixture remain at reft for fome time, and the mucilage will precipitate to the bottom, and affume the confiftence of jelly. Decant off the liquid part, and evaporate the mucilage to drynefs by a gentle heat till it acquires the confiftence of horn. *Med. and Phyf. Jour.* iii. 370.

Extract. 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.*

‡ Vauquelin.

* Id. Ann. de Chim. vi. 178.

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.§

§ Cruickshank Rollo on Diabetes.

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.‖

‖ Ibid.

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:

¶ Hermstadt.

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.*

* Hermstadt.

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.†

† Fourcroy.

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.‡

‡ Fourcroy.

Extract is soluble in acids. Heat softens but does not melt it.§

§ Id. Ann. de Chim. viii.

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 tan. 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.

‖ Nicholson's Jo. i. 271.

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

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.*

[margin: ...ouſt, de ... xxv.]

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:

[margin: 46 ...s con-...ng it.]

	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.

47 [margin: ...erties ...nphor]

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.*

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.†

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.‡

[margin: ...ieu. ...ieu. Par. p. 41.]

Camphor. ‡ *Romieu, Mem. Par.* 1756, p. 41.

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.

§ *Bouillon la Grange, Ann. de Chim.* xxiii. 154.

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 §

§ *Fourcroy.*

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.‖

‖ *Bouillon la Grange, ibid*, p. 168.

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.* 48 Its analyſis.

* *Ibid*, p. 157.

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.

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.† 49 Plants containing it.

† *Ann. de Chim.* iv. 179.

Camphor, which was unknown to the ancient Greeks and Romans, was introduced into Europe by the Arabians.

Reſins.

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*.

* *Hermſtadt.*

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.

† *Crell's Annals*, i. 1790.

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.‡

‡ *Hermſtadt.*

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,	7. Sandarac,
2. Turpentine,	8. Guaiacum,
3. Pitch,	9. Labdanum,
4. Galipot,	10. Dragon's blood,
5. Elemi,	11. Copaiba.
6. Maſtic,	

52 Balſa[ms]

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 re[-] 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,	Aloes,
Galbanum,	Myrrh,
Scammony,	Ammoniac,
Aſafœtida,	Opium.

For an account of them we refer to the *Encyclopædia*.

Sect. XII. *Of Caoutchouc.*

54 Diſcove[ry] of caoutchouc.

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 [con-] 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.*

* *Aſiati[c] Reſearch[es]*, v. 167. London edition.

When

When any of these plants is punctured, there exudes 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.†

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*.

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.

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 foldered together, and thus made to assume whatever shape we please.§

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.

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.

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.

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. 60 Oils.

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. 61 Acids and alkalies.

Fabroni has discovered, that rectified petroleum dissolves it, and leaves it unaltered when evaporated.¶

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. 62 Heat.

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.

When treated with nitric acid, there came over azotic gas, carbonic acid gas, prussic acid gas; and oxalic acid was formed.||

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 soluble 63 How to separate it from plants.

(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.

|| Ann. de Chim. xi. 147.
* Berniard.
† Id.
‡ Id.
¶ Ibid. 195. & xii. 156.
§ Fourcroy, Ann. de Chim. xi. 232.
|| Ibid.

Wax.

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.*

* Hermstadt, Med. and Phys. Jour. iii. 372.

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.

† Id. ibid. 373.
‡ Enc. Meth. Forets et Bois, i. 100.

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.

§ Senebier, Ann. de Chim. xii. 60. and Jour. de Phys. xxxviii. 56.
|| Chaptal, iii. 164.
* Plin. l. 21. c. 14.
† Jour. de Phys. Nov. 1785.

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.

‡ Nicholson's Journal, i. 71.

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.†

* Lavo[isier] Jour. [de] Phys. [...] 59.
† Lem[ery] Mem. [...] 1708. [...] 53.

Sect. XIV. *Of the Woody Fibre.*

Woo[dy] Fibr[e].

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[ties] of woo[d].

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.*

* Fourc[roy] Ann. d[e] Chim. [...] 149.

68 Its anal[ysis].

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 ids. increaſe of weight in the product was evidently owing to the oxygen derived from the nitric acid.*

. de viii. 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.

. 151. 100.000*.

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

. xxi. 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.

SECT. XV. *Of Acids.*

THE acids found ready formed in vegetables are the following:

1. Oxalic,
2. Tartarous,
3. Citric,
4. Malic,
5. Gallic,
6. Benzoic,
7. Phoſphoric.

Sometimes alſo the ſulphuric, nitric, and muriatic acids occur in vegetables, combined with alkalies or earths, but never except in very minute quantities.

69 ts containing 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.§

heele, 's Jour. 7.Eng. nſl. d. 34. rmſtadt.

70 tarous 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.

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.†

uquelin, . de r. v. rmſtadt eget. s. ndheim, , 1788, . s. 42. offman Veimar. rmſtadt eget. s.

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:

Apples.
Berberis vulgaris, *barberry*.
Prunus domeſtica, *plum*.
———ſpinoſa, *ſloe*.
Sambucus nigra, *elder*.
Sorbus aucuparia, *roan* or *ſervice*.

† *Ibid.*

73 Malic and citric, In the following fruits he found nearly an equal quantity of malic and citric acids.‡

Ribes groſſularia, *gooſeberry*.
———rubrum, *currants*.
Vaccinium myrtillus, *bleaberry*.
Crategus aria, *beam*.
Prunus ceraſus, *cherry*.
Fragaria veſca, *ſtrawberry*.
Rubus chamæmorus, *cloudberries*, *evrocks*.
———idæus, *raſpberry*.

‡ *Ibid.*

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.

7. Phoſ-

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.‡

* Enc. Meth. Phyſiol. Veget. i. 100.
† Ann. de Chim. ii. 308.
‡ Bergman, v. 96.

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.†

† Ann. de Chim. xix. 174.

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.

78 Soda.

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*.

* Vau[quelin,] Ann. [de] Chim. 77.

SECT. XVII. *Of Earths.*

The only earths hitherto found in plants are the four following; *lime, ſilica, magneſia, alumina.*

79 Lime.

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.*

* Id. i[bid.]

80 Silica.

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.

81 Magneſia.

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.‡

† Id. 80. a[nd] 94.
‡ Ibid.

82 Alumina.

4. Alumina has only been found in very ſmall quantities in plants.

83 Propo[rtion] of ear[ths in] 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

* Wa[...]
† Kir[wan,] Iriſh [Tranſ.] iii. 3[...]
‡ Hom[...]
§ Wi[...]

(c) Thoſe marked * are from *Kirwan, Iriſh Tranſ.* v. 164. The reſt from *Pertuis, Ann. de Chim.* 19. 178.

Metals.

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.

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 Chim. 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
Three metals found in 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. Mag.* 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
Simple ſubſtances contained in plants.

1. Oxygen,	9. Gold,
2. Sulphur,	10. Lime,
3. Phoſphorus,	11. Magneſia,
4. Carbon,	12. Silica,
5. Hydrogen,	13. Alumina,
6. Azot,	14. Potaſs,
7. Iron,	15. Soda,
8. Manganeſe,	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.

Vegetation.

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 fortu-

Vegeta-tion.

nate 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.

* *Ann. de Chim.* xxxiv. 35.

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.§

§ *Enc. M. Phyſiol. Veget.* 124

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.

† *Phil. Tranſ.* Nº 53.

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

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.

* Experi-
es sur les
egetaux, ii.
† Mem.
hysico-
imique, iii.
31.

‡ Jour. de
hys. 1789,
ecemb.

§ Enc. Meth.
hysiol. Veg.
. 126.

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 enome-
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 e coty-
ons 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.

* Gough,
anch.
em. iv.
5, Cruick-
nk, Rollo
Diabetes,
452.

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.

† Ibid.

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.

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. 96 Which passes into the radicle, 97 And converts it into a root.

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. 98 Cotyledons become seminal leaves,

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

Vegetation.

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.

99 Which prepare the food sent from the root.

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.

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.*

* *Enc. Meth. Physiol. Veget.* 42.

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 Compo- 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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106 oodcom-fed of The WOOD lies immediately under the bark, and forms by far the greateft part of the trunk and large branches of trees. It confifts of concentric layers, the number of which increafes with the age of the part. Each of thefe layers, as Mr Du Hamel afcertained, may be feparated into feveral thinner layers, and thefe are compofed chiefly of longitudinal fibres. Hence the reafon that wood may be much more eafily fplit afunder than cut acrofs.

The *wood*, when we infpect it with attention, is not, through its whole extent, the fame; the part of it next the bark is much fofter and whiter, and more juicy

107 burnum d perfect od. than the reft, and has for that reafon obtained a particular name: it has been called the *alburnum* or *aubier*. The *perfect wood* is browner, and harder, and denfer, than the alburnum, and the layers increafe in denfity the nearer they are to the centre. Sir John Hill gave to the innermoft 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 h. The PITH occupies the centre of the wood. It is a very fpongy body, containing a prodigious number of cells, which anatomifts have compared to bladders. In young fhoots it is very fucculent; but it becomes dry as the plant advances, and at laft in the large trunks of many trees difappears altogether.

109 aves. The LEAVES are attached to the branches of plants by fhort footftalks. From thefe footftalks a number of fibres iffue, which ramify and communicate with each other in every part of the leaf, and form a very curious network. Thefe fibres may be obtained feparately, by keeping the leaf long in moifture. Every other part of it putrefies, and falls off, or may eafily be rubbed off, and only the fibres remain, conftituting a fkeleton of the leaf. In every leaf there are two layers of thefe fibres, forming two diftinct fkeletons, which had conftituted the upper and under furface of the leaf.

The whole leaf is covered with the epidermis of the plant; and this epidermis, as Sauffure has fhewn, contains in it a great number of glands. The other parts of the bark may alfo be traced on many leaves; at leaft Sauffure has fhewn, that the *bark* of leaves is compofed of two different layers. The interftices between the fibres of the leaf are filled up by a pulpy-like fubftance, to which the green colour of the leaf is owing.

Such is a fhort defcription of the moft confpicuous parts of plants. A more minute account would have been foreign to the fubject of the prefent article.

110 nts in-afe in . 9. Plants, after they have germinated, do not remain ftationary, but are continually increafing in fize. A tree, for inftance, every feafon, adds confiderably to its former bulk. The root fends forth new fhoots, and the old ones become larger and thicker. The fame increment takes place in the branches and the trunk. When we examine this increafe 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 juft under the bark. We find, too, that a layer of alburnum has affumed the appearance of perfect wood. Befides this addition of vegetable fibre, a great number of leaves have been produced; and the tree puts forth flowers, and forms feeds. Vegetation.

It is evident from all this, that a great deal of new matter is continually making its appearance in plants. Hence, fince it would be abfurd to fuppofe that they *create* new matter, it muft follow that they receive it by fome channel or other. Plants, then, require food as well as animals. Now, what is this food, and whence do they derive it? Thefe queftions can only be anfwered by an attentive furvey of the fubftances which are contained in vegetables, and an examination of thofe fubftances which are neceffary for their vegetation. If we could fucceed completely, it would throw a great deal of light upon the nature of foils and of manures, and on fome of the moft important queftions in agriculture. But we are far indeed at prefent from being able to examine the fubject to the bottom. 111 Therefore require food.

112 Water neceffary. 10. In the firft place, it is certain that plants will not vegetate without water; for whenever they are deprived of it, they wither and die. Hence the well known ufe of rains and dews, and the artificial watering of ground. We may conclude, then, that water is at leaft an effential part of the food of plants.

But many plants grow in pure water; and therefore it may be queftioned 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 demonftrate it. Indeed, it was the general opinion of the 17th century; and fome of the moft fuccefsful improvers of the phyfiology of plants, in the 18th century, have embraced it. The moft zealous advocates for it were, Van Helmont, Boyle, Bonnet, Duhamel, and Tillet.

113 Suppofed the whole food of plants; Van Helmont planted a willow which weighed five pounds, in an earthen veffel filled with foil previoufly dried in an oven, and moiftened with rain water. This veffel he funk into the earth, and he watered his willow, fometimes with rain, and fometimes with diftilled water. After five years it weighed 169¼lbs. and the earth in which it was planted, when again dried, was found to have loft only two ounces of its original weight. Here, it has been faid, was an increafe of 164lb. and yet the only food of the willow was pure water; therefore it follows that pure water is fufficient to afford nourifhment to plants. The infufficiency of this experiment to decide the queftion was firft pointed out by Bergman in 1773.* He fhewed, from the experiments of Margraff that the rain water employed by Van Helmont contained in it as much earth as could exift 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. Befides, as Mr Kirwan has remarked,‡ the earthen veffel muft have often abforbed moifture, from the furrounding earth, impregnated with whatever fubftance that earth contained; for unglazed earthen veffels, as Hales* and Tillet† have fhewn, readily tranfmit moifture.

Hence it is evident that no conclufion whatever can be drawn from this experiment; for all the fubftances which the willow contained, except water, may have been derived from the rain water, the earth in the pot, and the moifture imbibed from the furrounding foil. 114 But without reafon.

* *Opufc.* v. 92.

† *Opufc.* ii. 15 and 19.

‡ *Irifh Tranf.* v. 150.

* *Veget. Stat.* i. 5.

† *Mem. Par.* 1772. 298.

The

Vegetation.

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.*

* *Ann. de Chim.* xiii. 188.

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 ſalts

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

(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.

Vegetation. 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 And carbon. 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.

* Encyc. Meth. Phys. Veget. p. 5.

† Ann. de Chim. xiv.

‡ Encyc. Meth. Phys. Veget. p. 7.

119 Which must be in a particular 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.

* Ann. de Chim. xiv. 57.

† Ibid. p. 58.

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 importrant 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.†

* Ibid. p. 56.

† Mem. Par. 1748.

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

‡ Ann. de Chim. xiii. 320.

122 Though that gas is useful.

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.

† *Crell's Annals*, 1783. ii. 399.

* *Ibid.* 1791. i. 53.

† *Kirwan*, *Iriſh. Tranſ.* v. 156.

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.

* *Ingenhouſz.*

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.†

‡ *Phyſique des Arbres*, ii. 239.

† *Manch. Mem.* ii. 412.

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. 124 Diſſolved in water.

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. 125 Therefore fluid.

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. 126 Sap of plants.

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

Vegeta-tion.

may be suppofed to be greater. We fhould therefore examine the fap as early in the feafon as poffible, and at all events before the leaves have expanded.

127 Sap analyfed.

For the moft complete fet of experiments hitherto made upon the fap, we are indebted to Mr Vauquelin. An account of his experiments has been publifhed in the 31ft volume of the *Annales de Chimie*. He has neglected to inform us of the ftate of the tree when the fap which he analyfed was taken from it; fo that we are left in a ftate of uncertainty with refpect to the purity of the fap: but from the comparifon which he has put it in our power to draw between the ftate of the fap at different fucceffive periods, we may in fome meafure obviate this uncertainty.

He found that 1039 parts of the fap of the ulmus campeftris, or common elm, were compofed of

1027.567 water and volatile matter,
9.553 acetite of potafs,
1.062 vegetable matter,
0.818 carbonat of lime,

Befides fome flight traces of fulphuric and muriatic acids.

On analyfing the fame fap fomewhat later in the feafon, Mr Vauquelin found the quantity of vegetable matter a little increafed, and that of the carbonat of lime and acetite of potafs diminifhed. Still later in the feafon the vegetable matter was farther increafed, and the other two ingredients farther diminifhed. The acetite of potafs, in 1039 parts of this third fap, amounted to 8.615 parts.*

* *Ann. de Chim.* xxxi. 2.

If thefe experiments warrant any confequence to be drawn from them, they would induce us to fuppofe that the carbonat of lime and acetite of potafs were contained in the pure afcending fap, and that part at leaft of the vegetable matter was derived from the peculiar juices altered by the fecreting organs of the plant; for the two falts diminifhed in quantity, and the vegetable matter increafed as the vegetation of the tree advanced. Now this is precifely what ought to have taken place, on the fuppofition that the fap became more and more mixed with the peculiar juices of the tree, as we are fuppofing it to do. If thefe conclufions have any folidity, it follows from them, that carbonat of lime and acetite of potafs are abforbed by plants as a part of their food. Now thefe falts, before they are abforbed, muft be diffolved in water. But the carbonat of lime may be diffolved in water by the help of carbonic acid. This fhews us how water faturated with carbonic acid may be ufeful to plants vegetating in a proper foil, while it is ufelefs to thofe that vegetate in pure water. In the pure water there is no carbonat of lime to be diffolved; 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 fap by alcohol. This part feems to have been gummy. Now gums we know are produced by vegetation.

The fap of the fagus fylvatica, or beech, contained the following ingredients.

Water,
Acetite of lime with excefs of acid,
Acetite of potafs,
Gallic acid,
Tan,
A mucous and extractive matter,
Acetite of alumina.

Although Mr Vauquelin made two different analyfes of this fap at different feafons, it is impoffible to draw any fatisfactory conclufions from them, as he has not given us the proportions of the ingredients. It feems clear that the gallic acid and tan were combined together; for the fap tafted like the infufion of oak bark. The quantity of each of thefe ingredients increafed as vegetation advanced; for the colour of the fecond fap collected later was much deeper than that of the firft. This fhews us that thefe ingredients were produced by vegetation, and that they did not form a part of the afcending fap. Probably they were derived from the bark of the tree. The prefence of alumina, and the abfence of carbonic acid gas, would feem to indicate that all plants do not imbibe the very fame food.

The fap of the carpinus fylveftris contains water, acetite of potafs, acetite of lime, fugar, mucilage, vegetable extract. It cannot be doubted that the fugar and the mucilage are the produce of vegetation.

The fap of the betula alba, or common birch, contains water, fugar, vegetable extract, acetite of lime, acetite of alumina, and acetite of potafs.

Thefe experiments are curious, and certainly add to the precifion of our notions concerning the food of plants; but they are not decifive enough to entitle us to draw conclufions. They would feem to fhew, either that acetite of potafs and lime are a part of the food of plants, or at leaft fome fubftances which have the property of affuming thefe combinations.

128 Whether the food is altered by the roots.

16. Thefe experiments led to the conclufion that acetous acid forms a component part of the fap. Now it is not eafy to fuppofe that this fubftance is actually abforbed by the roots in the ftate of acetous acid. The thing might be determined by examining the mould in which plants grow. This examination indeed has been performed; but no chemift has ever found acetous acid, at leaft in any fenfible quantity. Is it not probable, then, that the food, after it is imbibed, is fomewhat modified and altered by the roots? In what manner this is done we cannot fay, as we know very little about the vafcular ftructure of the roots. We may conclude, however, that this modification is nearly the fame in moft plants: for one plant may be engrafted on another, and each continue to produce its own peculiar products; which could not be, unlefs the proper fubftances were conveyed to the digeftive organs of all. There are feveral circumftances, however, which render the modifying power of the roots fomewhat probable. The ftrongeft of thefe is the nature of the ingredients found in the fap. It is even poffible that the roots may, by fome means or other, throw out again fome part of the food which they have imbibed as excrementitious. This has been fufpected by feveral phyfiologifts; and there are feveral circumftances which render it probable. It is well known that fome plants will not vegetate well after others; and that fome again vegetate unufually well when planted in ground where certain plants had been growing. Thefe 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 laft ftage of vegetation. That is to fay, when the food, after digeftion, is applied to the purpofes which the root requires. But the fact ought to be fupported by experiments, otherwife it cannot be admitted.

17. The

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.*

* Veg. Stat. i. 105.

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*.

* Phyſique des Arbres i. 57.

† Fundament. Hiſt. Nat. Micr. Front. Part i. 54.

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?‡

‡ Veget. Stat. i. 1

134 Hypotheſis of Grew, Malpighi 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 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 thoſe 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,

(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 motion 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.

* Edin. Tranſ. i.

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 op 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.

† Encyc. Meth. Phyſ. Veget. p. 267.

‡ Mem. Par. 1

§ Phil. Tranſ. lxxviii.

139
In conſequence of 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.*

* Ann. Chim. xxiii. 6

140
Peculiar juice formed 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.

† Bell. Manch. Mem. i 402.

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

zeta-on.

142 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.

il. f. 53. — et. i. 5. 15. — l. 30. — d. 5. — d. 27. 48. — d. 22. em. 1748.

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.

143 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, $\frac{1}{4}$ grain of matter soluble in water, and having the appearance of gum, and $\frac{1}{6}$ 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 $\frac{1}{4}$ grain of carbonat of lime, $\frac{1}{4}$ grain of sulphat of lime, $\frac{1}{4}$ grain of mucilage, and $\frac{1}{4}$ grain of resin. The liquid transpired by the *aster novæ Angliæ* afforded precisely the same ingredients.‡

‡ Metb. Veget.

144 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: Vegetation.

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.

* *Mem. Par.* 1749.
† *Physique des Arbres*, i. 158.
‡ *Traité des Feuilles*, 1 *Mem.*

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. 145 Why the leaves fall off.

* *Enc. Method. Veget.* 285.

20. Leaves have also the property of absorbing carbonic acid gas from the atmosphere.

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 146 Leaves absorb carbonic acid gas.

¶ *On Air*, iii. 251.

the

Vegetation.

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:

* *On Air*, i. 100.

† ii. 341.

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.

‡ *Ann. de Chim.* xxiv. 145. 148.

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.†

‖ *On Air*, iii. 284.

* *Ingen. on Veg.* i. 15, &

† *Ibid.*

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.

‡ *Enc. Meth. Phys. Veget.*

148
But during the day.

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.

149
In this way plants acquire much carbon.

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 $\frac{1}{30}$ of its weight of carbonaceous matter; but the same plant, after being made to vegetate in the light for 30 days, contained $\frac{1}{12}$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.

* *Mem. Par.* 1

It is evident, however, that this absorption and decomposition of carbonic acid gas does not depend upon the

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.

* *Ingenhousz* ii. passim.

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.

† *On Vegetables*, i. 47, and ii. passim.

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

Vegetation.

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.†

† *Ingenhousz* ii.

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.

* *Ann. Chim.* 225.
† *Ibid.* 139.

* *Ann. Chim.* 188.

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 colour of plants produced by 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-

egeta-
ion.

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.

Manch. Memoirs, 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.
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...d. 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.

Vegeta-
tion.

157
How they
are produ-
ced.

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 five

(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.

Vegetation.

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.

* *Ann. de Chim.* xxi. 285.

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 decay 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 Phenomena of vegetable 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 geta-tion. 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
62 *matter* without altering the meaning of the word.

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
63 known phenomena, cannot be reduced under mechanical and chemical laws. The cauſe of life, then, in e- tly g to nima- cauſe. 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). Vegetation.

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.

CHAP.

(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.

Bread.

CHAP. III. OF THE DECOMPOSITION OF VEGETABLE SUBSTANCES.

NOT only entire plants undergo decompofition after death, but certain vegetable fubftances alfo, whenever they are mixed together, and placed in proper circum-
167 Vegetable decompofitions, ftances, mutually decompofe each other, and new compound fubftances are produced. Thefe mutual decompofitions, indeed, are naturally to be expected: for as all vegetable fubftances are compofed of feveral ingredients, differing in the ftrength of their affinity for each other, it is to be fuppofed that, when two fuch fubftances are mixed together, the divellent affinities will, in many cafes, prove ftronger than the quiefcent; and therefore decompofition, and the formation of new compounds, muft take place: juft as happens when the acetite of lead and fulphat of potafs are mixed together.

Thefe mutual decompofitions of vegetable fubftances are by no means fo eafily traced, or fo readily explained, as the mutual decompofitions of neutral falts; partly on account of the number of fubftances, whofe affinities for each other are brought into action, and partly becaufe we are ignorant of the manner in which the ingredients of vegetable fubftances are mutually combined.

168 Called FERMENTATION. Chemifts have agreed to give thefe mutual decompofitions which take place in vegetable fubftances the name of *fermentation*; a word firft introduced into chemiftry by Van Helmont;* and the new fubftances produced they have called the *products* of fermentation. All the phenomena of fermentation lay for many years concealed in the completeft darknefs, and no chemift was bold enough to hazard even an attempt to explain them. They were employed, however, and without hefitation too, in the explanation of other phenomena; as if giving to one procefs, the name of another of which we are equally ignorant, could, in reality, add any thing to our knowledge. The darknefs which enveloped thefe phenomena, has lately begun to difperfe; but they are ftill furrounded with a very thick mift; and we muft be much better acquainted with the compofition of vegetable fubftances, and the mutual affinities of their ingredients, than we are at prefent, before we can explain them in a fatisfactory manner.

* *Stahl, Fundament. Chem.* i. 124.

169 Divifion of them. The vegetable fermentations or decompofitions 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 fpontaneous decompofition of decayed vegetables. Thefe fhall be the fubject of the five following fections. In order to avoid long titles, we fhall give to the firft three fections the name of the new fubftances produced by the fermentation.

SECT. I. *Of Bread.*

170 Difcovery of bread. SIMPLE as the manufacture of bread may appear to us who have been always accuftomed to confider it as a common procefs, its difcovery was probably the work of ages, and the refult of the united efforts of men, whofe fagacity, had they lived in a more fortunate period of fociety, would have rendered them the rivals of Ariftotle or of Newton.

Bread.

The method of making bread fimilar to ours was known in the Eaft at a very early period; but neither the precife time of the difcovery, nor the name of the perfon who publifhed it to the world, has been preferved. We are certain that the Jews were acquainted with it in the time of Mofes: for in Exodus* we find a prohibition to ufe leavened bread during the celebration of the paffover. It does not appear, however, to have been known to Abraham; for we hear in his hiftory of cakes frequently, but nothing of leaven. Egypt, both from the nature of the foil and the early period at which it was civilized, bids faireft for the difcovery of making bread. It can fcarcely be doubted, that the Jews learned the art from the Egyptians. The Greeks affure 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 Chriftian era.‡ Since that period the art has never been unknown in the fouth of Europe; but it made its way to the north very flowly, and even at prefent in many northern countries fermented bread is but very feldom ufed.

* Chap. v. 15.
† *Iliad*, 216.
‡ *Plin.* cap. 11

The only fubftance well adapted for making bread, we mean *loaf bread*, is wheat flour, which is compofed of four ingredients; namely, gluten, ftarch, albumen, and a *fweet mucous matter*, which poffeffes nearly the properties of fugar, and which is probably a mixture of fugar and mucilage. It is to the gluten that wheat flour owes its fuperiority to every other as the bafis of bread. Indeed, there are only two other fubftances at prefent known of which good loaf bread can be made; thefe are *rye* and *potatoes*. The rye loaf is by no means fo well raifed as the wheat loaf; and potatoes will not make bread at all without particular management. Potatoes, previoufly boiled and reduced to a very fine tough pafte by a rolling pin, muft be mixed with an equal weight of potato ftarch. This mixture, baked in the ufual way, makes a very white, well raifed, pleafant bread. We are indebted for the procefs to Mr Permentier. Barley-meal perhaps might be fubftituted for ftarch. 17 Subftances which make bread.

The baking of bread confifts in mixing wheat flour with water, and forming it into a pafte. The average proportion of thefe is two parts of water to three of flour. But this proportion varies confiderably, 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 pafte, after being thus formed, be allowed to remain for fome time, its ingredients gradually act upon each other, and the pafte acquires new properties. It gets a difagreeable four tafte, and a quantity of gas (probably carbonic acid gas) is evolved. In fhort, the pafte ferments (H). Thefe changes do not take place without water; that liquid, therefore is a neceffary agent. Poffibly it is decompofed by the action of the ftarch upon it; for when ftarch is diluted with water, it gradually becomes four. The gluten, too, is altered, either by the action of the water on it, or of the ftarch; for if we examine the pafte after 17 Baking bread.

(H) It was from this procefs that Van Helmont transferred the word *fermentation* into chemiftry.

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.

173 rm. 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.†

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.

n. · 7. · nch. · ii. · Meth. 249.

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°.

Bread. 174 Heat of the oven

*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 difcovered in it. The only chemift who has attempted an analyfis 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 refiduum infoluble in water.

96 608
3.392 lofs.

100.

But this analyfis, which was publifhed in the Memoirs of the French Academy for the year 1732, was made at a time when the infant ftate of the fcience of chemiftry did not admit of any thing like accuracy.

SECT. II. *Of Wine.*

177 Fruits affording wine

THERE is a confiderable number of ripe fruits from which a fweet liquor may be expreffed, having at the fame time a certain degree of acidity. Of fuch fruits we have in this country the apple, the cherry, the goofeberry, the currant, &c. but by far the moft valuable of thefe fruits is the *grape*, which grows luxuriantly in the fouthern parts of Europe. From grapes, fully ripe, may be expreffed a liquid of a fweet tafte, to which the name of *muft* has been given. This liquid is compofed almoft entirely of five ingredients; namely, *water*, *fugar*, *jelly*, *mucilage*, and *tartarous* acid partly faturated with potafs. The quantity of fugar which grapes fully ripe contain is very confiderable; it may be obtained in cryftals by evaporating muft to the confiftence of fyrup, feparating the tartar which precipitates during the evaporation, and then fetting the muft afide for fome months. The cryftals of fugar are gradually formed.

178 Undergo the vinous fermentation;

When muft 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 inteftine 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 ceafes, the thick part fubfides to the bottom, the liquid becomes clear, it has loft much of its faccharine tafte, and affumed a new one, its fpecific gravity is diminifhed; and, in fhort, it has become the liquid well known under the name of *wine*.

Now what is the caufe of this fermentation; what are the fubftances which mutually decompofe each other; and what is the nature of the new fubftance formed?

Thefe changes are produced altogether by the mutual action of the fubftances contained in muft; for they take place equally well, and wine is formed equally well in clofe veffels as in the open air.§

If the *muft* be evaporated to the confiftency of a thick fyrup, or to a *rob*, as the elder chemifts termed it, the fermentation will not commence, though the proper temperature, and every thing elfe neceffary to produce fermentation, be prefent.‖ But if this fyrup be again diluted with water, and placed in favourable circumftances, it will ferment. Therefore the prefence of *water* is abfolutely neceffary for the exiftence of vinous fermentation.

179 For which water,

§ *Fabroni, Ann. de Chim.* xxxi. 302.

‖ *Stahl*, i.

180 Sugar,

If the juice of thofe fruits which contain but little fugar, as currants, be put into a favourable fituation, fermentation indeed takes place, but fo flowly, that the product is not *wine*, but *vinegar*: but if a fufficient quantity of fugar be added to thefe very juices, wine is readily produced. No fubftance whatever can be made to undergo vinous fermentation, and to produce wine, unlefs fugar be prefent. *Sugar* therefore is abfolutely neceffary for the exiftence of vinous fermentation; and we are certain that it is decompofed during the procefs; for no fugar can be obtained from properly fermented wine.

181 An acid,

All thofe juices of fruits which undergo the vinous fermentation, either with or without the addition of fugar, contain an acid. We have feen already in the firft chapter that the vegetable acids are obtained chiefly from fruits. The apple, for inftance, contains malic acid; the lemon, citric acid; the grape, tartarous acid. The Marquis de Bullion has afcertained, that *muft* will not ferment if all the tartarous acid which it contains be feparated from it.* We may conclude from this, that the prefence of a vegetable acid is abfolutely neceffary for the commencement of the vinous fermentation. This renders it probable that the effential part of barm is a vegetable acid, or fomething equivalent; for if fugar be diffolved in four times its weight of water, mixed with the yeaft of beer, and placed in a proper temperature, it undergoes the vinous fermentation.†

* *Chaptal*

† *Bergman*

182 And jelly are neceffary.

All the juices of fruits which undergo the vinous fermentation contain a quantity of jelly, or mucilage, or of both. Thefe two fubftances refemble each other in fo many particulars, and it is fo difficult to feparate them, that we fhall fuppofe they have the fame effect in the mixture. The prefence of thefe fubftances renders it probable that they alfo are neceffary for the vinous fermentation. Perhaps they act chiefly by their tendency to become acid.

Thus we fee, that for the production of wine a certain temperature, a certain portion of water, fugar, a vegetable acid, and, in all probability, jelly alfo, is neceffary. Mr Lavoifier found that fugar would not ferment unlefs diffolved in at leaft four times its weight of water. This feems to indicate that the particles of fugar muft be removed to a certain diftance from each other before the other ingredients can decompofe them. The evolution and feparation of carbonic acid gas in fuch quantity, fhews us that the proportion of the carbon and the oxygen of the fugar is diminifhed. It is not certain that the mucilage of the wine is decompofed fo completely as the fugar; for it has been obferved, that when the muft abounds in mucilage, the wine is apt to become four.

183 Decompofition of wine.

When wine is diftilled by means of a low heat, there comes over a quantity of *alcohol*, and the remainder is a folution of acetous acid. From this fact, it has been concluded that wine is compofed of acetous acid and alcohol. But that the diftillation occafions 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 fhew that alcohol exifted ready formed; but his proofs are not conclufive. Fabroni

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.†

Acetous Fermentation, Putrefaction.

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.

* *Collier, Manch. Mem.*

† *Henry, Manch. Mem.* ii. 257.

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.

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.*

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.

Albumen

19[2] Fibrina how obtained.

19[3] Its properties.

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.

* Fourc[roy,] Ann. d[e] Chim. i[...]

† Fourc[roy]

‡ Fourc[roy,] Ann. de Chim. i[...]

Sect. II. *Of Albumen.*

19[4] Albumen contained 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[5] Coagulated 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.

§ Cullen

The taste of coagulated albumen is quite different from that of liquid albumen: its appearance, too, and its

(L) This is merely the Latin term for the white of an egg. It was first introduced into chemistry by the physiologists.

umen. its properties, are entirely changed; for it is no longer foluble, 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 prefent there is no abforption of it, nor does albumen in coagulating change its volume.* Acids have the property of coagulating albumen, as Scheele afcertained.‡ Alcohol alfo produces, in fome meafure, the fame 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 fufficient quantity of water, it can no longer be coagulated by any of thefe 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 alfo lofe their power, if the albumen be diluted with a much greater quantity of water, as has been afcertained 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 diftributed through every part of the liquid. Confequently its integrant particles muft be farther feparated from each other, and their diftance muft increafe with the quantity of water with which they are diluted. We fee, therefore, that albumen ceafes to coagulate whenever its particles are feparated from each other beyond a certain diftance. That no other change is produced, appears evident from this circumftance, that whenever the watery folution of albumen is fufficiently concentrated by evaporation, coagulation takes place, upon the application of the proper agents, precifely as formerly.

It does not appear that the diftance of the particles of albumen is changed by coagulation; for coagulated albumen occupies precifely the fame fenfible fpace as liquid albumen.*

Thus two things feem certain refpecting the coagulation of albumen: 1. That its particles muft not be beyond a certain diftance; 2. That the coagulation does not produce any fenfible change in their diftance. To what, then, is the coagulation of albumen owing? We can conceive no change to take place from a ftate of liquidity to that of folidity, without fome change in the figure of the particles of the body which has undergone that change: for if the figure and the diftance of the particles of bodies continue the fame, it is impoffible to conceive any change at all to take place. Since, then, the diftance of the particles of albumen does not, as far at leaft as we can perceive, change, we muft conclude, that the figure of the particles actually does change. Now fuch a change may take place three ways: 1. The figure may be changed by the addition of fome new molecules to each of the molecules of the body. 2. Some molecules may be abftracted from every integrant particle of the body. 3. Or the molecules, of which the integrant particles are compofed, may enter into new combinations, and form new integrant particles, whofe form is different from that of the old integrant particles. Some one or other of thefe three things muft take place during the coagulation of albumen.

1. Scheele and Fourcroy have afcribed the coagulation of albumen to the firft of thefe caufes, namely, to the addition of a new fubftance. According to Scheele, *caloric* is the fubftance which is added. Fourcroy, on the contrary, affirms that it is *oxygen*.

Scheele fupported his opinion with that wonderful ingenuity which fhone fo 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 fufficient to faturate the alkali. The albumen coagulated: but when he repeated the experiment, and ufed carbonat of alkali inftead of pure alkali, no coagulation enfued. In the firft cafe, fays he, there was a double decompofition: the muriatic acid feparated from a quantity of caloric with which it was combined, and united with the alkali; while, at the fame inftant, the caloric of the acid united with the albumen, and caufed it to coagulate. The fame combination could not take place when the alkaline carbonat was ufed, becaufe the carbonic acid gas carried off the caloric, for which it has a ftrong affinity.*

This explanation is plaufible; but it is contrary to every other known fact in chemiftry, to fuppofe that caloric can combine with a fubftance without occafioning any alteration in its bulk, and cannot therefore be admitted without the moft rigid proof.

Fourcroy obferves, in fupport of his opinion, that the white of an egg is not at firft capable of forming a hard coagulum, and that it only acquires that property by expofure to the atmofphere. It is well known that the white of a new laid egg is milky after boiling; and that if the fhell be covered over with greafe, to exclude the external air, it continues long in that ftate; whereas the white of an old egg, which has not been preferved in that manner, forms a very hard tough coagulum. Thefe facts are undoubted; and they render it exceedingly probable, that albumen acquires the property of forming a hard coagulum only by abforbing oxygen: but they by no means prove that coagulation itfelf is owing to fuch an abforption. And fince coagulation takes place without the prefence of air, and fince no air, even when it is prefent, is abforbed, this opinion cannot be maintained without inconfiftency.

2. The only fubftance which can be fuppofed to leave albumen during coagulation, fince it does not lofe weight, is *caloric*. We know that in moft cafes where a fluid is converted into a folid, caloric is actually difengaged. It is extremely probable, then, that the fame difengagement takes place here. But the opinion has not been confirmed by any proof. Fourcroy indeed fays, that in an experiment made by him, the thermometer rofe a great number of degrees. But as no other perfon has ever been able to obferve any fuch thing, it cannot be doubted that this philofopher has been mifled by fome circumftance or other to which he did not attend.† It is ufual, in many cafes, for bodies to lofe bulk when they give out caloric; but that there are exceptions to this rule, is well known.

3. Even if the fecond opinion were true, it is fcarcely poffible to conceive the coagulation of albumen to take place without fome change in its integrant particles. We can fee how all the fubftances which coagulate albumen might produce fuch a change; and the infolubility of coagulated albumen in water, and its other different properties, render it more than probable that fome fuch change actually takes place. But what that change is, cannot even be conjectured.

Margin notes (partly cut off): 96 … ome- … this … ıla- — *radori. de* … xxix. — *eele*, … 3. — *adori.* … 97 … ry … s

* *Scheele*, ii. 58.

† *Thomfon'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.

* Scheele, ii. 57.
† Vauquelin, Ann. de Chim. xxix. 15.
‡ Ibid.
§ Nicholson's Journal, i. 271.

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.

* 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.

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.†

* Scheele, Crell's A... ii. 17. E... Transl.
† Fourcr... Ann. de Chim. i.

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.

Whenever an animal substance possesses the following properties, it is at present denominated an animal mucilage by chemists. 201 Propert... of muci... lage.

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.*

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 202 Basis of... how ob... tained.

3 of le. 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 ‡

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 from both 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 oines 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, 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. Urea. 206 Its properties.

† 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.*

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 207 Its component parts.

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.

When a solution of urea in water is left to itself for some time, it is gradually decomposed. A froth collects 208 Spontaneous decomposition.

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.*

* Fourcroy and Vauquelin, Ann. de Chim. xxxii p. 96.

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.†

† Ibid, p. 104.

When nitric acid is poured upon crystallized urea, a violent effervescence takes place, the mixture frothes, 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.‡

‡ Ibid, p. 107.

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.‖

‖ Ibid.

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.*

Sug

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

1. The method of obtaining sugar of milk has been already detailed in the article Chemistry, n° 488. to which we refer the reader. For an account of its properties, we are indebted to the observations of Mr Lichtenstein. Sugar milk.

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.§

§ Sche ii. 70.

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.* 21 Honey

* Four

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

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°.*

ol- our- 71. 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.

5 rtics 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.*

THE acids hitherto diſcovered in the animal kingdom are the nine following. Acids.

1. Sulphuric,	4. Carbonic,	7. Formic,
2. Muriatic,	5. Benzoic,	8. Bombyc,
3. Phoſphoric,	6. Sebacic,	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 $\frac{1}{24}$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,	6. Phoſphorus,	11. Magneſia,
2. Carbon,	7. Muriatic acid,	12. Silica,
3. Hydrogen,	8. Potaſs,	13. Iron,
4. Oxygen,	9. Soda,	14. Manganeſe.
5. Lime,	10. Sulphur,	

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,	6. Cartilages,
2. Muſcles,	7. Skin,
3. Tendons,	8. Brain and nerves,
4. Ligaments,	9. Horns and nails,
5. Membranes,	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,	6. Mucus of the noſe,
2. Saliva,	7. Sinovia,
3. Pancreatic juice,	8. Semen,
4. Bile and biliary calculi,	9. Liquor of the amnios,
5. Tears,	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 Properties of bones.

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 component 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

(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.

es. 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.†

:bett, Transf. 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

The enamel of the teeth is composed of the same earthy ingredients as other bones; but it is totally destitute of cartilage.*

chett, Transf. p.

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.*

21 o- parts lls.

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.

* *Hatchett, Phil. Transf.* 1799, p. 321. and 324.

† *Merat-Guillot, Ann. de Chim.* xxxiv. 71.

‡ *Ibid.*

|| *Vauquelin, ibid.* xxix. 6.

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

* *Herissant, Mem. Par.* 1766, p. 22. *Hatchett, ibid.* 317.

† *Hatchett, ibid.*

‡ *Ibid.* 318.

|| *Merat-Guillot, ibid.*

¶ *Merat-Guillot, ibid.*

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 subject;

Muscles of Animals. 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 efflorescence. 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*.*

* *Humbolt on Galvanism*, 170.

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.

Skin.

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.†

† *Phil. Transf.* 1800, p. 333.

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 Epidermis.

1. The epidermis is easily separated from the cutis by maceration in hot water. It possesses a very great degree of elasticity.

225 Its properties.

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.§

‡ *Chaptal, Ann. de Chim.* xxvi. 221.

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.‖

§ *Cruikshank on Insensible Perspiration*, p. 32.

‖ *Ibid.*

226 Cutis.

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*.*

* *Seguin, Nicholson's Journal*, i. 271.

227 Composition of gelatine.

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.

† *Ibid.*

228 Nature of 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

Brain and Nerves. goes on so slowly that the texture of the skin is not altered. Leather, therefore, is merely a combination of gelatine and tan.‡

‡ Nicholson's Journal, 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.‡

* Jour. de Phys. xxxviii. 329
‡ Ann. de Chim. 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.

229 Properties of brain. 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.‡

‡ Ibid. 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*.§

§ Ibid. 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

230 Its analysis.

Phosphat of lime,
——— soda,
——— ammonia.

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 $\frac{1}{100}$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

Blood.

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.||

§ *Merat-Guillot, Ann. de Chim.* xxxiv. 70.
|| *Hatchett, Phil. Tranſ.* 1799, p. 332.

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.

* *Haller's Phyſiology,* ii. 41.
† *Ann. de Chim.* vii. 147.

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.

‡ *Jurin, Haller's Phyſiology,* ii. 41.

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.||

|| *Fourcroy,* iii. 267.

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.*

¶ *Ibid.*
* *Well's Phil. Tr.* 1797.

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.

† *Jurin, Haller's Phyſiolog[y]* ii. 41.
§ *Cullen.*
† *De Ge[n]. Anim.* p. 161.
‡ *Fourcr[oy], Ann. de Chim.* vi[i]. 157.
§ *Ibid.*

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.*

|| *Ibid.*

If ſerum be mixed with twice its weight of water, and, after coagulation by heat, the albumen be ſeparated ood.

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.¶

¶ *...rcroy, ...de ... vii.*

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 ..., 35.*
* *...rcroy, ...de ... vi.*

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.*

* *...ller's ...ology, ...*

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.†

† *...rcroy, ...de ... vii.*

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.‡

‡ *... 153.*

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.‡

Blood.

‡ *Fourcroy, Ann. de Chim.* vii. 151.

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: 235

235 Component parts of blood.

1. Water,	5. Iron,
2. Fibrina,	6. Soda,
3. Albumen,	7. Muriat of ſoda,
4. Gelatine,	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: 1*ſt*, Its colouring matter is darker, and ſeems to be more abundant; 2*d*, It contains no fibrina, but probably a greater proportion of gelatine than blood of adults; 3*d*, It contains no phoſphoric acid.§

§ *Ibid.* 162.

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

laxed

Milk. 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[ter]

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 ho[w]

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

* *Jour. de Phys.* xxxvii. 362.

† *Fourcroy, Ann. de Chim.* vii. 167.

* Parme[ntier and] Deyeux, *Ann. de Chim.* vi[i.] 372.

† *Ibid.* 3[..]

‡ *Ibid.* 3[..]

§ *Ibid.*

|| *Fourcr[oy] Ann. de Chim.* vi[i.] 170.

* *Ibid.* 3[..]

† *Fourcr[oy] ibid.* 169

‡ *Young d[e] Lacte*, 15[..]

§ *Mid-L[o]thian Rep[ort] for* 1795.

ilk. cannot be doubted, that the portion abforbed is oxygen.

Thefe facts are fufficient to afford us a key to explain what takes place during the procefs of churning. There is a peculiar oil in milk, which has fo ftrong an affinity for the other ingredients, that it will not feparate from them fpontaneoufly; 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 caufing it to abforb oxygen from the air, or, if that be impoffible, by feparating it from the acid which exifts in four cream. Hence the abforption of air during churning; hence alfo the increafe of temperature of the cream, which Dr Young found to amount conftantly to 4°; and hence the fweetnefs 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 fuch, that it never feparates completely from them. Not only is curd and whey always found in the cream, but fome of this oil is conftantly found in creamed milk and even in whey: for it has been afcertained 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 thofe who fuperintend dairies, that a good deal more butter may be obtained from the fame quantity of milk, provided it be churned as drawn from the cow, than when the cream alone is collected and churned.

|| ...d-Lo-... Report,

The butter-milk, as Parmentier and Deyeux afcertained by experiment, poffeffes precifely the properties of milk deprived of cream.¶

¶ ...n. de ... vii.

272 ...erties ...rd.

Curd, which may be feparated from creamed milk by rennet, has all the properties of coagulated albumen. It is white and folid; and when all the moifture is fqueezed out, it has a good deal of brittlenefs. It is infoluble in water; but pure alkalies and lime diffolve it readily, efpecially when affifted by heat; and when fixed alkali is ufed, a great quantity of ammonia is emitted during the folution. The folution of curd in foda is of a red colour, at leaft if heat be employed; owing probably to the feparation of charcoal from the curd by the action of the alkali.* Indeed, when a ftrong heat has been ufed, charcoal precipitates as the folution cools.† The matter diffolved by the alkali may be feparated from it by means of any acid; but it has loft all the properties of curd. It is of a black colour, melts like tallow by the application of heat, leaves oily ftains on paper, and never acquires the confiftence of curd.‡ Hence it appears that curd, by the action of a fixed alkali, is decompofed, and converted into two new fubftances, ammonia, and oil or rather fat.

* ...l.

† ...rcroy, ... 175.

‡ ...l.

Curd is foluble alfo 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 fenfibly acid tafte, the whole is diffolved after a little boiling.§ Acetous acid and lactic acid do not diffolve curd when very much diluted.|| But thefe acids, when concentrated, diffolve it readily, and in confiderable quantity.¶ It is remarkable enough, that concentrated vegetable acids diffolve curd readily, but have very little action on it when they are very much diluted: whereas the mineral diffolve it when much diluted; but when concentrated, have either very little effect on it, as fulphuric acid;* or decompofe it, as nitric acid. By means of this laft acid, as Berthollet difcovered, a quantity of azotic gas may be obtained from curd.

§ ...eele, ii.

|| ...l.

¶ ...rmen-...nd ...x, 417.

* ...roy, ... 173.

* Parmentier, ibid.

Milk.

273 Of cheefe.

Curd, as is well known, is ufed in making *cheefe*; and the cheefe is the better the more it contains of cream, or of that oily matter which conftitutes cream. It is well known to cheefemakers, that the goodnefs of it depends in a great meafure on the manner of feparating the whey from the curd. If the milk be much heated, the coagulum broken in pieces, and the whey forcibly feparated, as is the practice in many parts of Scotland, the cheefe is fcarce good for any thing; but the whey is delicious, efpecially the laft fqueezed-out whey, and butter may be obtained from it in confiderable quantity. A full proof that nearly the whole creamy part of the milk has been feparated with the whey. Whereas if the milk be not too much heated (about 100° is fufficient), if the coagulum be allowed to remain unbroken, and the whey be feparated by very flow and gentle preffure, the cheefe is excellent; but the whey is almoft tranfparent, and nearly colourlefs.

Good cheefe melts at a moderate heat; but bad cheefe, 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 conftitutes the diftinguifhing characteriftic of cream; hence its flavour and fmell; and hence alfo the white colour of milk.

274 Coagulation of milk.

This famenefs of curd and albumen fhews us, that the coagulation of milk and of albumen depend upon the fame caufe. Heat, indeed, does not coagulate milk, becaufe the albumen in it is diluted with too large a quantity of water. But if milk be boiled in contact with air, a pellicle foon forms on its furface, which has the properties of coagulated albumen: if this pellicle be removed, another fucceeds; and by continuing the boiling, the whole of the albuminous or curdy matter may be feparated from milk.* When this pellicle is allowed to remain, it falls at laft to the bottom of the veffel, where, being expofed to a greater heat, it becomes brown, and communicates to milk that difagreeable tafte which, in this country is called a *finged* tafte. It happens more readily when milk is boiled along with rice, flour, &c.

* Parmentier, ibid. p. 415.

If to boiling milk there be added as much of any neutral falt as it is capable of diffolving, or of fugar, or of gum arabic, the milk coagulates, and the curd feparates.† Alcohol alfo coagulates milk;‡ as do all acids, rennet, and the infufion of the flowers of artichoke, and of the thiftle.|| If milk be diluted with ten times its weight of water, it cannot be made to coagulate at all.¶

† Scheele, ii. 52.

‡ Parmentier, ibid. p. 416.

|| Ibid.

¶ Scheele, ii. 54.

275 Properties of whey.

Whey, after being filtered, to feparate a quantity of curd which ftill continues to float through it, is a thin pellucid fluid, of a yellowifh green colour and pleafant fweetifh tafte, in which the flavour of milk may be diftinguifhed. It always contains fome curd; but nearly the whole may be feparated by keeping the whey for fome time boiling; a thick white fcum gathers on the furface, which in Scotland is known by the name of *float whey*. When this fcum, which confifts of the curdy part, is carefully feparated, the whey, after being allowed to remain at reft for fome hours, to give the

remainder

Milk.

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.

* Parmentier, p. 417.
† Scheele, ii. 61.
‡ Rouelle.

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.*

* Parmentier, ibid. p. 343.

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.†

† Scheele, ii. 68.

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.

‡ Parmentier, ibid. p. 365.
|| Scheele, ii. 66.

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 *franchipann*. 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.†

¶ Bouquet.
* Parmentier, ibid. 368.
† Mem. Med. P... 1787, p. 607.

278
Its component parts.

Thus we ſee, that cows milk is compoſed of the following ingredients.

1. Water,	5. Sugar of milk,
2. Oil,	6. Muriat of lime,
3. Albumen,	7. Muriat of potaſs,
4. Gelatine,	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.

* Clarke, Iriſh. Tr... ii. 175.
† Parmentier, ibid. 419.

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.*

‡ Ibid.
* Ibid.

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 peculiarities.

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.

|| Ibid. p. 420.

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

Milk, Saliva. 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.*

Aſſes milk therefore differs from cows milk in three particulars.

282 pecu-rities.
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 oats 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.†

284 ewes 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.‡

285 ares milk. 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.‖

* Parmen-, p. 483.
† Ibid. p. 5.
‡ Ibid. p. 8.
‖ Ibid. p. 1.

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 of 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,

* Haller's Phyſ. vi.
† Nareceſſus, Haller, ibid. 54.
‡ Fordyce on Digeſt. p.
§ Fourcroy, Ann. de Chim. viii. 262.
¶ Ibid.
* Haller's Phyſ. vi.

and is compoſed of muriat of ſoda and phoſphat of lime.†

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.

† Verbeyen, 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*.

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.†

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

290 Its component parts. 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.†

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

* Haller's Phyſ. vi. 546.
† Ramſay, Theſaur. Med. Edin. ii. 459.
‡ Maclurg, p. 10.
§ Cadet, Mem. Par. 1767, p. 340.
* Theſaur. Edin. ii. 460.
† Fourcroy, Ann. de Chim. vii. 176.
‡ 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.*

* Cadet, ibid. p. 343. † Ibid. p. 350. ‡ Ibid. * Ibid. p. 342.

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.‡

† Maclurg, p. 56. ‡ Ramsay, ibid. p. 462. § Fourcroy, iii. 292. * Ibid. † Ibid. ‡ Vauquelin.

Sect. XI. *Of Biliary Calculi.*

Biliary Calculi.

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 calculi of three kinds.

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 Properties of the first.

1. The first species of biliary calculi was pointed out for the first time by Haller, 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 $\frac{1}{20}$ 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

† Fourcroy, Ann. de Chim. iii. 249. ‡ Ann. de Chim. v. 186. § Fourcroy, ibid. ii. 1[illegible]. * Ibid. p. 180. † Ibid. iii. 256. ‡ Gren, ibid. v. 1[illegible]. ‡ Fourcroy, ibid. iii. 247.

ry Cal-uli, ears. must be a gall stone of this species. Fourcroy found a quantity of the same substance in the dried human liver.*

urcroy, p. 126.

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.

293 he se-l.

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.

294 he l.

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.‡

the r, p. yfiol. 67.

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.‡

urcroy Vau-n, Jour. hys. x. 256. id. p. — id. p.

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.§

id.

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.|| — Tears, Sinovia.

|| Fourcroy and Vauquelin, Jour. de Phys. p. 259.

296 Component parts.

Thus it appears that tears are composed of the following ingredients:

1. Water,	4. Soda,
2. Mucilage,	5. Phosphat of lime,
3. Muriat of soda,	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.*

* Ibid. p. 257.

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.†

† Ibid. p. 259.

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.*

* Margueron, Ann. de Chim. xiv. 124.

299 Its properties.

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

Sinovia, Semen.

and depofites fome pellicles on the fides of the difh ; but its vifcidity is not diminifhed.†

When alcohol is poured into finovia, a white fubftance precipitates, which has all the properties of albumen. One hundred parts of finovia contain 4.52 of albumen. The liquid ftill continues as vifcid as ever ;

300 Its component parts.

but if acetous acid be poured into it, the vifcidity difappears altogether, the liquid becomes tranfparent, and depofites a quantity of matter in white threads, which poffeffes the following properties :

1. It has the colour, fmell, tafte, and elafticity of vegetable gluten.

2. It is foluble in concentrated acids and pure alkalies.

3. It is foluble in cold water, the folution frothes ; acids and alcohol precipitate the fibrous matter in flakes. One hundred parts of finovia contain 11.86 of this matter.‡

When the liquid, after thefe fubftances have been feparated from it, is concentrated by evaporation, it depofites cryftals of acetite of foda. Sinovia, therefore, contains *foda*. Margueron found that 100 parts of finovia contained about 0.71 of foda.

When ftrong fulphuric, muriatic, nitric, acetic, or fulphurous acid is poured into finovia, a number of white flakes precipitate at firft, but they are foon rediffolved, and the vifcidity of the liquid continues. When thefe acids are diluted with five times their weight of water, they diminifh the tranfparency of finovia, but not its vifcidity ; but when they are fo much diluted that their acid tafte is juft perceptible, they precipitate the peculiar thready matter, and the vifcidity of the finovia difappears.§

When finovia is expofed to a dry atmofphere it gradually evaporates, and a fcaly refiduum remains, in which cubic cryftals, and a white faline efflorefcence, are apparent. The cubic cryftals are muriat of foda. One hundred parts of finovia contain about 1.75 of this falt. The faline efflorefcence is carbonat of foda.||

Sinovia foon putrefies in a moift atmofphere, and during the putrefaction ammonia is exhaled. When finovia is diftilled in a retort there comes over, firft water, which foon putrefies ; then water containing ammonia ; then empyreumatic oil and carbonat of ammonia. From the refiduum muriat and carbonat of foda may be extracted by lixiviation. The coal contains fome phofphat of lime.¶

From the analyfis of Mr Margueron it appears that finovia is compofed of the following ingredients :

11.86	fibrous matter,
4.52	albumen,
1.75	muriat of foda,
.71	foda,
.70	phofphat of lime (N),
80.57	water,
100.00.	

† Margueron, Ann. de Chim. xiv. 126.

‡ Ibid. p. 126—130.

§ Ibid. p. 127.

|| Ibid. 125.

¶ Ibid. 128.

Sect. XIV. *Of Semen.*

The peculiar liquid fecreted in the teftes of males, and deftined for the impregnation of females, is known by the name of *femen*. The human femen alone has hitherto been fubjected to chemical analyfis. Nothing is known concerning the feminal fluid of other animals. Vauquelin publifhed an analyfis of the human femen in 1791.

301 Properties of femen.

Semen, when newly ejected, is evidently a mixture of two different fubftances : the one, fluid and milky, which is fuppofed to be fecreted by the proftate gland ; the other, which is confidered as the true fecretion of the teftes, is a thick mucilaginous fubftance, in which numerous white fhining filaments may be difcovered.* It has a flight difagreeable odour, an acrid irritating tafte, and its fpecific gravity is greater than that of water. When rubbed in a mortar it becomes frothy, and of the confiftence of pomatum, in confequence of its enveloping a great number of air bubbles. It converts paper ftained with the bloffoms of mallows or violets to a green colour, and confequently contains an alkali.†

As the liquid cools, the mucilaginous part becomes tranfparent, and acquires greater confiftency ; but in about twenty minutes after its emiffion, the whole becomes perfectly liquid. This liquefaction is not owing to the abforption of moifture from the air, for it lofes inftead of acquiring weight during its expofure to the atmofphere ; nor is it owing to the action of the air, for it takes place equally in clofe veffels.‡

Semen is infoluble in water before this fpontaneous liquefaction, but afterwards it diffolves readily in it. When alcohol or oxy-muriatic acid is poured into this folution, a number of white flakes are precipitated.§ Concentrated alkalies facilitate its combination with water. Acids readily diffolve the femen, and the folution is not decompofed by alkalies ; neither indeed is the alkaline folution decompofed by acids.||

Lime difengages no ammonia from frefh femen ; but after that fluid has remained for fome time in a moift and warm atmofphere, lime feparates a great quantity from it. Confequently ammonia is formed during the expofure of femen to air.¶

302 Its component parts.

When oxy-muriatic acid is poured into femen, a number of white flakes precipitate, and the acid lofes its peculiar odour. Thefe flakes are infoluble in water, and even in acids. If the quantity of acid be fufficient, the femen acquires a yellow colour. Thus it appears that femen contains a mucilaginous fubftance, analogous to that of the tears, which coagulates by abforbing oxygen. Mr Vauquelin obtained from 100 parts of femen fix parts of this mucilage.

When femen is expofed to the air about the temperature of 60°, it becomes gradually covered with a tranfparent pellicle, and in three or four days depofites fmall tranfparent cryftals, often croffing each other in fuch a manner as to reprefent the fpokes of a wheel. Thefe cryftals, when viewed through a microfcope, appear to be four-fided prifms, terminated by very long four-fided pyramids. They may be feparated by diluting the liquid with water, and decanting it off. They have all the properties of phofphat of lime.* If, after the appearance of thefe cryftals, the femen be ftill allowed to remain expofed to the atmofphere, the pellicle on

* Vauquelin, Ann. 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 phofphat of lime in the finovia which he examined. He found, however, traces of fome other phofphat ; probably phofphat of foda. *Phil. Tranf.* 1799, p. 246.

men, uor of 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.‡

u- , Ann. im. p. … d.

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.§

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.

d. 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*.

03 or of uman os.

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.*

n. de 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

98.8 water,
1.2 { albumen, muriat of soda, soda, phosphat of lime, lime,
———
100.0

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 frothes 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.*

* Ann. de Chim. xxxiii. 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.*

* Cruickshank, Phil. Mag. ii. 240.

1. It reddens paper stained with turnsol and with the juice of radishes, and therefore contains an acid.

310 Contains phosphat of lime. 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 $\frac{1}{500}$ of the weight of the urine.§

† Scheele, 208.

‡ Ibid.

§ Phil. Mag. ii. 241.

311 Phosphat of magnesia. 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. de Chim. xxxi. 66.

312 Uric acid. 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

* Scheele, 207.

termittent ſevers 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.

Urine.

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,

(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.

Urine. 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,	7. Gelatine and albumen,
2. Phoſphoric acid,	8. Urea,
3. Phoſphat of lime,	9. Muriat of ſoda,
4. Phoſphat of magneſia,	10. Muriat of ammonia,
5. Uric acid,	11. Phoſphat of ſoda,
6. Benzoic acid,	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.*

* *Fourcroy and Vauquelin, Ann. de Chim.* xxxi. 69.

* *Cruickſhank, Phil. Mag.* ii. 241.

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.†

† *Fourcroy, Ann. de Chim.* vii. 183.

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.*

* *Ann. de Chim.* xxxi. 61.

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.*

* *Ann. Chim.* 70.

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.†

† *Ibid.*

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.

‡ *Vau. ibid.* 4.

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[…] Urinary calculi. 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 thoſe experiments which terminated in the diſcovery of the nature of the alkaline carbonats.

§ *De […]*

* *Veg. Stat.* […] 189.

3[…] Analyſis by Sc[heele]. 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

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
23 calculi, and aſcertained the preſence of ſeveral new ſub-
r com- ſtances which had not been ſuſpected. The ſubſtances
nt hitherto diſcovered in urinary calculi are the following:

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.

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
25 of am- ſo often preſent in urinary calculi as the laſt mentioned
1. 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- 1. 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.

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.* 328 Oxalat of lime.

* Ibid. 220.

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.† 329 Silica.

† Ibid. 221.

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.‡ 330 Animal matters.

‡ 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 generally

(q) Brugnatelli found alſo phoſphat of lime, with exceſs of acid, in calculi. See *Ann. de Chim.* xxxii. 183.

Urinary Calculus.

raily 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.

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. 332 Calculi of inferior animals.

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 1.9300. 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. Mag. 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.*	* Fourcroy
	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.‡	‡ Brugnatelli
	2. Phosphat of lime.¶	¶ Bartholdi
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.

nctions Animals. produced? What purpoſes do they ſerve? What are the diſtinguiſhing properties of animals, and the laws by which they are regulated?

333 mals mble 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*. Functions of Animals.

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

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, Carminati, &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 ons nals. mixed with large quantities of faliva, mucus, bile, food, &c. It may be queftioned, indeed, whether any gaftric juice at all can be obtained by thefe methods: for as the intention of the gaftric juice is to convert the food into chyme, in all probability it is only fecreted, or at leaft thrown into the ftomach when food is prefent.

We need not be furprifed, then, at the contradictory accounts concerning its nature, given us by thofe philofophers who have attempted to examine it; as thefe relate not fo much to the gaftric juice, as to the different fubftances found in the ftomach. The idea that the gaftric juice can be obtained by vomiting, or that it is thrown up fpontaneoufly by fome animals, is, to fay the leaft of it, very far from being probable.

According to Brugnatelli, the gaftric juice of carnivorous animals, as hawks, kites, &c. has an acid and refinous odour, is very bitter, and not at all watery; and is compofed of an uncombined acid, a refin, an animal fubftance, and a fmall quantity of muriat of foda.* The gaftric juice of herbivorous animals, on the contrary, as goats, fheep, &c. is very watery, a little muddy, has a bitter faltifh tafte, and contains ammonia, an animal extract, and a pretty large quantity of muriat of foda.† Mr Carminati found the fame ingredients; but he fuppofes that the ammonia had been formed by the putrefaction of a part of their food, and that in reality the gaftric juice of thefe animals is of an acid nature.‡

The accounts which have been given of the gaftric juice of man are fo various, that it is not worth while to tranfcribe them. Sometimes it has been found of an acid nature, at other times not. The experiments of Spallanzani are fufficient to fhew, that this acidity is not owing to the gaftric juice, but to the food. He never found any acidity in the gaftric juice of birds of prey, nor of ferpents, frogs, and fifhes. Crows gave an acidulous gaftric juice only when fed on grain; and he found that the fame obfervation holds with refpect to dogs, herbivorous animals, and domeftic fowls. Carnivorous birds threw up pieces of fhells and coral without alteration; but thefe fubftances were fenfibly diminifhed in the ftomachs of hens, even when inclofed in perforated tubes. Spallanzani himfelf fwallowed calcareous fubftances inclofed in tubes; and when he fed on vegetables and fruits, they were fometimes altered and a little diminifhed in weight, juft as if they had been put into weak vinegar; but when he ufed only animal food, they came out untouched. According to this philofopher, whofe experiments have been by far the moft numerous, the gaftric juice is naturally neither acid nor alkaline. When poured on the carbonat of potafs, it caufes no effervefcence.

Such are the refults of the experiments on the juices taken from the ftomach of animals. No conclufion can be drawn from them refpecting the nature of the gaftric juice. But from the experiments which have been made on the digeftion of the ftomach, efpecially by Spallanzani, the following facts are eftablifhed.

The gaftric juice attacks the furfaces of bodies, unites to the particles of them which it carries off, and cannot be feparated from them by filtration. It operates with more energy and rapidity the more the food is divided, and its action is increafed by a warm temperature. The food is not merely reduced to very minute parts; its tafte and fmell are quite changed; its fenfible properties are deftroyed, and it acquires new and very different ones. This juice does not act as a ferment; fo far from it, that it is a powerful antifeptic, and even reftores flefh already putrefied. There is not the fmalleft appearance of fuch a procefs; indeed, when the juice is renewed frequently, as in the ftomach, fubftances diffolve in it with a rapidity which excludes all idea of fermentation. Only a few air bubbles make their efcape, which adhere to the alimentary matter, and buoy it up to the top, and which are probably extricated by the heat of the folution.

Functions of Animals.

With refpect to the fubftances contained in the ftomach, only two facts have been perfectly afcertained: The firft is, that the juice contained in the ftomach of oxen, calves, fheep, invariably contains uncombined phofphoric acid, as Macquart and Vauquelin have demonftrated: The fecond, that the juice contained in the ftomach, and even the inner coat of the ftomach itfelf, has the property of coagulating milk and the ferum of blood. Dr Young found, that feven grains of the inner coat of a calf's ftomach, infufed in water, gave a liquid which coagulated more than 100 ounces of milk; that is to fay, more than 6857 times its own weight; and yet, in all probability, its weight was not much diminifhed.

What the fubftance is which poffeffes this coagulating property, has not yet been afcertained; but it is evidently not very foluble in water: for the infide of a calf's ftomach, after being fteeped in water for fix hours, and then well wafhed with water, ftill furnifhes a liquor on infufion which coagulates milk:* And Dr Young found, that a piece of the inner coat of the ftomach, after being previoufly wafhed with water, and then with a diluted folution of carbonat of potafs, ftill afforded a liquid which coagulated milk and ferum.

It is evident, from thefe facts, that this coagulating fubftance, whatever it is, acts very powerfully; and that it is fcarcely poffible to feparate it completely from the ftomach. But we know at prefent too little of the nature of coagulation to be able to draw any inference from thefe facts. An almoft imperceptible quantity of fome fubftances feems to be fufficient to coagulate milk. For Mr Vaillant mentions in his Travels in Africa, that a porcelain difh which he procured, and which had lain for fome years at the bottom of the fea, poffeffed, in confequence, the property of coagulating milk when put into it; yet it communicated no tafte to the milk, and did not differ in appearance from other cups.

It is probable that the faliva is of fervice in the converfion of food into chyme as well as the gaftric juice. It evidently ferves to dilute the food; and probably it may be ferviceable alfo, by communicating oxygen.

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Chyme converted into chyle and excrement.

5. The chyme, thus formed, paffes from the ftomach into the inteftines, where it is fubjected to new changes, and at laft converted into two very different fubftances, chyle and excrementitious matter.

6. The *chyle* is a white coloured liquid, very much refembling milk. It is exceedingly difficult to collect it in any confiderable quantity, and for that reafon it has never been accurately analyfed. We know only in general that it refembles milk; containing, like it, an albuminous part capable of being coagulated, a ferum, and globules which have a refemblance to cream.† It contains alfo different falts; and, according to fome, a fubftance fcarcely differing from the fugar of milk. It is probable alfo that it contains iron; but if fo, it muft be

* *Young.*

† *Forfyce on Digeftion*, 121.

be in the ſtate of a white oxyd; for an infuſion of nut galls does not alter the colour of chyle.‡

‡ Fordyce on Digeſtion, 122.

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.

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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.

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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[2]
Excre[ments] of fow[ls.]

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

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. Functions of Animals.

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 ſomething 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.

2. Carbonic

* Carradori, *Ann. de Chim.* xxix. 171.

† *Ann. de Chim.* xii. 278.

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2. Carbonic acid gas is emitted.

3. Water is emitted in the ftate of vapour.

The firft point is to afcertain exactly the amount of thefe changes. Though a great many experiments have been made on this fubject by different philofophers, the greateft confidence ought to be put in thofe of Lavoifier, 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.

Confequently there had difappeared	116 736
The carbonic acid gas formed was	130.472
This was compofed of about	94.234
oxygen, and	36.238

of carbon. Confequently fuppofing, as Mr Lavoifier did, that the oxygen abforbed had been employed in the formation of the carbonic acid gas, there ftill remained to be accounted for 22.502 grains of oxygen which had difappeared. He fuppofed that this had been employed in the formation of water, a quantity of which had appeared. If fo, the water formed muft have amounted to 26.429 grains; which was compofed of 3.927 hydrogen, the reft oxygen.*

* Ann. de Chim. v. 261.

Since the water emitted was not actually afcertained, this experiment can only be confidered as an approximation to the truth. Accordingly that very ingenious philofopher contrived an apparatus to afcertain the quantity of oxygen gas abforbed by man, and the quantity of carbonic acid gas and water emitted by him during refpiration. This apparatus he had conftructed at an expence at leaft equal to L.500 fterling. The experiments were completed, and he was preparing them for publication, when, on the 8th of May 1794, he was beheaded by order of Robefpierre, after having in vain requefted a fortnight's delay to put his papers in order for the prefs. Thus perifhed, in the 51ft year of his age, the man who, if he had lived a few years longer, promifed fair to become the rival of Newton himfelf. Chemiftry, as a fcience, is deeply indebted to him. He faved it from that confufion into which the thoughtlefs ardour of many of his contemporaries were plunging it headlong: he arranged and connected and fimplified and explained the multitude of infulated facts, which had been accumulating with unexampled celerity; and which, had it not been for his happy arranging genius, might have retarded, inftead of advanced, the progrefs of the fcience. He reduced all the facts under a few fimple heads, and thus made them eafily remembered and eafily claffified. In a few years more, perhaps, he would have traced thefe general principles to their fources, eftablifhed the fcience on the completeft induction, and paved for his fucceffors a road as unerring as that which Sir Ifaac Newton formed in mechanical philofophy.

Mr Lavoifier's experiments have never been publifhed, but fortunately Mr de la Place has given us the refult of them.† He informs us that it was as follows: A man, at an average, confumes, in twenty-four hours, by refpiration, 32 48437 ounces troy of oxygen gas; that is to fay, that a quantity of oxygen gas, equal to that weight, difappears from the air which he refpires in twenty-four hours; that he gives out by refpiration, in the fame time, 15.73 oz. troy of carbonic acid gas, and 28.55 of water in the ftate of vapour.

† La Place's Eloge.

Total	44.28	*Oxygen.*
The carbonic acid gas is compofed of and 5.243 carbon. The water of and 4.2825 hydrogen.		10.486
		24.2675
Total of the oxygen emitted		34.75416
Total abforbed		32.48437
So that there is		2.3697916

ounces of oxygen emitted more than is abforbed by refpiration. Thus it appears that, by refpiration, the abfolute quantity of oxygen in the blood is diminifhed.

Dr Menzies found that a man, at a medium, draws in at every refpiration 43.77 cubic inches of air, and that $\frac{1}{20}$th of that quantity difappears. Confequently, according to him, at every refpiration 2.1885 cubic inches of oxygen gas are confumed. Now 2.1885 cubic inches of that gas amount to 0 68669 gr. troy. Suppofing, with Hales, that a man makes 1200 refpirations in an hour, the quantity of oxygen gas confumed 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 Lavoifier confiderably; but the allowance of oxygen for every refpiration is rather too great. Indeed, from the nature of Dr Menzies's apparatus, it was fcarce poffible to meafure it accurately.

The quantity of water given out by refpiration, as determined by Hales, amounts in a day to 20.4 oz.;* but his method was not fufceptible of great accuracy. We may therefore, on the whole, confider Lavoifier's determination as by far the neareft to the truth of any that has been given.

* Veget. Stat. ii. 327.

There is, however, a very fingular anomaly, which becomes apparent when we compare his experiments on the refpiration of the guinea-pig with thofe on the refpiration of man.

The guinea-pig confumed in 24 hours 5.8368 oz. troy of oxygen gas, and emitted 6.5236 oz. of carbonic acid gas. Man, on the other hand, confumes in the fame time 32 48437 oz. of oxygen gas, and emits only 15.73 oz. of carbonic acid gas. The oxygen gas confumed 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 thefe experiments, they would prove, beyond a doubt, that the changes produced by the refpiration of the pig are different, at leaft in degree, from thofe produced in man; but it is more than probable that fome miftake has crept into one or other of the experiments. We have more reafon to fufpect the firft, as it was made before 1778, at a time when a great many circumftances, neceffary to infure accuracy, were unknown to Lavoifier.

Such are the fubftances imbibed and emitted during refpiration. It ftill 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 reddifh purple colour, whereas the arterial blood is of a florid fcarlet colour. Lower obferved that the colour of the veinous blood was converted into that of arterial during its paffage through the tions imals. 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: 1*ſt*, It acquires a florid red colour: 2*d*, 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

49 hypo- stoex- theſe ges. 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.

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.

350 ſts of ration ained. 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.‡

‡ ...n. de ...v. vii.

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. Functions of Animals.

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.

* *Prieſtley*, iii. 563.

† *Ibid*, and *Ann. de Chim.* ix. 269.

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.

‡ *Fourcroy, Ann. de Chim.* vii. 149.

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.

§ *Ibid.* ix. 268.

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.

‖ *Ibid.*

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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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 blood-vessels, 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.

35 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 diminution

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.

53 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.*

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.

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.

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.

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.

Margin notes: Functions of Animals. — 53 Supposed use of the circulation (partly cut off). — 353 Kidneys employed for the formation of urine (partly cut off). — 355 Cutaneous veſſels — 356 Emit aqueous vapour.

* ...anner, de ... xxxix. (cut off)

* *On Inſenſible Perſpiration,* p. 68.

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He repeated the experiment again after hard exercife, and collected in an hour 48 grains of water.* He found alfo, that this aqueous vapour pervaded his ftocking without difficulty; and that it made its way through a fhamoy leather glove, and even through a leather boot, though in much fmaller quantity than when the leg wanted that covering.†

* *On Infenfible Perfpiration*, p. 70.
† *Ibid.* p. 82.

It is not difficult to fee why the quantity of watery vapour diminifhes with cold. When the furface of the body is expofed to a cold temperature, the capacity of the cutaneous veffels diminifhes, and confequently the quantity which flows through them muft decreafe.

When the temperature, on the other hand, is much increafed, either by being expofed to a hot atmofphere, or by violent exercife, the perfpired vapour not only increafes in quantity, but even appears in a liquid form. This is known by the name of *fweat*. In what manner fweat is produced, is not at prefent known; but we can fee a very important fervice which it performs to the animal.

No fooner is it thrown upon the furface of the fkin than it begins to evaporate. But the change into vapour requires heat; accordingly a quantity of heat is abforbed, and the temperature of the animal is lowered. This is the reafon that animals can endure to remain for fome time in a much higher temperature without injury than could have been fuppofed.

The experiments of Tillet, and the ftill more decifive experiments of Fordyce and his affociates, are well known. These gentlemen remained a confiderable time in a temperature exceeding the boiling point of water.

357 Carbon,

Befides water, it cannot be doubted that *carbon* is alfo emitted from the fkin; but in what ftate, the experiments hitherto made do not enable us to decide. Mr Cruikfhank found, that the air of the glafs veffel 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 fome time in contact with the fkin, confifted almoft entirely of carbonic acid gas.† The fame conclufion may be drawn from the experiments of Ingenhoufz and Milly.‡

* *Ibid.* p. 70 and 81.
† *Enc. Meth. Med.* i. p. 515.
‡ *Ibid*, p. 511.

Now it is evident, that the carbonic acid gas which appeared during Mr Cruikfhank's experiment, did not previoufly exift in the glafs veffel; confequently it muft have either been tranfmitted ready formed through the fkin, or formed during the experiment by the abforption of oxygen gas, and the confequent emiffion of carbonic acid gas. The experiments of Mr Jurine do not allow us to fuppofe the firft of thefe to be true; for he found, that the quantity of air allowed to remain in contact with the fkin did not increafe. Confequently the appearance of the carbonic acid gas muft be owing, either to the emiffion of carbon, which forms carbonic acid gas by combining with the oxygen gas of the air, or to the abforption of oxygen gas, and the fubfequent emiffion of carbonic acid gas; precifely in the fame manner, and for the fame reafon, that thefe fubftances are emitted by the lungs. The laft is the more probable opinion; but the experiments hitherto made do not enable us to decide.

358 And an oily matter.

Befides water and carbon, or carbonic acid gas, the fkin emits alfo a particular odorous fubftance. That every animal has a peculiar fmell, is well known: the dog can difcover his mafter, and even trace him to a diftance by the fcent. A dog, chained fome hours after his mafter had fet out on a journey of fome hundred miles, followed his footfteps by the fmell, and found him on the third day in the midft of a crowd.* But it is needlefs to multiply inftances of this fact; they are too well known to every one. Now this fmell muft be owing to fome peculiar matter which is conftantly emitted; and this matter muft differ fomewhat either in quantity or fome other property, as we fee that the dog eafily diftinguifhes the individual by means of it. Mr Cruikfhank has made it probable that this matter is an oily fubftance; or at leaft that there is an oily fubftance emitted by the fkin. He wore repeatedly, night and day for a month, the fame veft of fleecy hofiery during the hotteft part of the fummer. At the end of this time he always found a oily fubftance accumulated in confiderable maffes on the nap of the inner furface of the veft, in the form of black tears. When rubbed on paper, it makes it tranfparent, and hardens on it like greafe. It burns with a white flame, and leaves behind it a charry refiduum.†

* *Cruikfhank*, ibid. p. 93.
† *Ibid.* p. 92.

It has been fuppofed that the fkin has the property of *abforbing moifture* from the air; but this opinion has not been confirmed by experiments, but rather the contrary.

359 Whether the fkin abforbs moifture,

The chief arguments in favour of the abforption of the fkin, have been drawn from the quantity of moifture difcharged by urine being, in fome cafes, 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 difeafe here alluded to, the weight of the body is continually diminifhing, and therefore part of it muft be conftantly thrown off. Befides, it is fcarcely poffible in that difeafe to get an accurate account of the food fwallowed by the patients; and in thofe cafes where very accurate accounts have been kept, and where deception was not fo much practifed, the urine was found not to exceed the quantity of drink.* In a cafe of diabetes, related with much accuracy by Dr Gerard, the patient was bathed regularly during the early part of the difeafe in warm water, and afterwards in cold water: he was weighed before and after bathing, and no fenfible difference was ever found in his weight.† Confequently, in that cafe, the quantity abforbed, if any, muft have been very fmall.

* See *Rollo on Diabetes*.
† *Ibid*, ii. 73.

It is well known, that thirft is much alleviated by cold bathing. By this plan, Captain Bligh kept his men cool and in good health during their very extraordinary voyage acrofs the South Sea. This has been confidered as owing to the abforption of water by the fkin. But Dr Currie had a patient who was wafting faft for want of nourifhment, a tumor in the œfophagus preventing the poffibility of taking food, and whofe thirft was always alleviated by bathing; yet no fenfible increafe of weight, but rather the contrary, was perceived after bathing. It does not appear, then, that in either of thefe cafes water was abforbed.

Farther, Seguin has fhewn that the fkin does not abforb water during bathing, by a ftill more complete experiment: He diffolved fome mercurial falt in water, and found that the mercury produced no effect upon a perfon that bathed in the water, provided no part of the ctions nimals. 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.

60 ny ·ſub- e. 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).

il. vi.

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*. Functions of Animals. 361 Blood ſupplies the waſte of the ſyſtem.

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.*

* Fordyce on Digeſtion, p. 189.

Again,

(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.

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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.†

† *Phil. Mag.* vi. 308.

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 Aſſimilation a chemical proceſs;

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? 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.

367 But the agent not chemical.

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

 injure the organ. And we fee that this feparation is always attended to even when the fubftances are apparently mixed together. For the very fame products are not obtained which would be obtained by mixing the fame fubftances together out of the body that are produced by mixing them in the body; confequently all the fubftances are not left at full liberty to obey the laws of their mutual affinities. The fuperior agent, however, is not able to exercife an unlimited authority over the chemical powers; fometimes they are too ftrong for it: fome fubftances accordingly, as madder, make their way into the fyftem; while others, as arfenic, decompofe and deftroy the organs of the body themfelves.

But it is not in digeftion alone that this fuperior agent makes the moft wonderful difplay of its power; it is in the laft part of affimilation that our admiration is moft powerfully excited. How comes it that the precife fubftances wanted are always carried to every organ of the body? How comes it that fibrina is always regularly depofited in the mufcles, and phofphat of lime in the bones? And what is ftill more unaccountable, how comes it that prodigious quantities of fome one particular fubftance are formed and carried to a particular place in order to fupply new wants which did not before exift? A bone, for example, becomes difeafed and unfit for the ufe of the animal; a new bone therefore is formed in its place, and the old one is carried off by the abforbents. In order to form this new bone, large quantities of phofphat of lime are depofited in a place where the fame quantity was not before neceffary. Now, who informs this agent that an unufual quantity of phofphat of lime is neceffary, and that it muft be carried to that particular place? Or granting, as is moft probable, that the phofphat of lime of the old bone is partly employed for this purpofe, who taught this agent that the old bone muft be carried off, new modelled, and depofited, and affimilated anew? The fame wonders take place during the healing of every wound, and the renewing of every difeafed part.

Thefe operations are incompatible with the fuppofition that the body of animals is a mere chemical and mechanical machine; and demonftrate the prefence of fome agent befides, which acts according to very different laws.

But neither in this cafe is the power of this agent over the chemical agents, which are employed, abfolute. We may prevent a fractured bone from healing by giving the patient large quantities of acids. And unlefs the materials for the new wanted fubftances be fupplied by the food, they cannot, in many cafes, be formed at all. Thus the canary bird cannot complete her eggs unlefs fhe be furnifhed with lime.

It is evident that the fupreme agent of the animal body, whatever that agent may be, acts according to fixed laws; and that when thefe laws are oppofed by thofe which are more powerful, it cannot overcome them. Thefe laws clearly indicate defign; and the agent has the power of modifying them fomewhat according to circumftances. Thus more phofphat of lime is fent to a limb which requires a new bone, and more lime than ufual is taken into the fyftem when the hen is laying eggs. Defign and contingency are confidered by us as infallible marks of confcioufnefs and intelligence. That they are infallible marks of the agency of mind is certain; but that they are in all cafes the proofs of immediate confcioufnefs and intelligence, as the Stahlians fuppofed, cannot be affirmed without running into inconfiftencies. For we ourfelves are not confcious of thefe operations which take place during *affimilation*.

To fay that a being can act with defign without intelligence, we allow to be a flat contradiction, becaufe defign always implies intelligence. There muft therefore be intelligence fomewhere. But may not this intelligence exift, not in the agent, but in the being who formed the agent? And may not the whole of the defign belong in reality to that being?

368 Nor material.

May not this agent, then, be material, and may not the whole of affimilation be performed by mere matter, acting according to laws given it by its maker? We anfwer, that what is called *matter*, or the fubftances enumerated in the firft part of CHEMISTRY (*Suppl.*) act always according to certain attractions and repulfions, which are known by the name of mechanical and chemical laws.

The phenomena of affimilation are fo far from being cafes of thefe laws, that they are abfolutely inconfiftent with them, and contrary to them; confequently the agent which prefides over *affimilation* is not *matter*. Concerning the nature of this fubftance it is not the bufinefs of this article to inquire; but as it poffeffes properties different from matter, and acts according to very different laws, it would be an abufe of terms to call it *matter*.

369 Animal principle.

We would give it the name of *mind*, were it not that metaphyficians have chofen to confider intelligence as the effence of mind; whereas this fubftance may be conceived to act, and really does act, without intelligence. There is no reafon, however, to fuppofe, with fome, that there are two fubftances in animals: one poffeffed of confcioufnefs as its effence, and therefore called *mind* or *foul* in man; another, deftitute of confcioufnefs, called the *living principle*, &c. employed in performing the different functions of affimilation, abforption, &c. It is much more reafonable to fuppofe, that in every animal and vegetable there is a peculiar fubftance, different from matter, to which their peculiar properties are owing; that this fubftance is different in every fpecies of animal and vegetable; that it is capable of acting according to certain fixed laws which have been impofed upon it by its Creator, and that thefe laws are of fuch a nature that it acts in fubfervience to a particular end; that this fubftance in plants is probably deftitute of intelligence; that in man and other animals it poffeffes intelligence to a certain extent, but that this intelligence is not effential to its exiftence nor to its activity; that it may be deprived of intelligence altogether, and afterwards recover it without altering its nature. Phyfiologifts have given it the name of *living principle*, becaufe its prefence conftitutes life. Perhaps it would be proper to diftinguifh that of animals by the name of *animal principle*. Upon what the intelligence of the animal principle depends, it is impoffible to fay; but it is evidently connected with the ftate of the brain. During a trance, or an apoplectic fit, it has often been loft for a time, and afterwards recovered.

370 Secretion.

17. Befides affimilation, the blood is alfo employed in forming all the different fecretions which are neceffary for the purpofes of the animal economy. Thefe have been enumerated in the laft chapter. The procefs is fimilar to that of affimilation, and undoubtedly the agents in both cafes are the fame; but we are

equally,

equally ignorant of the precife manner in which fecretion is performed as we are of affimilation.

371
Animals at length die, and why.

18. After thefe functions have gone on for a certain time, which is longer or fhorter according to the nature of the animal, the body gradually decays, at laft all its functions ceafe completely, and the animal dies. The caufe of this muft appear very extraordinary, when we confider the power which the animal has of renewing decayed parts; for it cannot be doubted that death proceeds, in moft cafes at leaft, from the body becoming incapable of performing its function. But if we confider that this power is limited, and that it muft ceafe altogether, when thefe parts of the fyftem begin to decay which are employed in preparing materials for future affimilation, our furprife will, in fome meafure, ceafe. It is in thefe parts, in the organs of digeftion and affimilation accordingly, that this decay ufually proves fatal. The decay in other parts deftroys life only when the wafte is fo rapid that it does not admit of repair.

What the reafon is that the decay of the organs caufes death, or, which is the fame thing, caufes the living principle either to ceafe to act, or to leave the body altogether, it is perfectly impoffible to fay, becaufe we know too little of the nature of the living principle, and of the manner in which it is connected with the body. The laft is evidently above the human underftanding, but many of the properties of the living principle have been difcovered: and were the facts already known properly arranged, and fuch general conclufions drawn from them as their connection with each other fully warrant, a degree of light would be thrown upon the animal economy which thofe, who have not attended to the fubject, are not aware of.

No fooner is the animal dead, than the chemical and mechanical agents, which were formerly fervants, ufurp the fupreme power, and foon decompofe and deftroy that very body which had been in a great meafure reared by their means. But the changes which take place upon animal bodies after death, are too important, and too intimately connected with the fubject of this article to be paffed over flightly. They fhall therefore form the fubject of the next chapter.

Chap. IV. Of the Decomposition of Animal Substances.

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Decompofition of animal fubftances expofed to the air.

All the foft and the liquid parts of animals, when expofed to a moderate temperature of fixty-five degrees or more, pafs with more or lefs rapidity through the following changes. Their colour becomes paler, and their confiftence diminifhes; if it be a folid part, fuch as flefh, it foftens, and a ferous matter fweats out, whofe colour quickly changes; the texture of the part becomes relaxed, and its organization deftroyed; it acquires a faint difagreeable fmell: the fubftance gradually finks down, and is diminifhed in bulk; its fmell becomes ftronger and ammoniacal. If the fubject be contained in a clofe veffel, the progrefs of putrefaction, at this ftage, feems to flacken; no other fmell but that of a pungent alkali is perceived; the matter effervefces with acids, and converts fyrup of violets to a green. But if the communication with the air be admitted, the urinous exhalation is diffipated, and a peculiar putrid fmell is fpread around with a kind of impetuofity; a fmell of the moft infupportable kind, which lafts 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 fmell is corrected, and as it were confined by ammonia. When the latter is volatilized, the putrefactive procefs becomes active a fecond time, and the fubftance fuddenly fwells up, becomes filled with bubbles of air, and foon after fubfides again. Its colour changes, the fibrous texture of the flefh being then fcarcely diftinguifhable; and the whole is changed into a foft, brown, or greenifh matter, of the confiftence of a poultice, whofe fmell is faint, naufeous, and very active on the bodies of animals. The odorant principle gradually lofes its force; the fluid portion of the flefh affumes a kind of confiftence, its colour becomes deeper, and it is finally reduced into a friable matter, rather deliquefcent, which being rubbed between the fingers, breaks into a coarfe powder like earth. This is the laft ftate obferved in the putrefaction of animal fubftances; they do not arrive at this term but at the end of a confiderable time.†

† Fourc

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Buried the eart

In carcafes buried in the earth, putrefaction takes place much more flowly; but it is fcarcely poffible to obferve its progrefs with accuracy. The abdomen is gradually dilated with elaftic fluids which make their appearance in it, and at laft it burfts and difcharges a horribly fetid and noxious gas; at the fame time a dark coloured liquid flows out. If the earth be very dry, and the heat confiderable, the moifture is often abforbed fo rapidly, that the carcafe, inftead 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 feparately. But when great numbers of carcafes are crowded together in one place, and are fo abundant as to exclude the action of external air, and other foreign agents, their decompofition is entirely the confequence of the reciprocal action of their ingredients themfelves upon each other, and the refult is very different. The body is not entirely diffipated or converted into mould, but all the foft parts are found diminifhed remarkably in fize, and converted into a peculiar *faponaceous matter*. This fingular change was firft accurately obferved in the year 1786.

375
Conver into a f naceou matter.

The burial ground of the Innocents in Paris having become noxious to thofe who lived in its neighbourhood, on account of the difagreeable and hurtful odour which it exhaled, it was found neceffary to remove the carcafes to another place. It had been ufual to dig very large pits in that burial ground, and to fill them with the carcafes of the poorer fort 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 fimilar pit, and fill it in the fame manner. Each pit held between 1000 and 1500 dead bodies. It was in removing the bodies from thefe pits that this faponaceous fubftance was found. The grave-diggers had afcertained, 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 fubftance. The inteftines and vifcera of the thorax had completely difappeared; but what is fingular enough, the brain had loft but little of its fize or appearance, though it was alfo converted into the fame fubftance.

* Fourc *Ann. d Chim.* 154.

37
Its pro ties.

This faponaceous matter was of a white colour, foft and unctuous to the touch, and melted, when heated, like mpo- cf A- Sub- ices. 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.†

† ...rcoy, ...de ... viii.

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.

‡ *Phil. Transf.* 1794 and 1795.

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 ...1 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 dell'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. Hellot,

* *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 Cloathing. 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.*

* *Ann. de Chim.* vi. 300.

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.

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.* 383 Silk.

Silk, before it is dyed, is always freed from its gum, and generally also from its resin. It may be dyed without ſtances ...d for ...thing.

out the application of heat; which is not the caſe with wool.

3. Cotton is a fine downy ſubſtance, contained in
384 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.

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
385 cotton has loſt any of its original whiteneſs.

4. Lint, from which *linen* is made, is the inner bark of the *linum uſitatiſſimum*, 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.

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.

Colours.

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.

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. 386 Colour produced by light.

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; thoſe 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. 387 Bodies reflect different rays.

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. 388 Hence their different colours.

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- 389 Newtonian theory to explain this difference

Colours. 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.*

* *Newton's Optics*, 191. Clarke's edition.

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:†

† *Ibid.* p. 215.

1.	Black	1		green	$25\frac{1}{5}$
	blue	$2\frac{2}{5}$		yellow	$27\frac{1}{7}$
	white	$5\frac{1}{4}$		red	31
	yellow	$7\frac{1}{9}$	4.	Green	35
	red	$8\frac{1}{2}$		red	$40\frac{1}{3}$
2.	Violet	$11\frac{1}{6}$	5.	Gr. blue	46
	blue	14		red	$52\frac{1}{2}$
	green	$15\frac{1}{8}$	6.	Gr. blue	$58\frac{3}{4}$
	yellow	$16\frac{2}{7}$		red	65
	red	$18\frac{1}{3}$	7.	Gr. blue	71
3.	Purple	21		reddiſh white	77
	blue	$23\frac{2}{5}$			

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.

Colours. 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.*

* *Newton's Optics*, 2[illegible]

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).

390 Examined.

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

(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.

391 found ctive.

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.

ncreaſt rma- 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.

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. 392 Bodies owe their colour to their affinity for light.

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*.

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 393 Why bodies change their colour.

cauſe

Colours.

caufe of change ever occurs, as many fubftances have been expofed to the action of light for a very long time without any change of colour. The abforbed light feems to make its efcape, either in its own form, or in fome unknown or unfufpected one. The fecond caufe of change is very common: indeed its action may be detected in almoft every cafe 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 pruffic acid, affumes a blue colour, and with gallic acid a black colour. The caufe of this change of colour, when the compofition of a body changes, is obvious: every change of compofition muft alter the affinity, becaufe it muft of neceffity produce changes in the fize, denfity, or figure of the particles, or perhaps in all of thefe. Now if the affinity of a body for other bodies be altered, it is natural to fuppofe that it will be altered alfo for light. Accordingly this happens in moft inftances. It does not, however, take place conftantly, for very obvious reafons. It may happen that the new denfity, fize or figure of the altered body is fuch, as to render it ftill proper for attracting the very fame rays of light which it formerly attracted. Juft as iron, after being combined with a certain dofe of oxygen, is converted into green oxyd, which ftill retains an affinity for oxygen.

It is evident from all this, that in moft cafes the permanence of colour in bodies will depend upon the permanence of their compofition, or on the degree of facility with which they are acted upon by thofe bodies, to the agency of which they are expofed.

394 Permanency of colour of great importance in *dyeing*.

In *dyeing*, 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 fome other. In all cafes, therefore, it is of confequence to attend to the fubftances to which dyed cloth is expofed, and to afcertain their action upon every particular dyeing ingredient. Now the bodies to which dyed cloth is almoft conftantly expofed are *air* and *light*; the combined action of which has fo much influence, that very few dyes can refift it.

395 How dyes lofe their colour.

It is evident that thofe fubftances which have a ftrong affinity for oxygen cannot retain their colour, provided they be able to take it from atmofpheric air. Thus the green colour of green oxyd of iron and of indigo is not permanent, becaufe thefe fubftances readily abforb oxygen from air. In order, then, that a colour can have any permanence, the coloured body muft not have fo great an affinity for oxygen as to be able to take it from air. Thofe bodies have in general the moft permanent colours which are already faturated with oxygen, and therefore not liable to abforb more. Such is the cafe with red oxyd of iron.

All coloured bodies are compounds; fome of thofe only excepted which ftill retain an affinity for oxygen. Coloured bodies, therefore, are compofed of feveral ingredients; and in every coloured body, at leaft *fome* of the ingredients have a ftrong affinity for oxygen. Now, before the colour of a body can be permanent, its ingredients muft be combined together by fo ftrong affinities, that oxygen gas is unable to decompofe it by combining with one or more of its ingredients and carrying it off. If this decompofition take place at once, it is impoffible for the colour of a body to have any permanence. If it takes place flowly, the colour of the body gradually decays. The action of oxygen gas upon bodies is much increafed in particular circumftances. Almoft all coloured bodies are decompofed by oxygen gas by the affiftance of heat. Thus if wheat flour be expofed to the heat of 448°, it lofes its white colour, and becomes firft brown and then black. At this temperature it is decompofed, and a part, or even the whole of its hydrogen, combining with oxygen, flies off. Cloth is fcarcely ever expofed to fo high a temperature; but there are other circumftances in which it may be placed which may have a fimilar effect. Thus the action of light feems in fome fubftances to be fimilar to that of heat, and to facilitate the decompofition of the coloured matter by the combination of fome of its ingredients with oxygen.*

Coloured bodies, in order to have permanent colours, muft not be liable to be decompofed by other fubftances more than by oxygen. For inftance, if they contain oxygen and hydrogen, thefe two bodies muft not be liable to combine together and form water, nor muft oxygen and carbon be liable to combine and form carbonic acid gas. Light feems to have a tendency to decompofe 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 filver black by carrying off part of its oxygen, and it reduces oxy-muriatic acid to common muriatic acid by the fame means.

* Berth. on Dye. i. 45.

Thefe are the caufes which induce a change in the colour of coloured bodies, as far as they have been traced; namely, the addition of oxygen, the abftraction of oxygen, partial decompofition by fome one of their ingredients combining with oxygen, complete or partial decompofition by the ingredients entering into new combinations with each other. The coloured matters ufed in dyeing are very liable to thefe changes, becaufe they are in general animal or vegetable fubftances of a very compound nature. Of courfe their ingredients have often no very ftrong affinity for each other, and therefore are very liable to decompofition; and every one of the ingredients has in general a very ftrong affinity for oxygen. This renders the choice of proper colouring matters for dyeing a very important point. In order to have permanency, they muft not be liable to the above changes, not to mention their being able alfo to withftand the action of foap, acids, alkalies, and every other fubftance to which dyed cloth may be expofed.

3[illegible] Meth[od of] afcert[ain]ing th[e perma]nence [of] dyes.

It becomes therefore a point of fome confequence to be able to afcertain whether cloth dyed of any particular colour be permanently dyed or not. The proper method of afcertaining this is by actually expofing fuch cloth to the fun and air; becaufe as thefe are the agents to which it is to be expofed, and which have the moft powerful action, it is clear, that if it withftand them, the colour muft be confidered as permanent. But this is a tedious procefs. Berthollet propofed expofing fuch cloth to the action of oxy-muriatic acid; thofe colours that withftand it being confidered as permanent. This method anfwers in many cafes: but it is not always to be depended on; for it deftroys fome permanent colours very fpeedily, and does not alter others which are very fading.* But we fhall have occafion to refume this fubject afterwards.

* Ban[croft,] i. 49.

3[illegible] Divifi[on of] colour[s].

Dyers divide colours into two claffes; namely, *fimple* and *compound*. The fimple colours are thofe which cannot

...ing in General. 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 ...t 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. Dyeing in General.

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. 400 They muſt be combined with the cloth.

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. 401 Can only be applied in a ſtate of ſolution.

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

(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.

Dyeing in General.

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.*

* Macquer 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.

* Bancroft 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.

404 Metallic mordants.

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 ng in eral. 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.

* . de xviii.

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.† Dyeing in General.

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.

† *Ann. de Chim.* xxv. 15.

‡ *Bancroft*, p. 290.

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.

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.* 405 Tan.

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.

* *Berthollet*, ii. 10.

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 406 Other mordants.

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.

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.

409 Dye-ſtuffs do not cover the whole ſurface of the cloth.

410 Compound 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

Blue. 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.*

111 :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.

112 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.

113 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.

114 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.* Blue.

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 Roxbourgh 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.

Pure

Blue.

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.†

* *Berg.* v. 3.

† *Haussmann.*

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.

‡ *Id.*

* *Bancroft,* i. 130.

§ *Berg.* v. 7.

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.*

* *Instruct. sur l'Art la Teinture,* p. 183.

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.

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.† 417

417 Method of dyeing by decomposing indigo.

† *Bancroft.*

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

(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.

ue. 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.

18 to in- a blue r ou 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.

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. 419. Silk.

The madder employed in the above proceſs may, at firſt ſight, appear ſuperfluous; it ſeems, however, to contribute ſomething to the colour.

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. 420 Cotton, and linen.

SECT. II. *Of Yellow.*

THE principal colouring matters employed to dye yellow are *weld*, *fuſtic*, and *quercitron bark*. 421 Yellow dyes.

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. 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.

422 Weld.

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.*

* *Berthollet*, ii. 260.

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* (F). 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.†

† *Id.* ii. 269.

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.‡

‡ *Bancr* i. 320.

425 Other yellow dy[e stuffs].

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.

426 Yellow [re]quires mordan[ts].

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

(F) 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.

ow. where a yellow is required. The mordant is alumina. When the mordant is oxyd of iron, fustic 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.

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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
roft, 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
329. 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 propor-
330. tion 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 co-
335. lour may be raised to a fine orange, or even an aurora‖.

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lk,

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.¶

Yellow.

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 solu-
tion,

¶ Bancroft, i. 345.

* Ibid. 351.

Yellow. 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*.

Red. 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.

433 Cochineal. 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

(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.

l. 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.†

bollet, i.

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.*

175.

un- 271.

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.

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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.

5 der,

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.‡

ollet, i.

6 amus.

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*.

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. 437 Brazil wood.

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.

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. 438 Red requires a mordant.

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.*

* *Bancroft*, i. 291.

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.†

† *Ibid.* 288.

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 dyeing 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 red

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.†

* *Bancr.* i. 312.

† *Berth.* ii. 203.

447 How to dye cotton and linen red

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.*

* *Bancr.* i. 316.

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

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.* *rtholl**et,*

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 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

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. Brown dyes.

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

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: Diviſion of compound colours.

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.

* *Bancroft*, i. 336.

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.†

† *Ibid.* 346.

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.

459 How induced on 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.†

* *Poern*

† *Decroizille, Berthollet*, ii. 331.

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.‡

‡ *Berth.* ii. 327.

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.*

* *Gubli Bertholl.* ii. 329

461 Cotton, and linen 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.

† *Berth.* ii. 337

Sect. III. *Of Mixtures of Yellow and Red.*

462 Orange and olive 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 induced on 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

...tures Black other ...ours. 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.

465 ...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.*

...rthollet, 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.† Aplig-bid.

SECT. IV. *Of Mixtures of BLACK with other Colours.*

466 ...rs, ..., and ...rs. 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. ...llicbe, bollet, 49.

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.

468 It conſiſts in applying mordants partially 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 penciled 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.

Calico Printing. 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.

* *Bancroft*, i. 373.

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.

473 Dye stuffs 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.*

* *Bancroft*, i. 120.

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[4] Method of printing 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

(K) Different proportions are used by different persons. Mr Hauffman 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 Hauffman, 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 potafs ley. The quantity of acetite of iron is always proportioned to the depth of the intended fhade.

75 ow, 2. For yellow, the block is befmeared 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 fame procefs, only madder is fubftituted for the bark.

77 ee, 4. The fine light blues, which appear fo often on printed cottons, are produced, by applying to the cloth a block befmeared with a compofition, confifting partly of wax, which covers all thofe 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 compofition is removed by means of hot water.

78 1, 5. Lilac, flea brown, and blackifh brown, are given by means of acetite of iron; the quantity of which is always proportioned to the depth of the fhade. For very deep colours, a little fumach is added. The cotton is afterwards dyed in the ufual manner with madder, and then bleached.

79 love. 6. Dove colour and drab, by acetite of iron and quercitron bark.

80 ca- f dif- co- o the cloth. When different colours are to appear in the fame print, a greater number of operations are neceffary. Two or more blocks are employed, upon each of which that part of the print only is cut which is to be of fome particular colour. Thefe are befmeared with different mordants, and applied to the cloth, which is afterwards dyed as ufual. Let us fuppofe, for inftance, that three blocks are applied to cotton; one with acetite of alumina, another with acetite of iron, a third with a mixture of thefe 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 fame liquid, blue may be given to fuch parts of the print as require it.

If the cotton be dyed with madder inftead 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 inftance, when thofe communicated by bark and thofe by madder are wanted at the fame 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 reft of the mordants, to fill up the pattern, are added, and the cloth is again dyed with quercitron bark and bleached. This fecond dyeing does not much affect the madder colours; becaufe the mordants, which render them permanent, are already faturated. The yellow tinge is eafily removed by the fubfequent bleaching. Sometimes a new mordant is alfo applied to fome of the madder colours; in confequence of which they receive a new permanent colour from the bark. After the laft 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 thefe complicated proceffes. Calico Printing.

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 lefs than 12 colours may be made to appear together in the fame print by thefe different proceffes.

Thefe inftances will ferve to give the reader an idea of the nature of calico printing, and at the fame time afford an excellent illuftration of the importance of mordants in dyeing.

If it were poffible to procure colours fufficiently permanent, by applying them at once to the cloth by the block or the pencil, as is the cafe with the mordants, the art of calico printing would be brought to the greateft poffible fimplicity: but at prefent this can only be done in one cafe, that of indigo; every other colour requires dyeing. Compofitions indeed may be made by previoufly combining the dye ftuff and the mordants. Thus *yellow* may be applied at once by employing a mixture of the infufion of quercitron bark and acetite of alumina; *red*, by mixing the fame mordant with the decoction of alumina, and fo on. Unfortunately the colours applied in this way are far inferior in permanency to thofe produced when the mordant is previoufly combined with the cloth, and the dye ftuff afterwards applied feparately. In this way are applied almoft all the fugitive colours of calicoes which wafhing or even expofure to the air deftroys. 481 Colours for pencilling.

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 fhall therefore conclude this chapter with a defcription of feveral colours of this kind propofed by Dr Bancroft, which have a confiderable 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 firft diffolved in a gallon of hot water, and then add two pounds of fugar of lead; ftir this mixture occafionally during the fpace of 24 or 36 hours, then let it remain 12 hours at reft, and afterwards decant and preferve the clear liquor; this being

(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.

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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.†

* *Bancroft* i. 400.

† *Ibid.*

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.

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 $\sqrt[3]{a}$ to $\sqrt[3]{b}$, 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.*

Sudbury || Suffield

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, 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.

* *W. Higgins, M. R. I. A.*

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.*

(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 Tenneffee, in Mero diftrict. According to the State cenfus of 1795, it contained 6,370 inhabitants, of whom 1,076 were flaves.—*ib.*

SUN (See ASTRONOMY-*Index*, Encycl.) is certainly that celeftial body which, of all others, fhould moft attract our attention. It has accordingly employed much of the time and meditation, not only of the aftronomer, but alfo of the fpeculative philofopher, in all ages of the world; and many hypothefes have been formed, and fome difcoveries made, refpecting the nature and the ufes of this vaft luminary.

Sir Ifaac Newton has fhewn, that the fun, by its attractive power, retains the planets of our fyftem in their orbits; he has alfo pointed out the method whereby the quantity of matter which it contains may be accurately determined. Dr Bradly has affigned the velocity of the folar light with a degree of precifion exceeding our utmoft expectation. Galliléo, Scheiner, Hevelius, Caffini, and others, have afcertained the rotation of the fun upon its axis, and determined the pofition of its equator. By means of the tranfit of Venus over the difk of the fun, our mathematicians have calculated its diftance from the earth, its real diameter and magnitude, the denfity of the matter of which it is compofed, and the fall of heavy bodies on its furface. We have therefore a very clear notion of the vaft importance and powerful influence of the fun on its planetary fyftem; but with regard to its internal conftruction, we are yet extremely ignorant. Many ingenious conjectures have indeed been formed on the fubject; a few of which we fhall mention as an introduction to Dr Herfchel's, of which, as it is the lateft, and perhaps the moft plaufible, we fhall give a pretty full account nearly in his own words.

The dark fpots in the fun, for inftance, have been fuppofed to be folid bodies revolving very near its furface. They have been conjectured to be the fmoke of volcanoes, or the fcum floating upon an ocean of fluid matter. They have alfo been taken for clouds. They were explained to be opaque maffes fwimming on the fluid matter of the fun, dipping down occafionally. It has been fuppofed that a fiery liquid furrounded the fun, and that by its ebbing and flowing the higheft parts of it were occafionally uncovered, and appeared under the fhape of dark fpots; and that by the return of the fiery liquid, they were again covered, and in that manner fucceffively affumed different phafes. The fun itfelf has been called a globe of fire, though perhaps metaphorically. The wafte it would undergo by a gradual confumption, on the fuppofition of its being ignited, has been ingenioufly calculated; and in the fame point of view its immenfe power of heating the bodies of fuch comets as draw very near to it has been affigned.

In the year 1779 there was a fpot on the fun which was large enough to be feen with the naked eye. By a view of it with a feven feet reflector, charged with a very high power, it appeared to be divided into two parts. The largeft of the two on the 19th of April, meafured 1' 8".06 in diameter, which is equal in length to more than 31,000 miles. Both together muft certainly have extended above 50,000. The idea of its being occafioned by a volcanic explofion violently driving away a fiery fluid, ought to be rejected (fays Dr Herfchel) on many accounts. "To mention only one, the great extent of the fpot is very unfavourable to fuch a fuppofition. Indeed a much lefs violent and lefs pernicious caufe may account for all the appearances of the fpot. When we fee a dark belt near the equator of the planet Jupiter, we do not recur to earthquakes and volcanoes for its origin. An atmofphere, with its natural changes, will explain fuch belts. Our fpot on the fun may be accounted for on the fame principles. The earth is furrounded by an atmofphere compofed of various elaftic fluids. The fun alfo has its atmofphere; and if fome of the fluids which enter into its compofition fhould be of a fhining brilliancy, in the manner that will be explained hereafter, while others are merely tranfparent, any temporary caufe which may remove the lucid fluid will permit us to fee the body of the fun through the tranfparent ones. If an obferver were placed on the moon, he would fee the folid body of the earth only in thofe places where the tranfparent fluids of our atmofphere would permit him. In others, the opaque vapours would reflect the light of the fun without permitting his view to penetrate to the furface of our globe. He would probably alfo find, that our planet had occafionally fome fhining fluids in its atmofphere; as, not unlikely, fome of our northern lights might not efcape his notice, if they happened in the unenlightened part of the earth, and were feen by him in his long dark night. Nay, we have pretty good reafon to believe, that probably all the planets emit light in fome degree; for the illumination which remains on the moon in a total eclipfe cannot be entirely afcribed to the light which may reach it by the refraction of the earth's atmofphere. For inftance, in the eclipfe of the moon October 22. 1790, the rays of the fun refracted by the atmofphere 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; fo that confequently there could be no illumination from rays refracted by our atmofphere. It is, however, not improbable, that about the polar regions of the earth there may be refraction enough to bring fome of the folar rays to a fhorter focus. The diftance of the moon at the time of the eclipfe would require a refraction of 54' 6", equal to its horizontal parallax at that time, to bring them to a focus fo as to throw light on the moon.

The unenlightened part of the planet Venus has alfo been feen by different perfons; and not having a fatellite, thofe regions that are turned from the fun cannot poffibly fhine by a borrowed light; fo that this faint illumination muft denote fome phofphoric quality of the atmofphere of Venus.

In the inftance of the large fpot on the fun already mentioned, Dr Herfchel concludes, from appearances, that he viewed the real body of the fun itfelf, of which we rarely fee more than its fhining atmofphere. In the year 1783 he obferved a fine large fpot, and followed it up to the edge of the fun's limb. Here he took notice that the fpot was plainly depreffed below the furface of the fun, and that it had very broad fhelving fides. He alfo fufpected fome part, at leaft, of the fhelving fides to be elevated above the furface of the fun; and obferved that, contrary to what ufually happens, the margin of that fide of the fpot which was fartheft from the limb was the broadeft.

The luminous fhelving fide of a fpot 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 $6\frac{1}{2}$ 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 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

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*.

Sun ‖ Sunda.

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 $\frac{4}{5}$ths 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, *Shepeweyau*, *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, 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 *River*, riſes in Lake Uſtayantho, 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

acres

acres of land. If this can be accomplifhed, an inland navigation may be eafily made to the Ohio and to Lake Erie, which would at once open a communication with above 2,000 miles extent of weftern country, viz. with all the great lakes, together with the countries which lie on the waters of Miffiffippi, Miffouri, and all their branches. The water communication between Schuylkill and Sufquehannah, which is the foul of all this, will be about 60 miles, as the navigation muft go, although the diftance on a line is only 40 miles. This tract is cut by two creeks, the Quitapahilla and the Tulpehoken. Thefe two creeks lead within 4 miles of each other; the level of their head waters is nearly the fame, and the fpace 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 muft pafs, will no where rife more than 30 feet above the level of the head waters of the two creeks above-mentioned, nor fo much as 200 feet above the level of the waters of Sufquehannah or Schuylkill. The Company, inftituted the 29th of Sept. 1791, has a capital of 1000 fhares at 400 dollars each, payable at fuch time as the Company fhall direct. The work is already commenced. Coal of an excellent quality is found on feveral parts of this river, particularly at Wyoming.—*ib.*

SUSSEX, the north-wefternmoft county of New-Jerfey. It is mountainous and healthy, and has feveral 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 Prefbyterian churches, 2 for Anabaptifts, 1 for German Lutherans, and 1 for Quakers. It contains 12 townfhips; the chief of which are Newton, Greenwich, Hardyfton, Knowltown, and Oxford. The population is 19,500 including 439 flaves. It is bounded N. E. by the State of New-York, N. W. by Delaware river, which feparates it from Northampton county, in Pennfylvania, and fouth-eaft and fouth by Morris and Hunterdon counties. Paulin's Kill is here navigable for fmall craft 15 miles. The Mufconetcony, which divides the county from Hunterdon, is capable of beneficial improvements, as is the Pequeft or Pequafet, between the above-mentioned rivers. The court-houfe in this county is 13 miles fouth-weft of Hamburg; 38 N. E. of Eafton, in Pennfylvania; 41 fouth-weft of Gofhen, 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 fouth-weft by Dinwiddie. It contains 10,554 inhabitants, including 5,387 flaves.—*ib.*

Sussex, a maritime county of Delaware State, bounded weft and fouth by the State of Maryland, north-eaft by Delaware Bay, eaft by the Atlantic Ocean, and north by Kent county. It contains 20,488 inhabitants, including 4,025 flaves. Cape Henlopen is in the north eaftern part of the county. Chief town, Georgetown.—*ib.*

SUTTON (Thomas Efq;), founder of the charter-houfe, was born at Knaith in Lincolnfhire in 1532, of an ancient and genteel family. He was educated at Eton-fchool, and probably at Cambridge, and ftudied the law in Lincoln's Inn; but this profeffion not fuiting his difpofition, he travelled into foreign countries, and made fo long a ftay in Holland, France, Spain, and Italy, as to acquire the languages of thofe various nations. During his abfence, his father died, and left him a confiderable fortune. On his return home, being a very accomplifhed gentleman, he became fecretary to the earl of Warwick and his brother the earl of Leicefter. By the former of thefe noblemen, in 1569, he was appointed mafter of the ordnance at Berwick; and diftinguifhing himfelf greatly in that fituation, on the rebellion which at that time broke out in the north, he obtained a patent for the office of mafter-general of the ordnance for that diftrict for life. He is named as one of the chiefs of thofe 1500 men who marched into Scotland, by the order of Queen Elizabeth, to the affiftance of the regent, the earl of Morton, in 1573; and he commanded one of the five batteries which obliged the ftrong caftle of Edinburg to furrender to the Englifh. He purchafed of the bifhop of Durham the manors of Gatefhead and Wickham; which, producing coal mines, became to him a fource 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 confiderable eftate; and taking up the bufinefs of a merchant, riches flowed in to him with every tide. He is faid to have had no lefs than thirty agents abroad. He was likewife one of the chief victuallers of the navy; and feems to have been mafter of the barque called Sutton, in the lift of volunteers attending the Englifh fleet againft the Spanifh armada. It is probable, alfo, that he was a principal inftrument 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 invafion for a whole year. He is likewife faid to have been a commiffioner for prizes under Lord Charles Howard, High Admiral of England; and going to fea with letters of marque, he took a Spanifh fhip 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 greateft eftate in the poffeffion of any private gentleman till much later times. He lived with great munificence and hofpitality; but lofing his lady in 1602, he retired from the world, leffened his family, and lived in a private frugal manner; and, having no iffue, refolved to diftinguifh his name by fome important charity. Accordingly, he purchafed of the Earl of Suffolk, Howard-Houfe, or the late diffolved charter-houfe, near Smithfield, for the fum of L. 13,000, where he founded the prefent hofpital, in 1611, for the relief of poor men and children. Before he had fixed upon this defign, the court endeavoured to divert him from his purpofe, 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 luftre 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 moft folemn proceffion, to Chrift-church in London, and there depofited, till 1614, when it was removed to the charter-houfe, and interred in a vault on the north fide of the chapel, under a magnificent tomb.

Sutton, a townfhip of New-Hampfhire, Hillfborough

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.

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 ſuccefsful, 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 againſt

(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.

Suworow. 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 Staloviz, 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, ow. 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!"

Suworow.

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,

Suworow. otherwife, and Suworow never difplayed greater refource in the day of danger, than in the numerous battles and fkirmifhes in which he was engaged on his march to the capital of Poland. At laft, after furmounting every obftacle, he fat down, on the 22d of October, before Praga, a ftrongly fortified fuburb of Warfaw, defended by a formidable artillery, and a garrifon of 30,000 men, rendered defperate by their fituation. The Ruffian army exceeded not 22,000; and with that comparatively fmall force he refolved to ftorm Praga, as he had ftormed Ifmail. Having erected fome batteries to deceive the garrifon into a belief that they were to be regularly befieged, he concerted with the other Generals the mode of affault; and when every thing was ready, he gave his orders in thefe words: "Storm, and take the batteries, and cut down all who refift; but fpare the inhabitants, unarmed perfons, and all who fhall afk for quarter."

There are but few examples of a military operation fo boldly conceived, fo fkilfully performed, or fo important in its confequences, as the taking of Praga. The affault was made at once in feven different places at five in the morning; and at nine the Ruffians were mafters 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 Warfaw; above 2000 were drowned in the Viftula; and 14,680 were taken prifoners, of whom 8000 were difarmed and immediately fet at liberty, and the remainder the next day. We mention thefe circumftances, becaufe they completely refute the tales of thofe Jacobin fcribblers, who have fo ftrenuoufly endeavoured to tarnifh the laurels of the Ruffian hero, by reprefenting him as having ordered a general maffacre of men, women, and children. The artillery taken from the enemy confifted of 104 pieces of cannon and mortars, chiefly of large calibre. The Ruffians had 580 men killed, of whom eight were fuperior and ftaff-officers, and 900 wounded, of whom 23 were officers.

Soon after the ftorming of Praga, Warfaw capitulated, and Suworow was received into the city by the magiftrates in a body, and in their ceremonial habits. When the prefident prefented to him the keys of the city, he preffed them to his lips, and then, holding them up towards heaven, he faid, "Almighty God, I render thee thanks, that I have not been compelled to purchafe the keys of this place as dear as . . . . ." Turning his face towards Praga, his voice failed him, and his cheeks were inftantly bathed with tears. As he rode through the ftreets, the windows were filled with fpectators, who were delighted with the return of order, and the affurance of peace; and the air refounded with the exulting exclamations of "Long live Catharine! Long live Suworow!"

Thus did Count Suworow, in the courfe of a very few months, overturn the kingdom and republic of Poland. It is not our bufinefs, in this article, to decide on the juftice of the caufe in which he was embarked. Of the Polifh revolution, which gave rife to the war that fubverted the republic, and fwept it from the number of fovereign ftates, the reader will find fome account under the title POLAND in the *Encyclopædia*; but it is here proper to acknowledge, that we do not now think fo favourably, as when we wrote that article, of the views and principles of thofe who framed the conftitution, which brought upon them the Ruffian and Pruffian arms. Subfequent events feem to have proved completely, that if Poland had not been conquered by the allied powers, it would foon have been involved, under Kofkiufko and his Jacobinical adherents, in all the horrors of revolutionary France; and the unhappy king, inftead of being carried captive into Ruffia, would probably have finifhed his courfe on a fcaffold. Suworow, who never concerned himfelf with the intrigues of courts, and expreffed on all occafions the moft fovereign contempt of thofe Generals who affected to poffefs the fecrets of ftatefmen, probably never enquired into the final object of the war, but thought it his duty to execute, in his own fphere, the orders of his Imperial miftrefs. So fenfible was Catharine of the propriety of this conduct, and of the zeal and abilities which he had difplayed in the Polifh campaign, that immediately on receiving accounts of the ftorming of Praga and the fubmiffion of Warfaw, fhe announced to him, in a letter written with her own hand, his well-earned advancement to the rank of Field-marfhal General. Nor did her munificence ftop there: She loaded him with jewels, and prefented him with an eftate of 7000 peafants, in the diftrict of Kubin, which had been the fcene of his firft battle in the courfe of the campaign.

From the fubjugation of Poland we hear little more of Field-marfhal Suworow till he entered upon his glorious career in Italy. He is faid, indeed, to have given offence to the Emperor Paul foon after his acceffion to the throne, by affording protection to fome meritorious officers, whom his Majefty had in an arbitrary manner difmiffed from the fervice; but that offence was overlooked, and Suworow called again into action, when Paul joined the coalition againft France.

Of the exploits of the Field-marfhal in Italy, where, to ufe his own words, he deftroyed armies and overturned ftates, we have given a full account under the title REVOLUTION in this *Supplement*. In his former campaigns, the wifdom of his meafures, the diftribution of his forces, the undaunted character of his operations, and the progreffive continuance of his fucceffes, furnifh proofs of the fuperiority of his talents hardly to be paralleled in the annals of modern war; but, animated by the noblenefs of his caufe, and confiding, as he faid, in the God of battles, he feems in his laft campaign to have furpaffed himfelf (B). It would appear, however, that

(B) Were any other proof than a fimple narrative of his fuccefs neceffary to evince the abilities difplayed by Marfhal Suworow in the laft campaign, that proof might be found in the fad reverfes of the prefent. At the opening of the campaign of 1800, the allies poffeffed infinitely greater advantages over the enemy than at the beginning of the campaign of 1799; and we ventured to fay, towards the end of the article REVOLUTION, in this *Supplement*, that the affairs of the French feemed in Italy to be defperate. But how egregioufly have we been miftaken? By the moft unaccountable infatuation, the Auftrian commander in Italy would not *believe* that the French army of referve, which was advancing upon him with the ufual celerity of the

Suworow. 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! Suworow.

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.

Suworow.

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 ‖ Swan.

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.*

SWAN-

(c) By the anonymous author of the life of Catharine II.

Swannano, || Swinton.

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 Mischiscoui 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.

Dic-ry.

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

Swinton.

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!"

* *The Champions, or Evening Advertiſer*, June 17th 1740.

Swinton ‖ Sypomba.

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.*

T.

Taawirry, ‖ Tabaſco.

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 ‖ Tacquet.

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, 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 *Tiago 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 Oakfuskee 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 Ekanfanoka 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 TALUD, 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 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, 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 50, 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 162,673 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

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

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.*

TEMPERAMENT OF THE SCALE OF MUSIC. I Introduction.

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

der 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

Temperament of the Scale of Music.

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.

Temperament of the Scale of Muſic.

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. 10

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*, $\overline{g}$. 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 [are] ſeven [notes] in the natural ſ[cale] and eight 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 era- f the of ic.

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.

ve.

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.

3 ctaves milar.

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.

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.

14 usic ined e oc- ; hence DIA- N.

Tempera-ment 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 differ-ent

Tempera-ment 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.

Tempe ment o Scale Mu

22
The th and ſev ſtep ar ſmalleſ

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*.

23
The Py gorean coveri not im prove Greek ſic.

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.

24
The tr poſition muſic n intercal notes ne ſary in t octave.

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 ſic.

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.

es of tha- s and xe- about l ra-

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.

of , di- , and aron.

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

(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.

Temperament of the Scale of Music.

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.

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. 29 But melody is quite insufficient.

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 $33\frac{1}{2}$. 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 30 Circular presentation of the scale. Plate XLIV.

npera- t of the ale of Iuſic.

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.

31 toxe- i ſcale iean s and nas,

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 +.

32 nd im- fect, and uired IPERA- NT.

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.

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

33 The Greeks did not cultivate the harmony of ſimultaneous ſounds.

(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.

Temperament of the Scale of Muſic.

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.

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 36.

(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.

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.

37

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.

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 approach

Temperament of the Scale of Music.

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.

39 Hence ariſes the great uſe of mathematics in muſic.

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 that 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.

40 BEATIN of imper fect con 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.

But

Tempera- of the Scale of Music. 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.

41 Smith's ... to science ... practice of music ... with effect ... thereof. 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 fingerboard 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.

* Mem. Acad. Par. 1702, and ...

C = 240. 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.

Easy and exact measures of temperament. 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 Crouder. 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♭, 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 Mr

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.

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 Determination of octave charac[ter] of con[cords]

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[6] Harm[ony] more [ſenſible] than m[elo]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 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.

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.

Temperament of the Scale of Muſic.

50 Determination of the IIId.

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*. 51

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. 52 Determination of the 3d.

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. 53

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 me- 54 Determination of the 6th.

Temperament of the Scale of Music.

lody; 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 harmonics 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.

Temperament of the Scale of Music.

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. 58.

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.*

59 Ratios belonging to the concords, &c.

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*^{b}
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 for pera- of the le of sic. 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.

o va- on the sol la.

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.

1 mina- f the 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*.

2 mina- f the 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.

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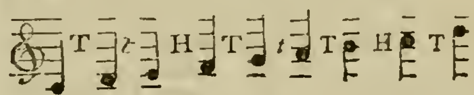
It will be convenient to represent the tones major and minor and the hemitone, by the symbols T, *t*, and H. Also to mark the notes by the Roman numerals, or by cyphers, according as they are the extremes of major or minor intervals. By this notation the octave may be represented thus: 63.

C D E F G A B *c* *d* *e*



$\frac{8}{9}$ $\frac{9}{10}$ $\frac{15}{16}$ $\frac{8}{9}$ $\frac{9}{10}$ $\frac{8}{9}$ $\frac{15}{16}$ $\frac{8}{9}$ &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.

Logarithmic measures of the musical intervals.

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

Temperament of the Scale of Music.

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 $303\frac{3}{4}$ 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 $= \frac{2\,q\,m\,N}{161\,p - q}$, or $\frac{2\,q\,n\,M}{161\,p + q}$; and if it be tempered flat, then $b = \frac{2\,q\,m\,N}{161\,p + q}$, or $\frac{2\,q\,n\,M}{161\,p - q}$ (*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 $\underline{e}\,g$ resulting from this process, and the VIth $c\,a$, 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 the ... may be ... tained by the beats.

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 ensuring 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 $= \frac{2qmN}{161 \times p + q}$. In the preſent caſe $q = 1$, $m = 3$, $N = 240$ 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 $N = 360$). 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 $\bar{d}\,\bar{a}$ muſt be made to beat flat 15 times in 6 ſeconds.

In like manner, inſtead of tuning upward the Vth $\bar{a}\,\bar{\bar{e}}$, 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.

If we take 15 ſeconds for the common period of all theſe beats, we ſhall have — Temperament of the Scale of Muſic.

The beats of $c\,g = 34$.
G $d = 25$.
$\bar{d}\,\bar{a} = 37\frac{1}{2}$.
$a\,e = 28$.

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*♭, $\bar{b}$♭, $\bar{b}$♭ *e*♭, 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 IIIds. 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

Temperament of the Scale of Music.

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 $= 2\ v$, the contemporaneous variation which thus induces on a limma will be $= -5 v$; and if the tone be diminished by the same quantity $- 2\ v$, the limma will increase by the quantity $5\ v$. Let us see what are the contemporaneous changes made on all the intervals of the octave when the tone is diminished by $2\ v$.

73 Proportional variations of temperament.

1. A Vth is made up of three tones and a limma. Therefore the variation of its temperament is $= -6 v + 5 v$, 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 $- 2\ v$.

Therefore a minor 7th is raised by $2\ v$.

3. A minor 3d is made up of a tone and a limma: therefore its variation is $= - 2\ v + 5\ v$, or $= 3\ v$.

Therefore a major VIth (its complement) loses $- 3\ v$.

4. A maj. IIId, or two tones, has its variation $= -4\ v$.

Therefore a minor 6th has its variation $= 4\ v$.

5. A maj. VIIth, the complement of a limma has $-5\ v$.

6. A tritone, or IVth, must have the variation $= -6\ v$.

Therefore the false 5th must have - - $6\ v$.

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 b[y 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 $= 3\ v$, the variation competent to the VIth; and E *e'* is $= 4\ v$, the proper variation for the IIId.

75 The temperer.

In like manner, *b b'* is $= 5\ v$, the variation of the VIIth and 2d. And, lastly, *t t'* is the variation $6\ v$ 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 Certain scales of great u[se].

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 $13\frac{1}{2}$ parts. This will express the logarithmic measures of the temperaments mentioned in n° 63. a comma being $= 54$.

The *second* scale should have *g*G divided into 36 parts. This

This gives the beats made in 16 feconds by the notes c, g, when tempered by any quantity Gg'.

The *third* fcale fhould have gG divided into 60 parts, for the beats made by the notes c, e, or the notes c, $\bar{a}$.

The *fourth* fcale fhould have gG divided into 72 parts. This gives the beats made by the key note C, with its minor third e^{b}.

The *fifth* fcale fhould have gG divided into 48 parts, for the beats made by the notes c, f.

The *fixth* fcale fhould have gG divided into 89 parts, on which Aa' is meafured, to get the beats of the fubordinate concord formed by g and e in the harmony of K — III — V.

And, *laftly*, 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 caufes of the pleafure we receive from certain confonances, and fhould therefore receive, with fatisfaction, any thing that can help us to approximate to a meafure of its degrees. We know that, in fact, the pleafantnefs of any individual concord increafes as the undulations called *beats* diminifh in frequency. It is probable that we fhall not deviate very far from the truth, if we fuppofe the harmonioufnefs of an individual tempered concord to be proportional to the flownefs of thefe undulations. But it by no means follows, that a tempered Vth and a IId are equally pleafant, each in its kind, when they beat equally flow. There is a difference *in kind* in the pleafures of thefe concords: and this muft arife from the peculiar manner in which the component pulfes of each concord divide each other. We are certain that this is all the difference that obtains between them in Nature. But the harmonioufnefs here fpoken of is the arrangement which produces this pleafure. We are intitled to fay, that this is equal in two given inftances, when the arrangements are precifely fimilar; and when the things arranged are the fame, nothing feems to remain in which the inftances can differ.

At any rate, it is of confequence to be able to proportion and diftribute thefe undulations at pleafure. They are unpleafant; and when reinforced by uniting, muft be more fo. The theory puts it in our power to prevent this union: perhaps by making them very unequal; or, if this fhould 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 defirable; and this is obtained by the theory of the beats of imperfect confonances.

But we are forgetting the procefs of tuning, and have only tuned three or four notes of our octave. We muft tune the reft by confidering their relation to notes already tuned. Thus, if $g\,c$ makes 36 beats in 16 feconds, F c fhould make one third lefs, or about 24 in the fame time; becaufe N in the formula is now 160 inftead of 240. Proceeding in this way, we fhall tune the octave C $\bar{\bar{c}}$ moft accurately as a fyftem 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 fharp or flat. Thus g is tuned from c,

Make $c\dot{g}$	beat	—	36 times in 16 feconds
$G\dot{c}$		+	36
$G\dot{d}$		—	27, *i. e.* $\frac{3}{4}$ths of $g\,c$

Make $c\dot{f}$		—	48
$c\dot{\bar{a}}$	beat	+	60 times in 16 feconds
$c\dot{e}$			0, *i. e.* a perfect IIId
$d\dot{f}$♯			0
$e\dot{g}$♯			0
$a\dot{\bar{c}}$♯			0
$\dot{b}^{b}f$ downward		—	24, *i. e.* $\frac{8}{9}$ths of $c\,g$
$b^{b}\dot{\bar{b}}^{b}$			0, *i, e.* a perfect octave
$\bar{b}^{b}\dot{e}^{b}$ downward		—	43, *i. e.* $\frac{6}{5}$ths of $c\,g$
$C\dot{\bar{c}}$			0 an octave.

Other proceffes may be followed, and perhaps fome of them better than the procefs here propofed. Thus, b^{b} and e^{b} may be tuned as perfect IIIds to d and g downwards. Alfo, as we proceed in tuning, we can prove the notes, by comparing them with other notes already tuned, &c. &c. &c.

Temperament of the Scale of Mufic.

We have directed to tune the two notes b^{b} and e^{b} by taking the leading Vth downwards. We fhould have come at the fame pipes in the character of a♯ and d♯ in the procefs of tuning upwards by Vths. But this would not have produced precifely the fame founds, although, in our imperfect inftruments, one key muft ferve for a♯ and b^{b}. By tuning them as here directed, they are better fitted for the places in which they will be moft frequently employed in our ufual modulations. 80

Another fyftem very fit for our inftruments.

It may reafonably be afked, Why fo much is facrificed in order to preferve the IIIds perfect? Were they allowed to retain fome part of the fharp temperament that is neceffary for preferving the Vths perfect, we fhould perhaps improve the harmony. And fince enlarging the fifth makes the tone greater, and therefore the limma *mi fa* much fmaller, it will bring it nearer to the magnitude of a half tone; and this will be better fuited for its double fervice of the fharp of the note below, and the flat of the note above. Accordingly, fuch a temperament is in great repute, and indeed is generally practifed, although the VIth and the fubordinate chords of full harmony are evidently hurt by it. Even Dr Smith recommends it as well fuited to our defective inftruments, and gives an extremely eafy method of executing it by means of the beats. His method is to make the Vth and IIId beat equally faft, along with the key, the Vth flat, and the IIId fharp. He demonftates (on another occafion), that concords beat equally faft with the fame bafs when their temperaments are inverfely as the major terms of their perfect ratios. Therefore draw EG, and divide it in p, fo that Ep may be to pG as 3 to 5. 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 refpective fcales. Fig. 2.

Therefore make	$c\,g$	beat 32 times in 16 feconds
	$G\,c$	32
	$G\,d$	24
	$G\,b$	24, and tune $b\,\bar{b}$
	$d\,\bar{a}$	36, and tune $a\,\bar{a}$
	$d\,f$♯	36
	$a\,e$	27
	$a\,\bar{c}$♯	27
	$e\,\bar{b}$	$40\frac{1}{2}$, proving $b\,\bar{b}$
	$e\,g$♯	$40\frac{1}{2}$

Therefore make F c $21\frac{1}{3}$, and tune F f
F a beat $21\frac{1}{3}$, proving a
$b^{\flat} f$ $28\frac{1}{3}$, and tune $b^{\flat}\ \overline{b^{\flat}}$
$e^{\flat}\ \overline{b^{\flat}}$ $38\frac{1}{3}$,
$c\ \overline{c}$ 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 $\frac{1}{108}$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.

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 harmony 84 Dr Smith's ſyſtem of EQUAL HARMONY.

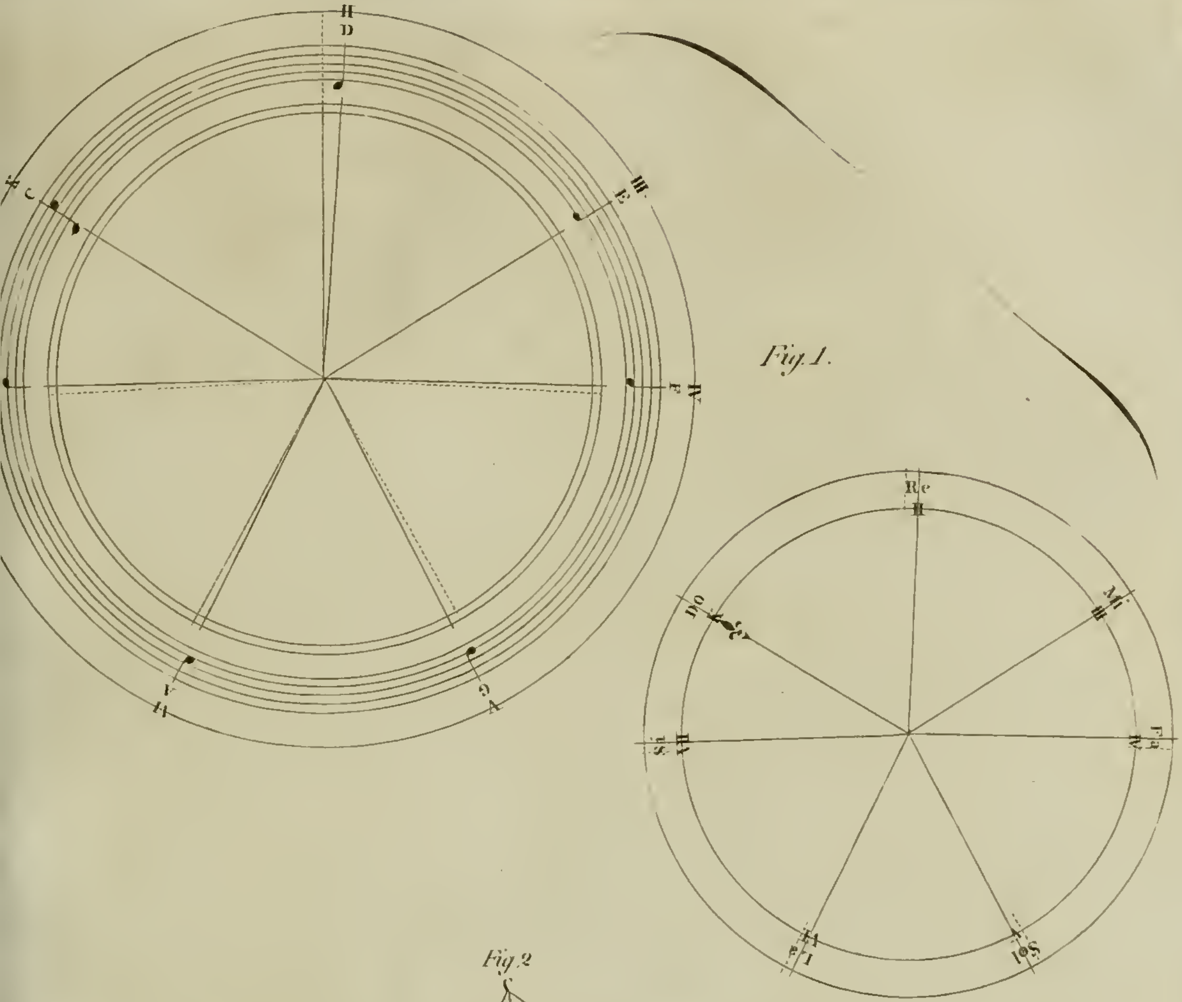

D
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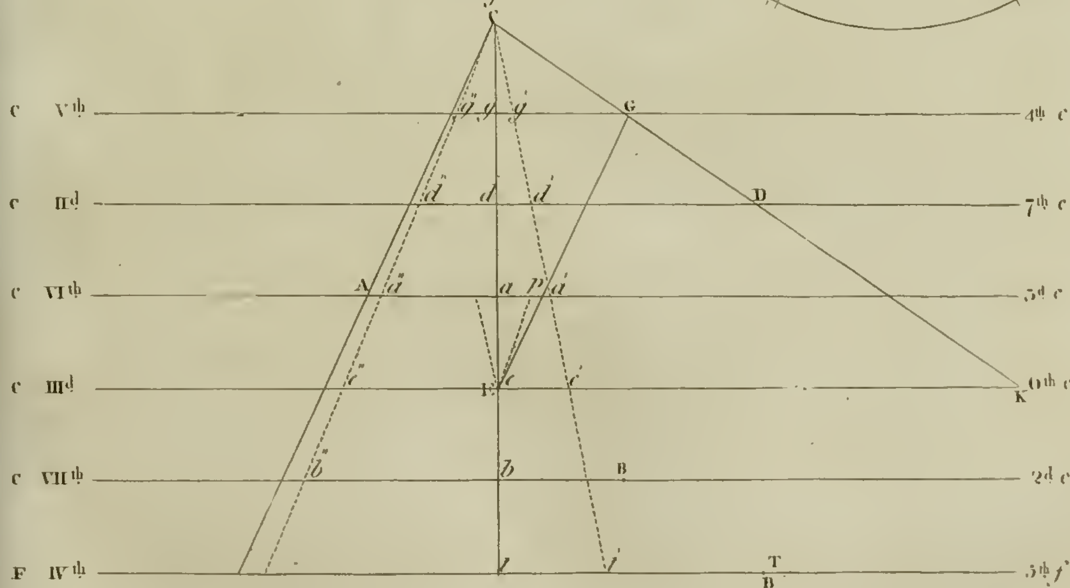
Fig. 1.

Fig. 2


C
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K
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c V th
c II d
c VI th
c III d
c VII th
F IV th
4th c
7th c
3d c
6th c
2d c
5th f

[Tempera-ment of the Scale of Music.] 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 [Maxims of temperament very gratuitous.] 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. [Tempera-ment of the Scale of Music.]

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. 87 [Equal harmony rejected]

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 tem-

 peraments

peraments 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.

This examination is neither difficult nor tedious. 89.
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. 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.

Templars.

"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

(A) *Layette*, N° 20. *Interrog. made at Caen.*
(B) See the *Council of Ravenna. Rubeus Hist. Raven.* lib. vi.

Templars.

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 Fiorence, though in all these councils the prelates were very ready to absolve all those knights who could succeed in their justifications.

Templars ‖ Templeman.

"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.*

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

Biog. Dict.

(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.*

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, 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 N° 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, Chickamauga 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 Mississippi. It is divided

Tenneffee. divided into 3 diftricts, viz. Wafhington, Hamilton, and Mero, which are fubdivided into 13 counties, viz. Wafhington, Sullivan, Greene, Carter, Hawkins, Knox, Jefferfon, Sevier, Blount, Grainger, Davidfon, Sumner, Robertfon, and Montgomery. The firft four belonging to Wafhington diftrict, the next five to that of Hamilton, and the four latter to Mero diftrict. The two former diftricts are divided from the latter, by an uninhabited country of 91 miles in extent; that is from the block-houfes, at the point formed by the junction of the river Clinch with the Tenneffee, called South-Weft Point, to Fort Blount upon Cumberland river, through which there is a waggon road, opened in the fummer of 1795. There are few countries fo well watered with rivers and creeks. The principal rivers are the Miffiffippi, Tenneffee, Cumberland, Holfton, and Clinch. The tract called the Broken Ground, fends immediately into the Miffiffippi, the Wolf, Hatchee, Forked-Deer, Obian or Obean, and Reelfoot; which are from 30 to 80 yards wide at their mouths; moft of the rivers have exceedingly rich low grounds, at the extremity of which is a fecond bank, as on moft of the lands of the Miffiffippi. Befides thefe rivers, there are feveral fmaller ones, and innumerable creeks, fome of which are navigable. In fhort, there is hardly a fpot in this country, which is upwards of 20 miles diftant from a navigable ftream. The chief mountains are Stone, Yellow, Iron, Bald, and Unaka, adjoining to one another, from the eaftern boundary of the State, and feparate 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 defcribe the mountains of this ftate, above half of which is covered with thofe that are uninhabitable. Some of thefe mountains, particularly the Cumberland or Great Laurel Ridge, are the moft ftupendous piles in the United States. They abound with ginfeng and coal. The caverns and cafcades in thefe mountains are innumerable. The *Enchanted Mountain*, about two miles fouth of Brafs-Town, is famed for the curiofities on its rocks. There are on feveral rocks a number of impreffions refembling the tracks of turkies, bears, horfes, and human beings, as vifible and perfect as they could be made on fnow or fand. The latter were remarkable for having uniformly fix toes each; one only excepted, which appeared to be the print of a negro's foot. By this we muft fuppofe the originals to have been the progeny of Titan or Anak. One of thefe tracks was very large, the length of the foot 16 inches, the diftance 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 horfe tracks was likewife of an uncommon fize, the tranfverfe and conjugate diameters, were 8 by 10 inches; perhaps the horfe which the Great Warrior rode. What appears the moft in favour of their being the real tracks of the animals they reprefent, is the circumftance of a horfe's foot having apparently flipped feveral inches, and recovered again, and the figures having all the fame direction, like the trail of a company on a journey. If it be a *lufus naturæ*, the old dame never fported more ferioufly. If the operation of chance, perhaps there was never more apparent defign. If it were done by art, it might be to perpetuate the remembrance of fome remarkable event of war, or engagement fought on the ground. The vaft heaps of ftones near the place, faid to be tombs of warriors flain in battle, feem to favour the fuppofition. The texture of the rocks is foft. The part on which the fun had the greateft influence, and which was the moft indurated, could eafily be cut with a knife, and appeared to be of the nature of the pipe ftone. Some of the Cherokees entertain an opinion that it always rains when any perfon vifits the place, as if fympathetic nature wept at the recollection of the dreadful cataftrophe which thofe figures were intended to commemorate. The principal towns are Knoxville, the feat of government, Nafhville, and Jonefborough, befides 8 other towns, which are as yet of little importance. In 1791, the number of inhabitants was eftimated at 35,691. In November, 1795, the number had increafed to 77,262 perfons. The foil is luxuriant, and will afford every production, the growth of any of the United States. The ufual crop of cotton is 800lbs. to the acre, of a long and fine ftaple; and of corn, from 60 to 80 bufhels. It is afferted, however, that the lands on the fmall rivers, that empty into the Miffiffippi, have a decided preference to thofe 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, fycamore, black and honey locuft, afh, horn-beam, elm, mulberry, cherry, dogwood, faffafras, poppaw, cucumber-tree, and the fugar-tree. The undergrowth, efpecially on low lands, is cane; fome of which are upwards of 20 feet high, and fo thick as to prevent any other plant from growing. Of herbs, roots, and fhrubs, there are Virginia and Seneca fnakeroot, ginfeng, and angelica, fpice-wood, wild plum, crab-apple, fweet annife, red-bud, ginger, fpikenard, wild hop and grape vines. The glades are covered with wild rye, wild oats, clover, buffaloe grafs, ftrawberries and pea-vines. On the hills, at the head of rivers, and in fome high cliffs of Cumberland, are found majeftic red cedars; many of thefe are four feet in diameter, and 40 feet clear of limbs. The animals are fuch as are found in the neighbouring States. The rivers are well ftocked with all kinds of frefh water fifh; among which are trout, perch, cat-fifh, buffaloe-fifh, red-horfe, eels, &c. Some cat-fifh have been caught which weighed upwards of 100 pounds: the weftern waters being more clear and pure than the eaftern rivers, the fifh are in the fame degree more firm and favory to the tafte. The climate is temperate and healthful; the fummers are very cool and pleafant in that part which is contiguous to the mountains that divide this ftate from N. Carolina; but on the weftern fide of the Cumberland Mountain the heat is more intenfe, which renders that part better calculated for the production of tobacco, cotton and indigo. Lime-ftone is common on both fides of the Cumberland Mountain. There are no ftagnant waters; and this is certainly one of the reafons why the inhabitants are not afflicted with thofe bilious and intermitting fevers, which are fo frequent, and often fatal, near the fame latitude on the coaft of the fouthern States. Whatever may be the caufes, the inhabitants have been remarkable healthy fince they fettled on the waters of Cumberland river. The country abounds with mineral fprings. Salt licks are found in many parts of the country. Iron ore abounds in the diftricts of Wafhington and Hamilton, and fine ftreams to put iron-works in operation. Iron ore was lately difcovered upon the fouth of Cumberland

berland river, about 30 miles below Nafhville, and a furnace is now erecting. Several lead mines have been difcovered, and one on French Broad has been worked; the ore produced 75 per cent. in pure lead. The Indians fay that there are rich filver mines in Cumberland Mountain, but cannot be tempted to difcover any of them to the white people. It is faid that gold has been found here; but the mine from which that metal was extracted is now unknown to the white people. Ores and fprings ftrongly impregnated with fulphur are found in various parts. Saltpetre caves are numerous; and in the courfe of the year 1796, feveral tons of faltpetre were fent to the Atlantic markets. This country furnifhes all the valuable articles of the fouthern States. Fine waggon and faddle horfes, beef cattle, ginfeng, deer-fkins, and furs, cotton, hemp, and flax, may be tranfported by land; alfo iron, lumber, pork and flour may be exported in great quantities, now that the navigation of the Miffiffippi is opened to the citizens of the United States. But few of the inhabitants underftand commerce, or are poffeffed of proper capitals; of courfe 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 foon be opened to their true intereft, and agriculture, commerce, and manufactures will each receive proper attention. The Prefbyterians are the prevailing denomination of Chriftians; in 1788, they had 23 large congregations, who were then fupplied by only 6 minifters. There are alfo fome Baptifts and Methodifts. The inhabitants have paid great attention to the interefts of fcience; befides private fchools, there are 3 colleges eftablifhed by law; Greenville in Green's county, Blount at Knoxville, and Wafhington in the county of that name. Here is likewife a "Society for promoting Ufeful Knowledge." A tafte for literature is daily increafing. The inhabitants chiefly emigrated from Pennfylvania, and that part of Virginia that lies weft of the Blue Ridge. The anceftors of thefe people were generally of the Scotch nation; fome of whom emigrated firft to Ireland, and from thence to America. A few Germans and Englifh are intermixed. In 1788, it was thought there were 20 white perfons to one negro; and the difproportion 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 fubfequent divifion, it made a part of N. Carolina. It was explored about the year 1745, and fettled by about 50 families in 1754; who were foon after driven off or deftroyed by the Indians. Its fettlement re-commenced in 1765. The firft permanent fettlement took place near Long-Ifland of Holfton, and upon Watauga, about 1774; and the firft appearance of any perfons 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 Robertfon, (fince Brig. Gen. Robertfon of Mero diftrict) paffed through a wildernefs of at leaft 300 miles to the French Lick, and there founded Nafhville. Their neareft neighbours were the fettlers of the infant State of Kentucky, between whom and them, was a wildernefs of 200 miles. From the year 1784, to 1788, the government of N. Carolina over this country was interrupted by the affumed 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 Congrefs provided for its government. A convention was held at Knoxville, in 1796, and on the 6th of February the conftitution of the State of Tenneffee was figned by every member of it. Its principles promife to enfure the happinefs and profperity of the people. The following are the diftances on the new road from Nafhville in Davidfon county, to Fort Campbell, near the junction of Holfton with the Tenneffee.

	Miles.
From Nafhville 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 Pelefon	11
To the Pappa Ford of the Pelefon or Clinch river	12
To Campbell's Station, near Holftein	10
To the Great Ifland	100
To Abingdon in Wafhington county	35
To Richmond in Virginia	310
Total	635

By this new road, a pleafant paffage may be had to the weftern country with carriages, as there will be only the Cumberland mountain to pafs, and that is eafy of afcent; and beyond it, the road is generally level and firm, abounding with fine fprings of water. The Indian tribes within and in the vicinity of this State are the Cherokees and Chickafaws.—*ib.*

TENSAW, a fettlement near Mobile Bay, inhabited by 90 American families, that have been Spanifh fubjects fince 1783.—*ib.*

TEOWENISTA *Creek*, runs foutherly about 28 miles, then wefterly 6 miles, and empties into Alleghany river about 18 miles from its mouth, and nearly 5 below the Hickory town.—*ib.*

TEQUAJO, or *Tiquas*, a province of Mexico; according to fome Spanifh travellers, being about lat. 37, where they found 16 villages.—*ib.*

TEQUEPA, a part of the coaft of New Mexico, about 18 leagues N. W. of Acapulco.—*ib.*

TEQUERY *Bay*, on the fouth-eaft part of the coaft of the ifland of Cuba, between Cape Cruiz, and Cape Maizi, at the eaft end. It affords good anchorage and fhelter for fhips, but is not much frequented.—*ib.*

TERANE', a town in Egypt, fituated on what Mr Browne

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 Caſhefs. 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 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

Terebratulæ.

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.

Terebratulæ ‖ Termina.

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

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, Comana, 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

Territory. 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 erected.
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, Kennotnic, 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-

Pennfylvania (A). 4. But the current down the Ohio and Miffiffippi, for heavy articles that fuit the Florida and Weft-India markets, fuch as corn, flour, beef, lumber, &c. will be more frequently loaded than any ftreams on earth. The diftance from the Scioto to the Miffiffippi, is 800 miles; from thence to the fea, is 900. This whole courfe is eafily run in 15 days; and the paffage up thofe rivers is not fo difficult as has ufually been reprefented. It is found, by late experiments, that fails are ufed to great advantage againft the current of the Ohio; and it is worthy of obfervation, that in all probability fteam boats will be found to do infinite fervice in all our extenfive river navigation. No country is better ftocked with wild game of every kind. The rivers are well ftored with fifh of various kinds, and many of them are of an excellent quality. They are generally large, though of different fizes; the catfifh, which is the largeft, and of a delicious flavour, weighs from 6 to 80 pounds. The number of old forts, found in this weftern country, are the admiration of the curious, and a matter of much fpeculation. They are moftly of an oblong form, fituated on ftrong, well chofen ground, and contiguous to water. When, by whom, and for what purpofe, thefe were thrown up, is uncertain. They are undoubtedly very ancient, as there is not the leaft vifible difference in the age or fize of the timber growing on or within thefe forts, and that which grows without; and the oldeft natives have loft all tradition refpecting them. The pofts eftablifhed for the protection of the frontiers, and their fituation, may be feen on the map. By an ordinance of Congrefs, paffed on the 13th of July, 1787, this country, for the purpofes of temporary government, was erected into one diftrict, fubject, however, to a divifion, when circumftances fhall make it expedient. The ordinance of Congrefs, of July 13th, 1787, article 5th, provides that there fhall be formed in this territory, not lefs than three, nor more than five States; and the boundaries of the States fhall become fixed and eftablifhed as follows, viz. the weftern State in the faid territory fhall be bounded on the Miffiffippi, the Ohio and Wabafh rivers; a direct line drawn from the Wabafh and Poft Vincents due north to the territorial line between the United States and Canada, and by the faid territorial line to the Lake of the Woods and Miffiffippi. The middle State fhall be bounded by the faid direct line, the Wabafh from Poft Vincents to the Ohio; by the Ohio by a direct line drawn due north from the mouth of the Great Miami to the faid territorial line, and by the faid territorial line. The eaftern State fhall be bounded by the laft mentioned direct line, the Ohio, Pennfylvania, and the faid territorial line: Provided however, and it is further underftood and declared, that the boundaries of thefe 3 States fhall be fubject fo far to be altered, that if Congrefs hereafter fhall find it expedient, they fhall have authority to form 1 or 2 States, in that part of the faid territory which lies N. of an E. and W. line drawn through the foutherly bend or extreme of Lake Michigan; and when any of the faid States fhall have 60,000 free inhabitants therein, fuch State fhall be admitted by its delegates into the Congrefs of the United States, on an equal footing with the original States in all refpects whatever; and fhall be at liberty to form a permanent conftitution and State government; provided the conftitution and government fo to be formed fhall be republican, and in conformity to the principles contained in thefe articles, and fo far as it can be confiftent with the general intereft of the confederacy, fuch admiffion fhall be allowed at an earlier period, and when there may be a lefs number of free inhabitants in the State, than 60,000. The fettlement of this country has been checked, for feveral years paft, by the unhappy Indian war, an amicable termination of which took place on the 3d of Auguft, 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-Kafhaws and Kafkafkias. By the third article of this treaty, the Indians cede to the United States, for a valuable confideration, all lands lying eaftward and fouthward of a line "beginning at the mouth of Cayahoga river, and running thence up the fame to the portage between that and the Tufcarawas branch of the Mufkingum; thence down that branch to the croffing place above Fort Lawrence; thence wefterly 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 wefterly courfe to Fort Recovery, which ftands on a branch of the Wabafh, then fouth-wefterly in a direct line to the Ohio, fo as to interfect that river oppofite the mouth of Kentucky or Catawa river." Sixteen tracts of land of 6 and 12 miles fquare, interfperfed at convenient diftances in the Indian country, were, by the fame treaty, ceded to the United States, for the convenience of keeping up a friendly and beneficial intercourfe between the parties. The United States, on their part, "relinquifh their claims to all other Indians lands northward of the river Ohio, eaftward of the Miffiffippi, and weftward and fouthward 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 relinquifhment, by the United States, the following tracts of land are explicitly excepted. 1ft. The tract of 150,000 acres near the rapids of the Ohio river, which has been affigned to Gen. Clark, for the ufe of himfelf and his warriors. 2d. The poft of St Vincents on the river Wabafh, and the lands adjacent; of which the Indian title has been extinguifhed. 3d. The land at all other places in poffeffion of the French people and other white fettlers among them, of which the Indian title has been extinguifhed, as mentioned in the third article; and 4th. The poft of Fort Maffac, towards the mouth of the Ohio. To which feveral parcels of land fo excepted, the faid tribes relinquifh all the title and claim which they or any of them may have." Goods to the value of 20,000 dolls. were delivered

(A) A gentleman of much obfervation, 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 firft coft in the United States, are to be delivered annually to the Indians at fome convenient place northward of the Ohio. A trade has been opened, fince this treaty, by a law of Congrefs, with the forementioned tribes of Indians, on a liberal footing, which promifes to give permanency to this treaty, and fecurity to the frontier inhabitants.—*Morse.*

TESTIGOS, iflands near the coaft of New Andalufia, in Terra Firma, on the fouth coaft of the Caribbean Sea, in the Weft-Indies. Several fmall iflands at the eaft end of the ifland of Margarita lie between that ifland, and thofe called Teftigos. N. lat. 11 6, W. long. 61 48.—*ib.*

TETEROA *Harbour*, on the W. fide of the ifland of Ulietea, one of the Society Iflands. S. lat. 16 51, W. long. 151 27.—*ib.*

TETHUROA, an ifland in the S. Pacific Ocean, about 24 miles from Point Venus in the ifland 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 folids, 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 fquare, a parallelogram, a rhombus, and a trapezium. It fometimes alfo means peculiarly a fquare.

TETRAGON, in aftrology, denotes an afpect of two planets with regard to the earth, when they are diftant from each other a fourth part of a circle, or 90 degrees. The tetragon is expreffed by the character □, and is otherwife called a fquare or quartile afpect.

TETZEUCO, a brackifh lake in Mexico.—*Morse.*

TEUSHANUSHSONG-GOGHTA, an Indian village on the northern bank of Alleghany river, in Pennfylvania, 5 miles north of the fouth line of the ftate, and 14 E. S. E. of Chatoughque Lake.—*ib.*

TEWKSBURY, called by the Indians, *Wamefit* or *Pawtuket*, a townfhip of Maffachufetts, Middlefex county, on Concord river, near its junction with Merrimack river, 24 miles northerly of Bofton. It was incorporated in 1734, and contains 958 inhabitants.—*ib.*

TEWKSBURY, a townfhip of New Jerfey, Hunterdon county. The townfhip of Lebanon, Readington, and Tewkfbury contain 4,370 inhabitants, including 268 flaves.—*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 veffels of confiderable burden; and thus far the tide flows. From this place the Thames purfues a foutherly courfe 14 miles, paffing by New-London on its weft bank, and empties into Long-Ifland Sound; forming the fine harbour of New-London.—*ib.*

THATCHER's *Ifland*, lies about a mile eaft of the fouth-eaft point of Cape Ann, on the coaft of Maffachufetts, and forms the northern limit of Maffachufetts Bay; and has two light-houfes. Cape Ann light-houfe lies in lat. 43 36 north, and long. 70 47 weft. —*ib.*

THEAKIKI, the eaftern head water of Illinois river, rifes about 8 miles S. of Fort St Jofeph. After running through rich and level lands, about 112 miles, it receives Plein river in lat. 41 48 N. and from thence the confluent ftream affumes the name of Illinois. In fome maps it is called *Huakiki*.—*ib.*

THEBES, in Egypt. Having in the *Encyclopædia* given Mr Bruce's account of this ancient city, which reprefents it as having been a paltry place, fo contrary to the defcription of Homer, juftice to the father of poetry requires that we here notice what has been faid of it by a fubfequent traveller, who remained three days among its ruins. According to Mr Browne, "the maffy and magnificent forms of the ruins that remain of ancient Thebes, the capital of Egypt, the city of Jove, the city with 100 gates, muft infpire every intelligent fpectator with awe and admiration. Diffufed on both fides of the Nile, their extent confirms the claffical obfervations, and Homer's animated defcription rufhes into the memory:

'Egyptian Thebes, in whofe palaces vaft wealth is ftored; from each of whofe hundred gates iffue two hundred warriors, with their horfes and chariots.'

"These venerable ruins, probably the moft ancient in the world, extend for about three leagues in length along the Nile. Eaft and weft 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 muft therefore have been about twenty-feven miles.

"In failing up the Nile, the firft village you come to within the precincts is Kourna, on the weft, where there are few houfes, the people living moftly in the caverns. Next is Abuhadjadj, a village, and Karnac, a fmall diftrict, both on the eaft. Far the largeft portion of the city ftood on the eaftern fide of the river. On the fouth-weft Medinet-Abu marks the extremity of the ruins; for Arment, which is about two leagues to the fouth, cannot be confidered as a part.

"In defcribing the ruins, we fhall begin with the moft confiderable, which are on the eaft of the Nile. The chief is the Great Temple, an oblong fquare building of vaft extent, with a double colonnade, one at each extremity. The maffy columns and walls are covered with hieroglyphics; a labour truly ftupendous. 1. The Great Temple ftands in the diftrict called *Karnac*. 2. Next in importance is the temple at *Abuhadjadj*. 3. Numerous ruins, avenues marked with remains of fphinxes, &c. On the weft fide of the Nile appear, 1. Two coloffal figures, apparently of a man and woman, formed of a calcareous ftone like the reft of the ruins. 2. Remains of a large temple, with caverns excavated in the rock. 3. The magnificent edifice ftyled 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 ftands at *Kourna*. 4. Behind the palace is the paffage ftyled *Bibân-el-Meluk*, leading up the mountain. At the extremity of this paffage, in the fides of the rock, are the celebrated caverns known as the fepulchres of the ancient kings."

Though Mr Browne agrees with Pococke and Bruce, that the paffage 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 fays, indeed, that fome faint remains of its furrounding wall are vifible at this day; and he thinks that he difcovered 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.

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 pious 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

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, 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.

Biog. Dict.

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 in

Therapeutæ. ‖ Thermometric.

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

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 freqnency 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

Thermometric.

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

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 interest

tereſt 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 Pictiſts," 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.*

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

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of the week." Engaged in purfuits of this kind, Bonnel Thornton did not very clofely follow the profeffion to which his father deftined him, but lived rather a literary life, employing his pen on various fubjects. To the daily paper called the *Public Advertifer*, 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 Mifs Sylvia Brathwaite, youngeft daughter of Colonel Brathwaite, who had been governor of a fort in Africa. In 1766, encouraged, as he fays himfelf, by the fuccefs of his friend Colman's Terence, he publifhed two volumes of a tranflation of Plautus in blank verfe; propofing to complete the whole if that fpecimen fhould be approved. Thefe volumes contained feven plays, of which the *Captive* was tranflated by Mr Warner, who afterwards completed all that Thornton had left unfinifhed; and the *Mercator* by Mr Colman. The remaining five are, the *Amphitryon*, *Miles Gloriofus*, *Trinummus*, *Aulularia*, *Rudens*. Some parts of the remaining plays which Thornton had tranflated are preferved by his continuator. There can be no doubt that this is the beft way of tranflating the old comedies, and that Thornton was well qualified for the tafk; but the work has never been in high favour with the public. Yet Warburton faid of it, that "he never read fo juft a tranflation, in fo pure and elegant a ftyle." Thornton publifhed in 1767, *The Battle of the Wigs*, as an additional canto to Garth's Difpenfary; the fubject of which was the difputes then fubfifting between the fellows and licentiates.

The life of Thornton was not deftined to attain any great extenfion: in the prime of his days, while he was furrounded by domeftic felicity, the comforts of fortune, and the refpect of fociety, ill health came upon him; and medical aid proving inefficient, he died, of the gout in his ftomach, May 9, 1768, at only 44 years of age. His wife, a daughter, and two fons, furvived him. Befides the productions already mentioned, he wrote the papers in the Adventurer marked A; "An Ode to St Cecilia's day, adapted to the ancient Britifh Mufic," a burlefque performance; "The Oxford Barber;" with many detached effays in the public papers. A few letters addreffed to his Sylvia before they were married, difplay great tendernefs, expreffed with franknefs and eafe. A fmall edition of his works might, with much propriety, be prefented to the public, before it fhall be too late to afcertain them all. His character may be taken from his epitaph, written in Latin by his friend Dr Warton, and placed on his monument in Weftminfter Abbey. It is to this effect: "His genius, cultivated moft happily by every kind of polite literature, was accompanied and recommended by manners open, fincere, and candid. In his writings and converfation he had a wonderful livelinefs, with a vein of pleafantry peculiarly his own. In ridiculing the failings of men, without bitternefs, and with much humour, he was fingularly happy; as a companion, he was delightful."

THETFORD, a townfhip in the fouth-eaft corner of Orange county, Vermont, on the weftern bank of Connecticut river, about 10 miles north of Dartmouth College, and contains 862 inhabitants.—*Morse*.

THOMAS's *Bay*, on the W. coaft of the ifland of Antigua. It affords fome fhelter from the S. and S. E. winds.—*ib.*

Thomas *Ifland, St*, or the *Danes Ifland*, is the largeft and moft northerly of the Virgin Iflands, in the Weft-Indies, and is about 9 miles long and 3 broad. It has a fandy foil and is badly watered, but enjoys a confiderable trade, efpecially in time of peace, in the contraband way; and privateers in time of war fell 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 fafe and commodious harbour, and lies about 30 miles eaft of the ifland of Porto Rico.—*ib.*

Thomas *Ifland, St*, on the weft coaft of New-Mexico. N. lat. 20 10, weft long. 113 5.—*ib.*

Thomas, *St*, a town of Guiana in S. America, fituated on the banks of the Oroonoko. N. lat. 75, weft long. 62 36.—*ib.*

Thomas, *Port St*, a harbour in the bay of Honduras, on the Spanifh Main; from which goods are fhipped to Europe.—*ib.*

Thomas, *St*, the chief town of New-Andalufia, or Paria, in the northern divifion of Terra Firma.—*ib.*

Thomas, *St*, a parifh of Charlefton diftrict, in S. Carolina. It contains 3,836 inhabitants; of whom 397 are whites, and 3,405 flaves.—*ib.*

THOMASTOWN, a poft-town of the Diftrict of Maine, Lincoln county, on the weft fide of Penobfcot Bay, and about 4 leagues from Franklin Ifland, at the mouth of the river St George, which divides this town from Warren and Cufhing, to the weftward. A confiderable river in the fouth-eaft part of the townfhip is called Weffoweffgeeg. From the hill of Madambettocks may be feen iflands and lands to a great diftance; and near it there is thought to be plenty of iron ore; but no attempts have been made to afcertain its quality. The grand ftaples of Thomaftown are lime and lumber. Lime-ftone is very common, and fpots of land, or rather rock, of fix rods fquare, are frequently fold for 100 dollars. There are now about 35 kilns erected, each of which, on an average, will produce 200 fifty gallon cafks. Thefe kilns, if burned only three times a year, (though many are 5 or 6 times) will furnifh about 21,000 cafks; which neat, after all expenfes, about fix fhillings a cafk. Too much attention being paid to this bufinefs, prevents a due cultivation of the lands. There are now owned on the river 12 brigs, fchooners, and floops, equal to about 1,100 tons, employed in foreign and coafting voyages. On the river, and its feveral ftreams, are a number of tide and other grift and faw mills, which afford great profit to their owners. A fort with a number of cannon, and a regular garrifon of provincials, was formerly ftationed about five miles below the head of the tide. Few veftiges of the fort now remain; but in place of it an elegant building was erected in 1794, by the Hon. Henry Knox, Efq. The fettlement of Thomaftown 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 fchools conftantly kept, though there are feveral private ones throughout the year. There are two churches, the one for Baptifts, who are the moft numerous, and the other for Congregationalifts. Here is alfo a focial library. The compact

pact 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 Thunder resembles the electrical shock.

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.

In several remarkable particulars.

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

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.

3
[F]rank-[lin's d]iſco-[very an]d that [h]as the [...].

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.

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?

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.

4
Electrical ſtates of the atmoſphere.

Dr Franklin took the lead, as we have already obſerved,

Thunder.

ferved, in this examination of the electrical ftate of the atmofphere. He feldom found it without giving figns of electricity, and this was generally negative. See *Phil. Tranf.* Vol. XLVIII. p. 358. and 785.

Mr Canton repeated thofe experiments, and found the fame refults; both, however, found that the electricity would frequently change from pofitive to negative, and from negative to pofitive, in very fhort fpaces of time, as different portions of clouds or air paffed the thunder-rod.

5 Cautions to be obferved in this examination by a thunder rod.

We muft here remark, that our acquaintance with the laws of electricity fufficiently 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 glafs, is a non-conductor; and that when it is brought into any ftate of electricity, either by communication, or by mere induction, it will remain in that ftate for fome time, and that it always changes its electricity *per ftratum*. A pofitive cloud, in the higher regions of the atmofphere, will render the air immediately below it negative, and a ftratum below that pofitive. If the thunder rod be in this pofitive ftratum, it will exhibit pofitive electricity; but if the cloud be confiderably nearer, the rod, by being in the adjoining negative ftratum, may fhow a negative electricity which will exceed the pofitive electricity which the diftant pofitive cloud would have induced on its lower end by mere pofition, had the intervening air been away. This excefs of negative electricity muft depend on the degree in which the furrounding ftratum of air has been rendered negative. If this has been the almoft inftantaneous effect of the prefence of the pofitive cloud, it cannot be rendered fo negative as to produce negative electricity in the lower end of the thunder rod. But if the ftratum of air has for fome confiderable time accompanied the pofitive cloud, its negative electricity has been increafing, and fome would remain, even if the cloud were removed. We muft, at all times, confider the thunder rod as affected by *all* the electricity in its neighbourhood. The diftant pofitive cloud would at any rate render the lower end of the rod pofitive, without communication, by merely difplacing the electricity in the rod itfelf, juft as the north pole of a loadftone would make the remote end of a foft iron rod a north pole. In like manner, the negative ftratum of air immediately adjoining to the pofitive cloud would make the lower end of the rod negative, without communication. A pofitive ftratum of air below this would have the contrary effect. The appearances, then, at the end of the rod, muft be the refult of the prevalence of one of thefe above the others; and many intervening circumftances muft be underftood, before we can infer with certainty the ftate of a cloud from the appearances at the lower end of the apparatus. It would, therefore, be a moft inftructive addition to a thunder rod to have an electrofcope at both ends. If they fhew the fame kind of electricity, we may be affured that it is by communication, and is the fame with that of the furrounding ftratum of air: But if they fhew oppofite electricities (which is generally the cafe), then we learn that it is by pofition or induction. We recommend this to the careful attention of the philofopher.

In this way we perfectly explain an appearance which puzzled both of the above-mentioned obfervers. When a fingle low cloud approached the rod, the electrofcope would fhew pofitive electricity, but negative when the cloud was in the zenith, and pofitive again when it had paffed by. We alfo learn from this the caufe of Dr Franklin's difappointment in his expectations of very remarkable phenomena by means of his kite. He imagined that it would be vaftly fuperior to the apparatus which he had recommended to the philofophers of Europe. But the ftring of the kite, traverfing feveral ftrata in different ftates of electricity, ferved as a conductor between them, and he could only obtain the fuperplus; which might be nothing, even when the clouds were ftrongly electrified.

The moft copious and curious obfervations on the electrical ftate of the atmofphere are thofe by Profeffor Beccaria of Turin. He had connected the tops of feveral fteeples of the city by infulated wires. He did the fame thing at a monaftery on a high hill in the neighbourhood. Each of thefe collected the electricity of a feparate ftratum of confiderable extent. He frequently found thefe two ftrata in oppofite ftates of ftrong electricity.

6 Beccaria's general laws of atmofpheric electricity.

The following general obfervations are made out from a comparifon of a vaft variety of more particular ones made in different places:

1. The air is almoft always electrical, efpecially in the day time and dry weather; and the electricity is generally pofitive. It does not become negative, unlefs by winds from places where it rains, fnows, or is foggy.

2. The moifture of the air is the conftant 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 moift, and dries very faft, the electricity is very intenfe, and diminifhes when the air attains its greateft drynefs; and may continue long ftationary, by a fupply of air in a drying ftate from diftant places.

4. If, while the fky overcafts in the zenith, only a high cloud is formed, without any fecondary clouds under it, and if this cloud is not the extenfion of another which rains in fome remote place, the electricity (if any) is always pofitive.

5. If the clouds, while gathering, are fhaped like locks of wool, and are in a ftate of motion among each other; or if the general cloud is forming far aloft, and ftretches down like defcending fmoke, a frequent pofitive electricity prevails, more intenfe as the changes in the atmofphere are quicker; and its intenfity predicts the great quantity of fnow or rain which is to follow.

6. When an extenfive, thin, level cloud forms, and darkens the fky, we have ftrong pofitive electricity.

7. Low thick fogs, rifing into dry air, carry up fo much electricity as to produce fparks at the apparatus. If the fog continues round the apparatus without rifing, the electricity fails.

8. When, in clear weather, a cloud paffes over the apparatus, low and tardy in its progrefs, and far from any other, the pofitive electricity gradually diminifhes, 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 pofitive electricity increafes.

10. In

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.

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.

7

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.

The

Thunder.

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.

9 Strata of the atmoſphere in diff[erent] ſtates of electri[city] and ar[e] tranſp[a]rent.

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.

1[0] Theſe [ſtra]ta ha[ve] ſtrata clouds interpoſ[ed]

This is in all probability the ſtate of the atmoſphere, conſiſting of ſtrata of clear air many hundred yards thick, under.

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.

1 lec- uili- is d lowly eral.

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.

; l and ve tion nder

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.

Thunder.

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

ſometimes

Thunder.

16 Particular account of forked lightning, and explanation of the long continued and rumbling noise of thunder.

sometimes seen at once through an extent of several miles.

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.

18 Deluc's [...]tion of thunde[...] probab[...]

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.

19 Why a[...] how th[...] der ma[...] continu[...] some ti[...]

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.*

20 t thunſtrokes RENING OKES

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

Thunder.

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.

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.

25 Scientific account of the state of electricity induced on a building by a thunder cloud.

26 And on a 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 of interruptions in conductors.

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

Thunder.

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 fmall part of it is difcharged—What will be the fate of the building? We believe that it will be perfectly fafe.

However rapid we may fuppofe that motion by which electricity is communicated, it is ftill motion, and time elapfes during the propagation. The cloud is difcharged, not in a very inftant, but in a very fhort time. Part of the cloud is therefore difcharged, while it explodes the conductor, and the electricity of the remainder is now too weak (by our fuppofition) to ftrike the building no longer furnifhed with a conductor. This muft be the cafe, however large and powerful the cloud may be, and however fmall the conductor.

But fuppofe that the cloud has come fo near as to ftrike the building unprovided with a conductor. Then as much will be difcharged through the building as it can conduct; and if the quantity be too great, the building will be deftroyed: but let a conductor (though infufficient) be added. The difcharge will be made through it as long as it lafts, and the remainder only will be difcharged through the houfe, furely with much lefs danger than before.

The truth of thefe conclufions from theory is fully verified by fact. When the church of Newbury in New England was ftruck by lightning in 1755, a bell wire, no bigger than a knitting needle, conducted the thunder with perfect fafety to the building as far down the fteeple as the wire reached, though the ftroke was fo great that the wire had been exploded, and no part of it remained, but only a mark along the wall occafioned by its fmoke. From the termination of the wire to the ground the fteeple was exceedingly fhattered, and ftones of great weight were thrown out from the foundation (where they were probably moifter) to the diftance of 20 and 30 feet.

Another remarkable inftance happened in the fummer palace at St Peterfburg. A Heyduk and a foldier of a foot regiment were ftanding centinels at the door of the jewel-chamber: the Heyduk, with his fcimitar refting on his arm, was carelefsly leaning on the foldier, who had his mufket fhouldered. Both were ftruck down with lightning; and the foldier was killed, his left leg fcorched, and his fhoes burft. The Heyduk had received no damage, but felt himfelf tripped up, as if a great dog had run againft him. A narrow flip of gold lace, which was fewed along the feam of his jacket and pantaloon breeches, reaching to his fhoes, had been exploded on the left fide. This feems to have been his protection. In all probability, the ftroke came to both along the mufket (or perhaps to the Heyduk along the fcimitar). The Heyduk had a complete, though infufficient, conductor, and was fafe. The foldier had not, and was killed. The pufh felt by the former probably arofe from the explofion of the lace.

It feems therefore plain that metalline conductors are always a protection; that advancing them above the building, increafes their protection; and that pointing them may fometimes enable them to diminifh a ftroke, by difcharging part of the electricity filently.

Dr Franklin having formed all his notions of thunder from his pre-eftablifhed theory, and having feen the principal phenomena fo conformable to it, was naturally led to expect this conformity in cafes which he could not eafily examine precifely by experiment. Accordingly, in his firft differtation, he affirmed that a fine point always difcharges a thunder cloud filently, and at a great diftance. The analogous experiments in artificial electricity are fo beautiful and fo perfpicuous, that this confidence in the protecting power of fine points is not furprifing: and this confidence was rendered almoft complete by a moft fingular cafe which fell under his own obfervation. He was awakened one night by loud cracks in his ftair cafe, as if fome perfon had been lafhing the wainfcoating with a great horfewhip. He thought it fo, and got up in anger to chide the idle fool. On looking out at his chamber door, he faw that the difturbance proceeded from electric explofions at fome interruptions of his conductor. He faw the electricity pafs, fometimes in bright fparks, producing thofe loud thwacks, and fometimes in a long continued ftream of denfe white dazzling light as big as his finger, illuminating the ftair-cafe like funfhine, and making a loud noife like a cutler's wheel. Had the cloud (fays he) retained all this till it came within ftriking diftance, the confequences would have been inconceivably dreadful. Yet not long after this he found that he had been in a miftake; for the houfe of Mr Watt in Philadelphia, furnifhed with a finely pointed conductor, was ftruck by a terrible clap of thunder, and the point of the conductor was melted down about two inches. This is perhaps the only inftance on record of a finely-pointed *conductor* being ftruck. The board room at the powder magazine at Purfleet was indeed ftruck, though provided with a conductor; but the ftroke was through another part of the building. St Peter's church, Cornhill, has been eight times ftruck between 1772 and 1787; while St Michael's, in its neighbourhood, and much higher, has never had a ftroke fince 1772, when it was furnifhed with an excellent pointed conductor by Mr Nairne.

29 A point conductor may fometimes be ftruck.

Dr Franklin having feen the above exception to his rule, and reflected on it, acknowledges that there are cafes where a pointed conductor may be ftruck, viz. when it ferves as a ftepping ftone, to *complete* a canal of conveyance already near completed. A *fmall* cloud may fometimes ferve as a ftepping ftone (like the man coming under a luftre) for the electricity to come out of a great cloud, and difcharge through the pointed conductor. Whenever it comes to the ftriking diftance from the conductor, it will explode at once; whereas the great cloud itfelf muft have come nearer, and had its force gradually diminifhed. It is remarkable that a point, employed in this way in artificial electricity, muft be brought nearer to another body than a ball need be, before it can receive a ftroke. The difference is about one-third of the whole. Nairne found, that a ball nine-tenths of an inch in diameter, exploded at the diftance of nine inches, and a point at fix inches diftance.

We muft alfo obferve that a pointed conductor can have no advantage over a blunt one in the cafe of a returning ftroke; which is perhaps the moft common of any. This depends on another difcharge, which is made perhaps at a great diftance. This was moft diftinctly the cafe in the inftance mentioned fome time ago, of the perfon at Vienna who had a fhock from a thunder rod by an explofion far diftant. This thunder rod was a very fine one, furnifhed with five gilt points.

Still, however, this property of fharp points was greatly over-rated by Dr Franklin, and thofe who took all their

…nder. …o …ank- …er- …the …ation …ured …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 allowed 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- …afs;

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.

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. 52 And the influence of ſharp points is trifling.

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.

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. 33 An extenſive and ſubſtantial metalline conductor is the chief ſecurity.

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

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 ſoot 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.*

Tibron, 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.

a Auf- el Ef- ritu ito,

ville, *The Archipelago of the Great Cyclades*, and by Capt. Cook, *The New Hebrides*, may be confidered as the eaftern extremity of the vaft Archipelago of *New Guinea*. Thefe iflands are fituated between the latitudes of 14 29 and 20 4 S. and between 169 41 and 170 21 E. long. from Greenwich, and confift of the following iflands, fome of which have received names from the different European navigators, and others retain the names which they bear among the natives; viz. Tierra Auftral del Efpiritu Santo, St Bartholomew, Mallicollo, Pic de l'Etoile, Aurora, Ifle of Lepers, Whitfuntide, Ambrym, Paoon, Shepherds Ifles, Sandwich, Erromango, Immer, Tanna, Erronan, Annatom, Apee, Three Hills, Montagu, Hinchinbrook, and Erromanga. Quiros, who firft difcovered thefe iflands, in 1606, defcribes them, as "richer and more fertile than Spain, and as populous as they are fertile; watered with fine rivers, and producing filver, pearls, nutmegs, mace, pepper, ginger, ebony of the firft quality, wood for the conftruction of veffels, and plants which might be fabricated into fail-cloth and cordages, one fort of which is not unlike the hemp of Europe." The inhabitants of thefe iflands, he defcribes, as of feveral different races of men; black, white, mulatto, tawny, and copper-coloured; a proof, he fuppofes, of their intercourfe with various people. They ufe no fire arms, are employed in no mines, nor have they any of thofe means of deftruction which the genius of Europe has invented. Induftry and policy feem to have made but little progrefs among them: they build neither towns nor fortreffes; acknowledge neither king nor laws, and are divided only into tribes, among which there does not always fubfift a perfect harmony. Their arms are the bow and arrows, the fpear and the dart, all made of wood. Their only covering is a garment round the waift, which reaches to the middle of the thigh. They are cleanly, of a lively and grateful difpofition, capable of friendfhip and inftruction. Their houfes are of wood, covered with palm leaves. They have places of worfhip and burial. They work in ftone, and polifh marble, of which there are many quarries. They make flutes, drums, wooden fpoons, and from the mother of pearl, form chiffels, fciffars, knives, hooks, faws, hatchets, and fmall round plates for necklaces. Their canoes are well built and neatly finifhed. Hogs, goats, cows, buffaloes, and various fowls and fifh, for food are found in abundance on and about thefe iflands. Added to all thefe and many other excellencies thefe iflands are reprefented as having a remarkably falubrious air, which is evinced by the healthy, robuft appearance of the inhabitants, who live to a great age, and yet have no other bed than the earth. Such is the defcription which Quiros gives of thefe iflands in and about which he fpent fome months, and which he reprefents to the king of Spain as "the moft delicious country in the world; the garden of Eden, the inexhauftible fource of glory, riches, and power to Spain." On the north fide of the largeft of thefe iflands, called *Efpiritu Santo*, is a bay, called *San Felipe* and *Sant-Yago*, which, fays Quiros, "penetrates 20 leagues into the country; the inner part is all fafe, and may be entered with fecurity, by night as well as by day. On every fide, in its vicinity, many villages may be diftinguifhed, and if we may judge by the fmoke which rifes by day, and the fires that are feen 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 veffels. The anchorage is on an excellent bottom of black fand, in water of different depths, from 6 to 40 fathoms, between two fine rivers.—*ib.*

Tierra del Fuego, || Tillandfia.

TIERRA DEL FUEGO, feveral iflands at the fouthern extremity of America. They take their name from a volcano on the largeft of them. They are all very barren and mountainous; but from what Mr Forfter fays, in his Voyage to the South Sea, the climate does not appear to be fo rigorous and tempeftuous as it is reprefented in Anfon's Voyage. Upon the lower grounds and iflands, that were fheltered by the high mountains, Mr Forfter found feveral forts of trees and plants, and a variety of birds. Among the trees was Winter's bark-tree, and a fpecies of *arbutus*, loaded with red fruit of the fize of fmall cherries, which were very well tafted. In fome places there is alfo plenty of celery. Among the birds was a fpecies of duck, of the fize of a goofe, which ran along the fea 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 Iflands it is called a *loggerhead-duck*. Among the birds are alfo plenty of geefe and falcons. The rocks of fome of the iflands are covered with large mufcle-fhells, the fifh of which is well flavoured. The natives of this country are fhort in their perfons, not exceeding five feet fix inches at moft, their heads large, their faces broad, their cheek bones prominent, and their nofes flat. They have little brown eyes, without life; their hair is black and lank, hanging about their heads in diforder, and befmeared with train-oil. On the chin they have a few ftraggling fhort hairs inftead of a beard. The whole affemblage of their features forms the moft loathfome picture of mifery to which human nature can poffibly be reduced. Thofe which Mr Forfter faw had no other clothing than a fmall piece of feal fkin, which hung from their fhoulders to the middle of their back, being faftened round the neck with a ftring: the reft of their body was perfectly naked. Their natural colour feems to be an olive brown, with a kind of glofs, refembling that of copper; but many of them difguife themfelves with ftreaks of red paint, and fometimes, though feldom, with white. Their whole character is a ftrange compound of ftupidity, indifference, and inactivity. They have no other arms than bows and arrows; and their inftruments for fifhing are a kind of fifh-gigs. They live chiefly on feals flefh, and like the fat oily part moft. There is no appearance of any fubordination 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 captainfhip of Rio Grande in Brazil.—*Morse.*

TILLANDSIA, the large barren WILD PINE of the Weft Indies; a genus of the monogynia order, belonging to the hexandria clafs of plants. It is called *Caragatua* by Father Plumier, and is a parafitic plant, and ought perhaps, in ftrict propriety, to be denominated an *aquatic:* for although it is fufpended in the air among the branches of lofty trees, to whofe boughs it is faftened by its numerous roots; yet it is not indebted to thofe boughs, like the mifletoe and other parafitic plants, for nourifhment, but merely for fupport; provident Nature having, in a very extraordinary manner, fupplied this with other means to preferve its exiftence:

For

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 Picton, 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, nº 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'tiya'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,

ceased, 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 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 preeminence 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 33*d 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, courthouse, 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, sham, 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.

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

Torelli,

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;" Colon æ, 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

(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, nº 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 of electricity till affifted by the doubler. Will it be faid that this arofe from want of intenfity in the galvanic fhock? We can only reply, that a much lefs intenfe fhock of electricity would have produced a fenfible divergence in the inftrument without the doubler. What was the caufe of this difference? We have, however, no doubt but that electricity was concerned in this phenomenon; for we have fhewn elfewhere (fee THUNDER, *Suppl.*), that either *electricity* is produced, or the equilibrium of the electrical fluid difturbed, by every chemical folution; and we fhall fee immediately that chemical folutions are perpetually going on in Volta's apparatus.

Very early in the courfe of this experiment, the contacts being made fure by placing a drop of water upon the upper plate, Mr Carlifle obferved a difengagement of gas round the touching wire. This gas, though very minute in quantity, evidently feemed to have the fmell afforded by hydrogen when the wire of communication was fteel. This, with fome other facts, led Mr Nicholfon to propofe to break the circuit by the fubftitution of a tube of water between two wires. They therefore inferted a brafs wire through each of two corks inferted in a glafs tube of half an inch internal diameter. The tube was filled with New River water, and the diftance between the points of the wires in the water was one inch and three quarters. This compound difcharger was applied fo that the external ends of its wire were in contact with the two extreme plates of a pile of 36 half crowns, with the correfponding pieces of zinc and pafteboard. A fine ftream of minute bubbles immediately began to flow from the point of the lower wire in the tube which communicated with the filver, and the oppofite point of the upper wire became tarnifhed, firft deep orange, and then black. On reverfing the tube, the gas came from the other point, which was now loweft; while the upper, in its turn, became tarnifhed and black. Reverfing the tube again, the phenomena again changed their order. In this ftate the whole was left for two hours and a half. The upper wire gradually emitted whitifh filmy clouds, which, towards the end of the procefs, became of a pea-green colour, and hung in perpendicular threads from the extreme half inch of the wire, the water being rendered femiopaque by what fell off, and in a great part lay, of a pale green, on the lower furface of the tube, which, in this difpofition of the apparatus, was inclined about forty degrees to the horizon. The lower wire of three quarters of an inch long, conftantly emitted gas, except when another circuit, or complete wire, was applied to the apparatus; during which time the emiffion of gas was fufpended. When this laft mentioned wire was removed, the gas re-appeared as before, not inftantly, but after the lapfe of four beats of a half fecond clock ftanding 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.

Meffrs Nicholfon and Carlifle had been led, by their reafoning on the firft appearance of hydrogen, to expect a decompofition of the water; but it was with no little furprize that they found the hydrogen extricated at the contact with one wire, while the oxygen fixed itfelf, in combination with the other wire, at the diftance of almoft two inches. This new fact ftill remains to be explained, and feems, fays Mr Nicholfon, to point at fome general law of the agency of electricity in chemical operations. Does it not as naturally fuggeft a fufpicion that galvanifm is not electricity; efpecially as we are informed, by Mr Cruickfhank of Woolwich, that Meffrs Nicholfon and Carlifle difcovered, that "galvanifm decompofes water with much greater facility than electricity, and with phenomena fomewhat different?" What the particular differences are, he does not fay; but we learn from Mr Nicholfon himfelf, that from the general tenor of his experiments, it appears to be eftablifhed, that the decompofition of water by galvanifm is more effectual the lefs the diftance is between the wires, but that it ceafes altogether when the wires are in contact.

Mr Nicholfon concludes his memoir with mentioning concifely the effects of a pile of 100 half crowns, and a chemical incident, which appears to be the moft remarkable of thofe which he has yet obferved.

The pile was fet up with pieces of green woollen cloth foaked in falt water. It gave fevere fhocks, which were felt as high as the fhoulders. The tranfition was much lefs forcible through a number of perfons, but it was very perceptible through nine. The fpark was frequently vifible when the difcharge was made in the dark, and a gleam of light was alfo, in fome inftances, feen about the middle of the column at the inftant of the explofion. The affiftants were of opinion that they heard the fnap.

The extrication of the gafes was rapid and plentiful by means of this apparatus. When copper wires were ufed for the broken circuit, with muriatic acid diluted with 100 parts of water in the tube, no gas, nor the leaft circulation of the fluid was perceived, when the diftance of the wires was two inches. A fhort tube, with two copper wires very near each other in common water, was made part of the circuit, and fhewed by the ufual phenomena, that the ftream of electricity was rapidly paffing. The wires in the muriatic acid were then flided within the third of an inch of each other. For the fake of brevity he avoids enumerating the effects which took place during feveral hours, and fimply ftates, that the minus wire gave out fome hydrogen during an hour; while the plus wire was corroded, and exhibited no oxyd; but a depofition 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 depofition was going on, and the fmall tube fhewed the continuance of the electric ftream; and that the depofition, at the end of four hours, formed a ramified metallic vegetation, nine or ten times the bulk of the wire it furrounded.

In this experiment, it appeared that the influence of electricity increafing the oxydability of the upper wire, and affording nafcent hydrogen from the lower, caufed the latter to act as the precipitant of a folution of one and the fame metal.

Mr Nicholfon, we fee, continues to call it electricity with the utmoft confidence, as if it could not poffibly be any thing elfe; and yet he fays that the galvanic fhock is much lefs forcible when paffed through a number of perfons than when paffed only through one. This, we believe, does not hold in the fhocks of common electricity; and the difference probably arifes from the cuticle

ticle obftructing the paffage of the one and not of the other. Volta himfelf fays, that *this* electricity, for he too is defirous to prove it electricity, does not diffufe itfelf through the air. It is fo univerfally known that very dry air is no conductor of electricity, that he muft mean, on this occafion, air not uncommonly dry; otherwife the non-diffufion of *this* electricity through air would not diftinguifh it, as he feems to admit it does, from common electricity. But what occafions this diftinction, if the two electricities be the fame?

Lieutenant-colonel Haldane, well known in the fcientific world, made experiments with Volta's pillar, both in a horizontal and in a vertical pofition. With a large pillar, placed vertically, he obtained very weak figns of electricity. He connected the apparatus with the conductor of an electrical machine, and found the effect rather impeded than affifted by the common electric ftream. He placed the plate of Bennet's electrometer in the circuit, without producing electric figns. He found that the galvanic apparatus, placed between the outfide and infide of a jar, prevented its charging, and that it is alfo 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 caufticity, the fhock, and the oxydation, are fo very powerful, he cannot be perfuaded that electricity is the principal agent, though fome might be generated, or difengaged, during the operation of the apparatus.

This is exactly our own opinion, which is ftrongly corroborated by the refults of fome very curious experiments made by Mr Cruickfhank of Woolwich. Thefe experiments our limits permit us not to detail. They were made with a view to afcertain the nature and relative proportions of the gafes obtained from water and other fluids by this influence; and the author thinks himfelf authorifed to conclude from them:

1. That hydrogen gas, mixed with a very fmall proportion of oxygen and ammonia, is fomehow difengaged at the wire connected with the filver 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 folutions are employed inftead of water, the fame wire which feparates the hydrogen revives the metallic calx, and depofits it at the extremity of the wire in its pure metallic ftate; in this cafe no hydrogen gas is difengaged. The wire employed for this purpofe may be of any metal.

3. That of the earthy folutions, thofe of magnefia and argil only are decompofed by the filver wire; a circumftance which ftrongly favours the production of ammonia.

4. That when the wire connected with the zinc extremity of the pile confifts either of gold or platinum, a quantity of oxygen gas, mixed with a little azote and nitrous acid, is difengaged; and the quantity of gas thus obtained is a little better than ⅓d of the hydrogen gas feparated by the filver wire at the fame time.

5. That when the wire connected with the zinc is filver, or any of the imperfect metals, a fmall portion of oxygenous gas is likewife given out; but the wire itfelf is either oxydated or diffolved, or partly oxydated and partly diffolved: indeed, the effect in this cafe produced upon the metal is very fimilar to that of the concentrated nitrous acid, where a great deal of the metal is oxydated, and but a fmall quantity held in folution.

6. That when the gafes obtained by gold or platinum wires are collected together and exploded over mercury, the whole nearly difappears and forms water, with probably a little nitrous acid; for there was always a thick white vapour perceived for fome time after the explofion. The refiduary gas, in this cafe, appeared to be azote.

In reflecting on thefe experiments, it would appear that in fome of them the water muft be decompofed: but how this can be effected is by no means fo eafily explained. For example, it feems extremely myfterious how the oxygen fhould pafs filently from the extremity of the filver wire to that of the zinc wire, and there make its appearance in the form of gas. It is to be obferved, likewife, that this effect takes place which ever way the wires are placed, and whatever bends may be interpofed between their extremities, provided the diftance be not too great. On confidering thefe facts more minutely, it appeared to Mr Cruickfhank that the eafieft and fimpleft mode of explanation would be, to fuppofe that the galvanic influence (whatever it may be) is capable of exifting in two ftates, that is, in an oxygenated and deoxygenated ftate; that when it paffes from metals to fluids containing oxygen, it feizes their oxygen, and becomes oxygenated; but when it paffes from the fluid to the metal again, it affumes its former ftate, and becomes deoxygenated. Now when water is the fluid interpofed, and the influence enters it from the filver fide deoxygenated (and we fuppofe that it always paffes from the deoxygenated to the oxygenated fide), it feizes the oxygen of the water, and difengages 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 efcapes 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 chemifts, form nitrous acid. When a metallic folution is the interpofed fluid, the effect produced may be explained in two ways; but the fimpleft is to fuppofe that the influence, in paffing from the filver wire, feizes the oxygen of the metallic calx, and afterwards depofits it on entering the zinc one. In this cafe no gas fhould appear at the filver wire; but when a perfect metal is employed, oxygen fhould be difengaged from the zinc wire: and this, as has been already mentioned, is exactly what takes place.

What our author confiders as the ftrongeft argument in favour of this hypothefis, and what we confider as an argument equally ftrong to prove that galvanifm differs effentially from electricity, is, that all fluids which do not contain oxygen, are incapable of tranfmitting the galvanic fluid, fuch as alcohol, æther, the fat, and effential oils, as he has proved by direct experiment; but on the contrary, that all thofe which do contain oxygen conduct it more or lefs readily, as all aqueous fluids, metallic folutions, and acids, more efpecially the concentrated fulphuric acid; which it decompofes. In this laft inftance, the oxygen produced can hardly be afcribed to the decompofition of water; for this acid, when properly concentrated, does not contain any fenfible quantity. By this theory alfo we can readily explain the oxydation of the zinc plates in the machine; where the fluid in paffing from the different pairs of plates appears to be alternately oxygenated and deoxygenated. Although I am not (fays Mr Cruickfhank) by any means entirely fatisfied with this hypothefis, yet as it is the only one by which I can explain the different phenomena, it was thought advifable to throw it out, merely with a view to induce others to reafon upon the fubject, and to incite them to make experiments, by which alone truth can be afcertained.

We approve heartily of his conduct. It is for the fame reafon, and not to maintain at all hazards any preconceived opinion of our own, that we have urged every objection that occurs to us againft the hypothefis of the identity of galvanifm and electricity. Thefe fluids or influences appear to us to differ effentially; but ftill we admit that future experiments and future reafonings *may remove* our objections, which, however, ought never to be loft fight of *till* they be removed. If ingenious men, adopting implicitly the hypothefis of Volta and Mr Nicholfon, fhall inftitute a fet of experiments to afcertain the laws of the galvanic influence, they will be very apt to make their experiments fupport their hypothefis, inftead of employing them as guides to the temple of truth. Mr Nicholfon fays, that in all the experiments made by him and Mr Carlifle, the action of the inftrument was freely tranfmitted through the ufual conductors of electricity (meaning, we fuppofe, metals and watery fluids), but that it was ftopped by glafs and other non-conductors. We have experienced the fame thing, and fo far we acknowledge a ftriking refemblance between galvanifm and electricity; but, on the other hand, we have never been able to make any accumulation of galvanifm by means of coated electrics, whilft Mr Cruickfhank found that the galvanic influence cannot be tranfmitted through alcohol, ether, or effential oils. In thefe inftances, the difference between galvanifm and electricity feems to be as ftriking as the refemblance is in the others. Indeed thefe differences between the one and the other are fo many and fo great, that M. Fabbroni attributes the phenomena of galvanifm not to electricity, but to a chemical operation; to the tranfition of oxygen into a combination, and to the formation of a new compound. He had obferved, in repeating the common experiment, that if he wiped his tongue as accurately as poffible, the fenfation of tafte excited by the two metals was fo diminifhed as to be hardly diftinguifhed. The faliva, or fome other moifture, muft therefore be of fome importance in this phenomenon. He afterwards inftituted a fet of very proper experiments; from which it appeared to him that an evident chemical action takes place in the operations of galvanifm, and that it is unneceffary to feek farther for the nature of the new ftimulus. Galvanifm (he fays) is manifeftly a combuftion or oxydation of the metals; and the ftimulating principle may be either the caloric which is difengaged, or the oxygen which paffes into new combinations; or the new metallic falt; but which of thefe he has not afcertained.

Without adopting or rejecting thefe conclufions, we recommend them to the attention of our chemical readers; for it is only by expert and fcientific chemifts that we expect the nature and properties of galvanifm to be afcertained. In the mean time it is proper to obferve, that the pile of Volta continues in order for about three days, and fcarcely three; and that on account of the corrofion of the fæces of the zinc, it is neceffary to renew them previous to each conftruction of the pile. This may be done by fcraping or grinding, or by cleaning them with diluted muriatic acid.

To avoid the trouble of conftantly repiling the pieces of filver and zinc, Mr Cruickfhank conftructed a kind of trough of baked wood, 26 inches in length, 1.7 inches deep, and 1.5 inches wide; in the fides of this trough grooves were made oppofite to each other about the tenth of an inch in depth, and fufficiently wide to admit one of the plates of zinc and filver when foldered together; three of thefe grooves were made in the fpace of one inch and three tenths, fo that the whole machine contained 60 pair of plates. A plate of zinc and filver, each 1 6 inches fquare, well cemented together, were introduced into each of thefe grooves or notches, and afterwards cemented into the trough by a compofition of rofin and wax, fo perfectly that no water could pafs from one cell to the other, nor between the plates of zinc and filver. This circumftance muft be ftrictly attended to, elfe the machine will be extremely imperfect. When all the plates were thus fecured in the trough, the interftices or cells formed by the different pairs of plates were filled with a folution of the muriat of ammonia, which here fupplied the place of the moiftened papers in the pile, but anfwered the purpofe much better. It is hardly neceffary to obferve, that in fixing the zinc and filver plates, they muft be placed regularly, as in the pile, *viz.* alternately zinc and filver, the filver plate being always on the fame fide. When a communication was made between the firft and laft cell, a ftrong fhock was felt in the arms, but fomewhat different from that given by the pile, being quicker, lefs tremulous, and bearing a greater refemblance to the common electrical fhock. He conftructed two of thefe machines, which contained in all 100 pair of plates; thefe when joined together gave a very ftrong fhock, and the fpark could be taken in the day time at pleafure; but what furprifed him not a little, was the very flender power which they poffeffed in decompofing water: in this refpect they were certainly inferior to a pile of 30 pair, although fuch a pile would not give a fhock of one third the ftrength.

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 furfaces of the metals. To remedy this defect, he foldered the zinc and filver plates together, and found that this method anfwers 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 fuperfede the pile, efpecially if it fhould be found to decompofe water, &c. but flowly, yet in other refpects it will no doubt be found very convenient and portable.

If this article be thought long, and if we appear to have loft fight of our original fubject, the *Torpedo*, we have only to plead in excufe for our conduct, that whilft we could not avoid pointing out the refemblance between the fhock given by the torpedo and that by Volta's apparatus, we felt it a kind of duty to embrace the only opportunity that we fhall have of laying before our readers the additional information refpecting the phenomena of Galvanism which we have received ed fince the publication of that article. Thefe phenomena are yet new, and they are unqueftionably important; indeed fo very important, that to us it appears neither impoffible, 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 fouthern coaft 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 almoft circular, and has from 14 to 50 fathoms water in it. A prodigious fea fets into it in winter.—*Morse.*

TORRINGTON, a townfhip 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 Miffiffippi in Louifiana 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 largeft boats.—*ib.*

TORTUE, an ifland on the N. fide of the ifland 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 ifland in 1632; in 1638, the Spaniards maffacred all the French colony; and in 1639, the buccaniers retook Tortue. In 1676, the French took poffeffion of it again.—*ib.*

TORTUGAS, *Dry*, fhoals to the weftward, a little foutherly from Cape Florida, or the S. Point of Florida, in North-America. They are 134 leagues from the bar of Penfacola, and in lat. 24 32 N. and long. 83 40 W. They confift of 10 fmall iflands or keys, and extend E. N. E. and W. S. W. 10 or 11 miles; moft of them are covered with bufhes, and may be feen at the diftance of four leagues. The fouth-weft key, one of the fmalleft, but the moft 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 vifibly difcoloured.—*ib.*

TORTUGAS HARBOUR, *Turtle's Harbour*, or *Barracco de Tortugas*, on the coaft of Brazil, in S. America, is 60 leagues at E. S. E. from the point or cape of Arbrafec, or Des Arbres Sec, and the fhore is flat all the way from the gulf of Maranhao.—*ib.*

TORTUGAS, an ifland fo named from the great number of turtle found near it, is near the N. W. part of the ifland of St Domingo.—*ib.*

TORTUGAS, or *Sal Tortuga*, is near the W. end of New-Andalufia and Terra Firma. It is uninhabited, although about 30 miles in circumference, and abounding with falt. N. lat. 11 36, W. long. 65. It is 14 leagues to the weft of Margaritta Ifland, and 17 or 18 from Cape Blanco on the main. There are many iflands of this name on the north coaft of South-America.—*ib.*

TORTUGAS *Point*, on the coaft of Chili, and in the South Pacific Ocean, is the fouth point of the port of Coquimbo, and 7 or 8 leagues from the Pajaros Iflands. Tortugas road is round the point of the fame name, where fhips may ride in from 6 to 10 fathoms, over a bottom of black fand, near a rock called the Tortugas. The road is well fheltered, but will not contain above 20 or 30 fhips fafely. Ships not more than 200 tons burden may careen on the Tortugas rock.—*ib.*

TOSQUIATOSSY *Creek*, a north head water of Alleghany river, whofe mouth is eaft of Squeaughta Creek, and 17 miles north-wefterly of the *Ichua Town.*—*ib.*

TOTOWA, a place or village at the Great Falls in Paffaik river, New-Jerfey.—*ib.*

TOTTERY, a river which empties through the fouth-eaftern bank of the Ohio, and is navigable with batteaux to the Occafioto Mountains. It is a long river, and has few branches, and interlocks with Red Creek, or Clinche's river, a branch of the Tenneffee. It has below the mountains, efpecially for 15 miles from its mouth, very good land.—*ib.*

TOUCAN, or AMERICAN GOOSE, is one of the modern conftellations of the fouthern hemifphere, confifting of nine fmall ftars.

TOULON, a townfhip of New-York, in Ontario county. In 1796, 93 of the inhabitants were electors.—*Morse.*

TOWERHILL, a village in the townfhip of South-Kingftown, Rhode-Ifland, where a poft-office is kept. It is 10 miles weft of Newport, and 282 from Philadelphia.—*ib.*

TOWNSHEND, a townfhip of Windham county, Vermont, weft of Weftminfter and Putney, containing 676 inhabitants.—*ib.*

TOWNSHEND, a townfhip of Middlefex county, Maffachufetts, containing 993 inhabitants. It was incorporated in 1732, and lies 45 miles northward of Bofton.—*ib.*

TOWNSHEND, a harbour on the coaft of the Diftrict of Maine, where is a bold harbour, having 9 fathoms water, fheltered from all winds. High water, at full and change, 45 minutes after 10 o'clock.—*ib.*

TRACADUCHE, now *Carleton*, a fettlement on the northern fide of Chaleur Bay, about 5 leagues from the great river Cafquipibiac, in a fouth-weft direction. It is a place of confiderable trade in cod-fifh, &c.—*ib.*

TRACTORS, METALLIC. See PERKINISM in this *Suppl.*

TRACTRIX, in geometry, a curve line, called alfo CATENARIA; which fee, *Encycl.* and ARCH, *Suppl.*

TRADESCANT (John), an ingenious naturalift and antiquary, was, according to Anthony Wood, a Fleming or a Dutchman. We are informed by Parkinfon, that he had travelled into moft parts of Europe, and into Barbary; and from fome emblems remaining upon his monument in Lambeth church-yard, it plainly appears that he had vifited Greece, Egypt, and other eaftern countries. In his travels, he is fuppofed to have collected, not only plants and feeds, but moft of thofe curiofities of every fort which, after his death, were fold by his fon to the famous Elias Afhmole, and depofited in his mufeum at Oxford. When he firft fettled in England cannot, at this diftance of time, be afcertained. 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 reprefents him as a perfon very far advanced in years, feems 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

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 καθισσας
> 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

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*."

he Odes Anacreon, slated English e, printed t York, 6.

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!"

ristram ndy.

"As there is nothing (continues our author) which so much conduces both to the ease and spirit of composition 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 βατραχῳ 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 necessary 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

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 above-mentioned.

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 alfo equal to the number of fhot in a triangular pile of balls, the number of rows, or the number in each fide of the bafe, being n.

The fum of the reciprocals of the triangular feries, infinitely continued, is equal to 2; viz.

$$1+\tfrac{1}{3}+\tfrac{1}{6}+\tfrac{1}{10}+\tfrac{1}{15}, \&c. = 2.$$

For the rationale and management of thefe numbers, fee *Malcolm's Arith.* book 5. ch. 2.; and *Simpfon's Algeb.* fec. 15.

TRIESTE, a fmall, but ftrong and ancient feaport of Italy, in Iftria, on the gulph of Venice, with a bifhop's fee. It is beautifully fituated on the fide of a hill, about which the vineyards form a femicircle. The ftreets are narrow; but there is a large fquare, where they keep the annual fair. The harbour is fpacious, but not good; becaufe it is open to the W. and S. W. winds. The inhabitants have a good trade in falt, oil, almonds, iron, &c. brought from Laubach; and they make good wines. The cathedral, and the late Jefuits church, are the two beft buildings. It belongs to the Houfe of Auftria, and is eight miles north of Capo d'Iftria, and 80 north-eaft of Venice. E. Long. 14 4. N. Lat. 45. 56.

TRIESTE *Bay*, on the coaft of Terra Firma, is nearly due fouth from Bonair Ifland, one of the Little Antilles, to the eaft of Curaffou Ifland.—*Morse.*

TRIESTE *Ifland*, a fmall ifland at the bottom of the Gulf of Campeachy, weftward of Port-Royal Ifland, about 3 leagues from E. to W. The creek which feparates it from Port-Royal Ifland is fcarcely broad enough to admit a canoe. Good frefh water will be got by digging 5 or 6 feet deep in the falt fand; at a lefs depth it is brackifh and falt, and at a greater depth than 6 feet it is falt again.—*ib.*

TRINIDAD, a fmall ifland in the S. Atlantic Ocean, due E off Spiritu Santo, in Brazil. S. lat. 20 30, W. long. 41 20. It is alfo called Trinity.—*ib.*

TRINADAD, or *Trinidada Ifland*, near the coaft 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 coaft. 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 fets fo ftrong along the coaft from E. to W. as to render moft of its bays and harbours ufelefs. It produces fugar, fine tobacco, indigo, ginger, a variety of fruit, fome cotton and Indian corn. It was taken by Sir Walter Raleigh, in 1595, and by the French in 1676, who plundered the ifland, and extorted money from the inhabitants. It was captured by the Britifh in February, 1797. It is fituated 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 Jofeph.—*ib.*

TRINIDAD, LA, a town of Mexico, in the province of Guatimala, on the banks of the river Belen, 12 miles from the fea; but the road is almoft impaffable by land. It is 70 miles S. E. of Guatimala, and 24 eaft of La Conception. N. lat. 13, W. long. 91 40.—*ib.*

TRINIDAD, LA, on the north coaft of the Ifthmus of Darien, lies eaftward of Bocca del Toro, and fome clufters of fmall iflands, and S. W. of Porto Bello and Fort Chagre. N. lat. 8 30, W. long. 81 30.—*ib.*

TRINIDAD, or *La Sonfonate 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 fent 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 neareft landing to Guatimala for fhips that come from Peru, Panama, and Mexico.—*ib.*

TRINIDAD, LA, one of the fea-ports on the fouth part of the ifland of Cuba, in the Weft-Indies; fituated N. W. from the weft end of the groupe of iflands 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 ifland of Tobago on the N. W. and that of Trinidad on the fouth.—*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 inftituted at Rome in the year 1198, under the pontificate of Innocent III. the founders whereof were John de Matha and Felix de Valois. His Holinefs gave them permiffion to eftablifh 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 crofs. After the death of the two founders, Pope Honorious III. continued the order; and their rule was approved by his fucceffor Clement IV. in 1367. At firft they were not permitted to eat flefh; and when they travelled, were to ride only upon affes. But their rule was corrected and mitigated by the bifhop of Paris, and the abbots of St Victor and St Genevieve, who allowed them to eat any kind of food, and to ufe horfes. This order poffeffed, at one time, about 250 convents in 13 different provinces: fix of which were in France; namely, France, Normandy, Picardy, Champaine, Languedoc, and Provence; three in Spain, viz. New Caftile, Old Caftile, and Arragon; one in Italy, and one in Portugal. There was formerly the province of England, where this order had 43 houfes; that of Scotland, where it had nine; and that of Ireland, where it had 52; befides a great number of monafteries in Saxony, Hungary, Bohemia, and other countries. The convent of Cerfroy in France was head of the order. It is impoffible for us to fay what is now the ftate of the order, which can have no vifible exiftence in France, and is probably fuppreffed even in Italy.

TRINITY *Bay*, on the eaft fide of Newfoundland Ifland, between lat. 47 53 30, and 48 37 N.—*Morse.*

TRINITY *Port*, a large bay of Martinico Ifland, in the Weft-Indies, formed on the fouth-eaft by Point Caravelle.—*ib.*

TRINITY *Ifle* lies near the coaft of Patagonia, in S. America, eaftward of York Iflands. S. lat. 50 37.—*ib.*

TRINITY *Ifle*, the north-eafternmoft of the fmall iflands on the fouth-eaft coaft of the peninfula of Alafka, on the N. W. coaft of N. America, N. E. of Foggy Iflands.—*ib.*

TRIO, a cape on the coaft of Brazil, S. America.—*ib.*

TRIONES, in aftronomy, a fort of conftellation, or 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

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 Marsouines; 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

manner in defence of Mr Locke's writings; a female metaphyfician being a remarkable phenomenon in the republic of letters.

She returned to the exercife of her dramatic genius in 1703, and fixed upon the revolution of Sweden, under Guftavus Erickfon, for the fubject of a tragedy. This tragedy was acted, in 1706, at the Queen's theatre in the Hay-Market. In 1707, her doubts concerning the Romifh religion, which fhe had fo many years profeffed, having led her to a thorough examination of the grounds of it, by confulting the beft books on both fides of the queftion, and advifing with men of the beft judgment, the refult was a conviction of the falfenefs of the pretenfions of that church, and a return to that of England, to which fhe adhered during the remainder of her life. In 1708, fhe was married to the Rev. Mr Cockburn, then curate of St Dunftan's in Fleet-ftreet, but he afterwards obtained the living of Long-Horfeley, near Morpeth in Northumberland. He was a man of confiderable abilities; and, among feveral other things, wrote an account of the Mofaic Deluge, which was much approved by the learned.

Mrs Cockburn's remarks upon fome writers in the controverfy concerning the foundation of moral duty and moral obligation, were introduced to the world, in Auguft 1743, in the Literary Journal, intitled *The Hiftory of the Works of the Learned*. The ftrength, clearnefs, and vivacity fhewn in her remarks upon the moft abftract and perplexed queftions, immediately raifed the curiofity of all good judges about the concealed writer; and their admiration was greatly increafed when her fex and advanced age were known. Dr Rutherforth's Effay on the Nature and Obligations of Virtue, publifhed in May 1744, foon engaged her thoughts; and notwithftanding the afthmatic diforder which had feized her many years before, and now left her fmall intervals of eafe, fhe applied herfelf to the confutation of that elaborate difcourfe, and finifhed it with a fpirit, elegance, and perfpicuity equal, if not fuperior, to all her former writings.

The lofs of her hufband in 1748, in the 71ft year of his age, was a fevere fhock to her; and fhe did not long furvive him, dying on the 11th of May 1749, in her 71ft year, after having long fupported a painful diforder with a refignation to the Divine will, which had been the governing principle of her whole life, and her fupport 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 fouth fide of the ifland of St Domingo. From this to Cape Beate, or Cape a Foux, the fhore is rocky.—*Morse*.

TROU, Le, a fettlement in the northern part of the French divifion of the ifland 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 poft-town of New-York, Ranffelaer county, 6 miles north of Albany, 3 S. of Lanfingburg city, and 271 from Philadelphia. The townfhip of Troy is bounded E. by Peterfburg, and was taken from Renffellaerwyck townfhip, and incorporated in 1791. In 1796, 550 of the inhabitants were electors. Seven years ago, the fcite of the flourifhing village of Troy was covered with flocks and herds, and the fpot on which a fchool, containing 160 fcholars, is now erected, was then probably a fheepfold. The fchool is under the direction of three fchoolmafters, and is a very promifing feminary.—*ib.*

Trumpet Marine.

TRUMPET Marine, or Marigny. This is a ftringed inftrument, invented in the 16th century by an Italian artift Marino or Marigni, and called a *trumpet*, becaufe it takes only the notes of the trumpet, with all its omiffions and imperfections, and can therefore execute only fuch melodies as are fitted for that inftrument. It is a very curious inftrument, though of fmall mufical powers, becaufe its mode of performance is totally unlike that of other ftringed inftruments; and it deferves our very particular attention, becaufe it lays open the mechanifm of mufical founds more than any thing we are acquainted with; and we fhall therefore make ufe of it in order to communicate to our readers a philofophical theory of mufic, which we have already treated in detail as a liberal or fcientific art.

The trumpet marine is commonly made in the form of a long triangular pyramid, ABCD, fig. A. on which a fingle ftring EFG is ftrained over a bridge F by means of the finger pin L. At the narrow end are feveral 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 fo on. The bow is drawn lightly acrofs the cord at H, and the ftring is ftopped by preffing it with the finger immediately above the frets, but not fo hard as to make it touch the fret. When the open ftring is founded, it gives the fundamental note. If it be ftopped, in the way now defcribed, at $\frac{1}{3}$d of its length from E, it yields the 12th of the fundamental; if ftopped at $\frac{1}{4}$th, it gives the double octave; if at $\frac{1}{5}$th, it gives the 17th major, &c. In fhort, it always gives the note correfponding to the length of the part between the fret and the nut E. The founds refemble thofe of a pipe, and are indeed the fame with thofe known by the name *harmonics*, and now executed by every performer on inftruments of the viol or violin fpecies. But in order to increafe the noife, the bridge F is conftructed in a very particular manner. It does not reft on the found-board of the inftrument 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 found-board; and thus the bridge being made to tremble by the ftrong vibration of the thick cord, rattles on the found-board, or on a bit of ivory glued to it. The ufual way in which this motion is procured, is to have another ftring paffing under the middle of the bridge in fuch a manner that, by ftraining it tight, we raife the corner *b* from the found-board to the proper height. This contrivance increafes prodigioufly the noife of the inftrument, and gives it fomewhat of the fmart found of the trumpet, though very harfh and coarfe. But it merits the attention of every perfon who wifhes to know any thing of the philofophy of mufical founds, and we fhall therefore fay as much on the fubject as will conduce to this effect.

Plate XLV.

Galileo, as we have obferved in the article Temperament, *Suppl.* was the firft who difcovered the real connection between mathematics and mufic, by demonftrating that the times of the vibrations of elaftic cords of the fame matter and fize, and ftretched by equal weights, are proportional to the lengths of the ftrings. He

Trumpet Marine.

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 *f* C and *f* B. 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 A *c*, *c* B, with the particle *f* situated in '*f*. This particle will be left somewhat behind, as in *φ*, and the cord will have a curved form A *c φ* 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 *δ* 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 $cD : cA = cA : r$, or that the radius of curvature is to the element cA as the extending force to the accelerating force; and $cD = \frac{cA^2}{r}$; 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.*

* See life, E

mpet rine.

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 K*m*′, K*m*′ perpendicular to the curve in K and *k*. They muſt meet in *m*′, the centre of the equicurve circle. Draw KN*n*′ 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, $EX = \frac{EL^2}{EC}$.

We have $Fr : Ff = CL : CF, = CL : CD.$

$Ff : Gg = \quad CD : CE.$

Therefore $Fr : Gg$, or $KO : Ok = CL : CE$.

The triangles ECL and *k*OK are therefore ſimilar, as are alſo *k*OK and K *n m*, and conſequently ECL and K *n m*; and becauſe EC is parallel to K *n*, EL is parallel to K *m*. For the ſame reaſon *km* is parallel to E*l*, and the triangles E *l x* and *m* K *k* are ſimilar, and

$Lx : Kk = LE : Km,$

and $Lx : Kk = EC : Kn$. But farther,

$Lx : Ll = CE : CL$

$Ll : Ff = KN : CD$, being $= FL : FC$

$Ff : Gg = CD : CE$, being $= Ff : kO$

$Gg : Kk = CE : CL$, being $= KO : Kk$.

Therefore $Lx : Kk = KN \times CE : EL^2, = KN : EX.$

Therefore $KN : EX = LE : Km$, and $Km = \frac{EX \cdot LE}{KN}$,

and $KN : EX = CE : Kn$, and $Kn = \frac{EX \cdot CE}{KN}$.

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 CE^2, and then we obtain K*m* or K*n* (which hardly differ) $= \frac{CE^2}{KN}$, 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.

Trumpet Marine.

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 $= \frac{CE^2}{CD}$.

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 $Dm = \frac{CE^2}{CD}$, but $c : 1 = AB : CE$, and $CE = \frac{AB}{c}$, and $cE^2 = \frac{ABc}{c^2}$. Therefore $Dm = \frac{AB^2}{c^2 \times CD}, = \frac{L^2}{9{,}87 CD}$ 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, $1 : c^2 = \frac{1}{2} DC : 2z$, and $c^2 . DC = 2z$.

Now, by the property of the harmonic curve,

$AB : Dm = 2z : AB$

But

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$$\text{But } Dm : Dd = E : f$$
$$\text{And } Dd : AB = w : W$$
$$\text{Therefore } 2z \cdot E \cdot w = AB \cdot f \cdot W$$
$$\text{And } f : w = 2z \times E : AB \times W$$
$$\text{But } w : f = 2S : 2z$$
$$\text{Therefore } 2S \times E = AB \times W$$
$$\text{And } 2E : W = AB : S.$$

That is, a mufical cord, extended by a force E, performs one vibration DCV in the time that a heavy body defcribes a fpace S, which is to the length of the cord as its weight is to twice the extending force.

Now let g be the fpace through which a heavy body falls in one fecond, and let the time of a vibration (eftimated in parts of a fecond) be T. We have

$$AB : S = 2E : W$$
$$S : g = T^2 : 1^2$$
$$\text{Therefore } AB : g = 2E \cdot T^2 : W$$
$$\text{And } AB \times W = T^2 \times 2E \times g$$
$$\text{Therefore } T^2 = \frac{AB \times W}{2g.E}, \text{ and } T = \sqrt{\frac{AB \times W.}{2g.E}}$$

Let n be the number of vibrations made in a fecond.

$$n = \frac{1}{T}, = \sqrt{\frac{2g.E}{AB.W}} = \sqrt{\frac{2gE}{LW}}.$$

If the length of the cord be meafured in feet, $2g$ is very nearly 32. If in inches, $2g$ is 386, more nearly. Therefore $n = \sqrt{\frac{32\,E}{L.W}}$ or $\sqrt{\frac{386\,E}{L.W}}$. This may eafily be compared with obfervation. Dr Smith hung a weight of 7 pounds, or 49,000 grains, on a brafs wire fufpended from a finger pin, and fhortened it till it was in perfect unifon with the double octave below the open ftring D of a violin. In this ftate 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 fecond. Dr Smith proceeded to afcertain the number of aereal pulfes made by this found, availing himfelf of the theory of the beats of tempered confonances invented by himfelf. 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 fharp by a comma, and he found that it beat 65 times in 20 feconds. Therefore the number of vibrations was $\frac{65}{20}$ 81, or 263,25. Thefe were complete pulfes or motions from D to V and back again, and therefore contained 526½ fuch vibrations as we have now been confidering. The double octave below fhould make ¼th of this, or 131,6, which is not a complete vibration more than the above theory requires: more accurate coincidence is needlefs.

This theory is therefore very completely eftablifhed, and it may be confidered as one of the fineft mechanical problems which has been folved in the 18th century. We mention it with the greater minutenefs, becaufe the merit of Dr Taylor is not fufficiently attended to. Mr Rameau, and the other great theorifts in mufic, make no mention of him; and fuch as have occafion to fpeak of the abfolute number of vibrations made by any mufical note, always quote Mr Sauveur of the French academy. This gentleman has written fome very excellent differtations on the theory of mufic, and Sir Ifaac 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 fimilar to that practifed by Dr Smith on his chamber organ, and which agrees extremely well with that meafure. But Mr Sauveur has alfo given a mechanical inveftigation of the problem, which gives the fame number of vibrations that he obferved. We prefume that Rameau and others took the demonftration for good: and thus Mr Sauveur paffes on the continent for the difcoverer of this theorem. But it was not publifhed till 1716, though read in 1713; whereas Dr Taylor's demonftration was read to the Royal Society in May 1714. But this demonftration of Mr Sauveur is a mere paralogifm, where errors compenfate errors; and the affumption on which he proceeds is quite gratuitous, and has nothing to do with the fubject. Yet John Bernoulli, from enmity to Taylor and the Englifh mathematicians, takes not the leaft notice of this fophifticated demonftration, accommodated to the experiment, and fo devoid of any pretenfions to argument that this fevere critic could not but fee its falfity.

Sauveur was one of the firft who obferved diftinctly that remarkable fact which Mr Rameau made the foundation of his mufical theory, *viz.* that a full mufical note is accompanied by its octave, its twelfth, and its feventeenth major. It had been cafually obferved before, by Merfennus, by Perrault, and others; but Sauveur tells diftinctly how to make the obfervation, and affirms it to be true in all deep notes. Rameau afferts it to be univerfally and neceffarily true in all notes, and the foundation of all mufical pleafure.

It had been difcovered before this time, that not only a full note caufed its unifon to refound, but alfo that a 12th, being founded near any open ftring, the ftring *refounded* to this 12th. It does the fame to a 15th, a 17th major, a 22d, &c.

Dr Wallis added a very curious circumftance to this obfervation. Two of his pupils, Mr Noble and Mr Pigot, in 1673, amufing themfelves with thefe refonances, obferved, that if a fmall bit of paper be laid on the ftring of a violin which is made to refound to its unifon, the paper is thrown off: a proof that the ftring refounded by really vibrating, and that it is thrown into thefe vibrations by the pulfes of the air produced by the other ftring. In like manner the paper is thrown off when the ftring refounds to its octave. But the young gentlemen obferved, that when the paper was laid on the middle point of the ftring, it remained without agitation, although the ftring ftill refounded. They found the fame thing when they made the ftring refound to its 12th: papers laid on the two points of divifion lay ftill, but were thrown off when laid on any other place. In fhort, they found it a general rule, that papers laid on any points of divifion correfponding to the note which was refounded, were not agitated.

Dr Wallis (the greateft theorift in mufic of the 17th century) juftly concluded that thefe points of the refounding ftring were at reft, and that the intermediate parts were vibrating, and producing the notes correfponding 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 fome other inftruments.

When

mpet arine.

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, - $\frac{1}{16}$

Muſical Trumpet

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.

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.

remark. Newton having difcovered that found moved at the rate of about 960 feet per fecond, obferved that, according to the experiments of Mr Sauveur, the length of an open pipe is half the length of an aereal pulfe. This he could eafily afcertain by dividing the fpace defcribed by found in a fecond by the number of pulfes.

Daniel Bernoulli, the celebrated promoter of the Newtonian mechanics, difcovered, or at leaft was the firft who attentively marked, fome other circumftances of refemblance 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, founding its fundamental note, but can alfo be made to fubdivide itfelf, and vibrate like a portion of the whole, with points of reft between the vibrating portions, when it gives one of its harmonic notes; fo a pipe cannot only have fuch undulations of air going on within it as are competent to the production of its fundamental note, but alfo thofe which produce one of its harmonic notes. Every one knows that when we force a flute by blowing too ftrongly, it quits its proper note, and gives the octave above. Forcing ftill more, produces the 12th. Then we can produce the double octave or 15th, and the 17th major, &c. In fhort, by attending to feveral circumftances 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 precifely the fame order, and with the fame omiffions and imperfections. This alone is almoft equivalent to a proof that the mechanifm of the undulations of air in a pipe are analogous to that of the vibrations of an elaftic cord. Having with fo great fuccefs inveftigated the mechanifm of the partial vibrations of wires, and alfo another kind of vibrations which we fhall mention afterwards, incomparably more curious and more important in the philofophy of mufical founds, Mr Bernoulli undertook the inveftigation of thofe more myfterious motions of air which are produced in pipes; and in a very ingenious differtation, publifhed 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 obferve in the wind inftruments of the flute and trumpet kind. We are not, however, fo well fatisfied with the truth of his *affumptions* refpecting the ftate of the air, and the precife form of the undulations which he affigns to it; but we fee that, notwithftanding a probability of his being miftaken in thefe circumftances (it is with great deference that we prefume to fuppofe him miftaken), the chief propofitions are ftill true; and that the changes from note to note muft be produced in the order, though perhaps not in the precife manner, affigned by him.

It is by no means eafy to conceive, with clearnefs, the way in which mufical undulations are excited in the various kinds of trumpets. Many who have reputation as mechanicians, fuppofe that it is by means of vibrations of the lips, in the fame manner as in the hautboy, clarionette, and reed pipes of the organ, where the air, fay 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 *occafions* of its mufical undulation, but they do not *immediately impel* it into thofe waves. This method (and indeed all methods but the vibrations of wires, bells, &c.) of producing found is little underftood, though it is highly worthy of notice, being the origin of animal voice, and becaufe a knowledge of it would enable the artifts to entertain us with founds hitherto unknown, and thus add confiderably to this gift of our Bountiful Father, who has fhewn in the ftructure of the larynx of the human fpecies, that he intended that we fhould enjoy the pleafures of mufic as a *laborum dulce lenimen*. He has there placed a micrometer apparatus, by which, *after* the other mufcles have done their part in bringing the glottis nearly to the tenfion which the intended note requires, we can eafily, and inftantly, adjuft it with the utmoft nicety.

We truft, therefore, that our readers will indulge us while we give a very curfory view of the manner in which the tremulous motion of the glottis, or of a reed in an organ pipe, produces the fonorous undulations with a conftant or uniform frequency, fo as to yield a mufical note.

If we blow through a fmall pipe or quill, we produce only a whizzing or hiffing noife. If, in blowing, we fhut the entry with our tongue, we hear fomething like a folid blow or tap, and it is accompanied with fome faint perception of a mufical pitch, juft as when we tap with the finger on one of the holes of a flute when all the reft are fhut. We are then fenfible of a difference of pitch according to the length of the pipe; a longer pipe or quill giving a graver found. Here, then, is like the beginning of a fonorous undulation. Let us confider the ftate of the air in the pipe: It was filled by a column of air, which was moving forward, and would have been fucceeded by other air in the fame ftate. This air was therefore nearly in its ftate of natural denfity. When the entry is fuddenly ftopped 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 preffure of the atmofphere. It is therefore retarded in its motion, totally ftopped (being in a rarefied ftate), and is then preffed back again. It comes back with an accelerated motion, and recovers its natural denfity, while the ftate of rarefaction goes forward through the open air like any other aereal pulfe. Its motions are fomewhat, but not altogether, like that of a fpiral wire, which has been in like manner moving uniformly along the pipe, and has been ftopped by fomething catching hold of its hindermoft extremity. This fpring, when thus catched behind, ftretches itfelf a little, then contracts *beyond* its natural ftate, and than expands again, quivering feveral times. It can be demonftrated that the column of air will make but one quiver. Suppofe this accomplifhed in the hundredth part of a fecond, and that at that inftant the tongue is removed for the hundredth part of a fecond, and again applied to the entry of the pipe. It is plain that this will produce fuch another pulfe, which will join to the former one, and force it out into the air, and the two pulfes together will be like two pulfes produced by the vibration of a cord. If, inftead of the tongue we fuppofe 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 fhall have *fonorous* undulations of *uniform* frequency, and therefore a mufical note. This is the way in which reeds produce their effect, not by *impelling* the air into alternate ftates

ftates of motion to and fro, and alternate ftrata of rarefied and condenfed air, but by giving them time to acquire this ftate by the combination of the air's elafticity with its progreffive motion.

The adjuftment of the fucceeding puff of air to the pulfe which precedes it, fo that they may make one fmooth and regular pulfe, is more exact than we have yet remarked; for the ftoppage of the hole not only *occafions* a rarefaction *before it*, but by checking the air which was juft going to enter, makes a condenfation *behind the door* (fo to fpeak); fo that, when the paffage is again opened, the two parcels of air are fitted for fupporting each other, and forming one pulfe.

Suppofe, in the next place, that the reed, inftead of completely fhutting the hole each time, only half fhuts it. The fame thing muft ftill happen, although not in fo remarkable a degree. When the paffage is contracted, the fupply is diminifhed, and the air now in the pipe muft rarefy, by advancing with its former velocity. It muft therefore retard; by retarding regain its former denfity; and the air not yet got into the pipe, muft condenfe, &c. And if the paffage be again opened or enlarged in the proper time, we fhall have a complete pulfe of condenfed and rarefied air; and this muft be accompanied by the beginning of a mufical note, which may be continued like the former.

This will be a fofter or more mellow note than the other; for the condenfed and rarefied air will not be fo fuddenly changed in their denfities. 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 mufical notes are by no means confined, as theorifts commonly fuppofe, to the regular cycloidal agitations of air, fuch as are produced by the vibrations of an elaftic cord; but that any crack, fnap, or noife whatever, when repeated with fufficient frequency, becomes *ipfo facto* a mufical found, of which we can tell the pitch or note. What can be lefs mufical than the folitary cracks of fnaps made by a ftiff door when very flowly opened? Do this brifkly, and the creak changes to a chirp, of which we can tell the note. The founds will be harfh or fmooth, according as the fnaps of which they are compofed are abrupt or gradual.

This diftinction of founds is moft fatisfactorily confirmed by experiment. If the tongue of the organ reed is quite flat, and if, in its vibrations, it apply itfelf to the whole margin of the hole at once, fo as completely to fhut it (as is the cafe in the oldfafhioned regal ftop of the organ), the note is clear, fmart, and harfh or hard: but if the lips of the reed are curved, or the tongue properly bent backward, fo that it applies itfelf to the edges of the hole *gradatim*, and never completely fhuts the paffage, the note may have any degree of mellow fweetnefs. This remark is worth the attention of the inftrument-makers or organ builders, and enables them to vary the VOICE of the organ at pleafure. We only mention it here as introductory to the explanation of the founds of the trumpet.

We truft that the reader now perceives how the air, proceeding along a pipe, may be put in the ftate of alternate ftrata of condenfed and rarefied air, the particles, in the mean time, proceeding along the pipe with a very moderate velocity; while the *ftate of undulation* is propagated at the rate of eleven or twelve hundred feet in a fecond; juft as we may fometimes fee a ftream of water gliding gently down a canal, while a wave runs along its furface with much greater rapidity.

It will greatly affift the imagination, if we compare thefe aëreal undulations with the undulations of water in an open canal. While the water is flowing fmoothly along, fuppofe a fluice to be thruft up from the bottom quite to the furface, or beyond it. This will immediately caufe a depreffion on the lower fide of the fluice, by the water's going along the canal, and a heaping up of the water on the other fide. By properly timing the motion of this fluice up and down, we can produce a feries of connected waves. If the fluice be not pufhed up to the furface but only one-half way, there will be the fame fucceffion of waves, but much fmoother, &c. &c.

It is in this ftate, though not by fuch means, that the air is contained in a founding trumpet. It is not brought into this ftate by any tremor of the lips. The trumpeter fometimes feels fuch a tremor; but whenever he feels it, he can no longer found his note. His lips are painfully tickled, and he muft change his manner of winding.

When blowing with great delicacy and care, the deepeft notes of a French horn, or trombone, we fometimes can feel the undulations of the air in the pipe diftinctly fluttering and beating againft 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 inftance of this when we attempt to whiftle in concert. If our accompanier intonates with a certain degree of incorrectnefs, we feel fomething at our own lips which makes it impoffible to utter the intended note. This happens very frequently to the perfon who is whiftling 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 dimenfions of a pipe are fuch that the undulations formed by the reed cannot be kept up in the pipe, or do not fuit the length of the pipe, the reed will either not play at all, or will vibrate only in ftarts. This is finely illuftrated by a beautiful and inftructive experiment. Take a fmall reed of the *vox humana* ftop of an organ, and fet it in a glafs foot, adapted to the windbox of the organ. Inftead of the common pipe above it, fix on it the fliding tube of a fmall telefcope. When all the joints are thruft down, touch the key, and look attentively to the play of the reed. While it is founding, draw out the joints, making the pipe continually longer. We fhall obferve the reed thrown into ftrange fits of quivering, and fometimes quite motionlefs, and then thrown into wide fonorous vibrations, according as the *maintainable* pulfe is commenfurate or not with the vibrations of the reed. This plainly fhews that the air is not impelled into its undulations by the reed, but that the reed accommodates itfelf to the undulations in the pipe.

We acknowledge that we cannot explain with diftinctnefs in what manner the air in a trumpet is firft put into mufical undulations. We fee that it is only in very long and flender tubes that this can be done. In fhort tubes, of confiderable diameter, like the cowherd's horn, we obtain only one or two very indiftinct notes, of which it is difficult to name the pitch; and this requires great force of blaft; whereas, to bring out

out the deep notes of the French horn, a very gentle and well regulated blaft is neceffary. The form of the lips, combined with the force of the blaft, form all the notes. But this is in a way that cannot be taught by any defcription. The performer learns it by habit, and *feels* that the inftrument leaps into its note without him, when he gradually varies his blaft, and continues founding the fame note; although he, in the mean time, makes fome fmall change in his manner of blowing. This is owing to what Mr Bernoulli obferved. The tube is fuited only to fuch pulfes, and can only maintain fuch pulfes as correfpond to aliquot parts of its length; and when the embouchure is very nearly, but not accurately, fuited to a particular note, that note *forms itfelf* in the tube, and, reacting on the lips, brings them into the form which can maintain it with eafe. We have a proof of this when we attempt to found the note correfponding to one-feventh of the length. Not having a diftinct notion of this note, which makes no part of our fcale of melody, we cannot eafily prepare for it in the way that habit teaches us to prepare for the others: whereas, from what we fhall fee prefently, the notes *one-fixth* and *one-eighth* are both familiar to the mind, and eafily produced. When, therefore, we attempt to produce the note *one-feventh*, we flide, againft our will, into the *one-fixth* or *one eighth*.

Nor can we completely illuftrate the formation of mufical pulfes by waves in water. A canal is equally fufceptible of every height and length of progreffive waves; whereas we fee that a certain length of tube will maintain only certain determined pulfes of air.

We muft therefore content ourfelves for the prefent with having learned, by means of the reed pipes, how the air may exift progreffively in a tube, in an alternate ftate of condenfation and rarefaction; and we fhall now proceed to confider how this ftate 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, fhew, with fufficient evidence, how the different notes are produced from the fame tube. It requires, however, a very fteady attention from the reader to enable him to perceive how the different portions of this air act on each other. We truft that this will now be given.

The conditions which muft be implemented, in order to maintain a mufical pulfe, are two: 1. That the vibrations of the different plates of air be performed in equal times, otherwife they would all mix and confound each other. 2. That they move all together, all beginning and all ending at the fame inftant. It does not appear that any other ftate of vibration can exift and be maintained.

The column of air in a tube may be confidered as a material fpring (having weight and inertia). This fpring is compreffed and coiled up by the preffure of the atmofphere. But in this coiled ftate it can vibrate in its different parts, as a long fpiral wire may do, though preffed a little together at the ends. It is evident that the air within a pipe, fhut at both ends, may be placed in fuch a fituation, *in a variety of ways*, that it will vibrate in every part, in the fame manner as a chord of the fame length and weight, ftrained by a force equal to the preffure of the atmofphere. Thus, in the fhut pipe AB (fig. 1.), fuppofe a harmonic curve ACB, or a wire of the fame weight with the air, throwing itfelf 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, fuppofe the air in this pipe divided into parallel ftrata or plates, croffing the tube like diaphragms. In order that thefe may vibrate in the fame manner (not acrofs the tube, but in the direction of its axis), all that is neceffary for the moment is, that the excefs of the preffure of the ftratum *dd* above that of the ftratum *ff* may be to the excefs of the preffure of DD above that of FF as *ce* to CE. In this cafe, the ftratum *ce* will be accelerated in the direction *ef*, and the ftratum EE is accelerated in the fame direction, and in the due proportion. Now this may be done in an infinite variety of ways for a fingle moment. It depends, not on the abfolute denfity, but on the *variation* of denfity; becaufe the preffure by which a particle of air is urged in any direction arifes from the *difference* of the diftances of the adjoining particles on each fide 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 denfity muft continue, and be according to fome connected law. This circumftance greatly limits the ways in which the vibration may be kept up. Mr Bernoulli finds that the ifochronifm and fynchronifm can be maintained in the following manner, and in no other that he could think of:

Let AB (fig. 2.) be a cylindrical pipe, fhut at A, and open at B. Then, in whatever manner the found is produced in the pipe, the undulations of the contained air muft be performed as follows: Let *aa* be a plate of air. This plate will approach to, and recede from, the fhut end A, vibrating between the fituations *bb* and *cc*, the whole vibration being *bc*, and the plate will vibrate like a pendulum in a cycloid. The greater we fuppofe the excurfions *ab*, *ac*, the louder will the found be; but the duration of them all muft be the fame, to agree with the fact that the tone remains the fame. The motion will be accelerated in approaching to *aa* from either fide, and retarded in the recefs from it. Let us next confider a plate $\alpha\alpha$, more remote from A. It muft make fimilar vibrations from the fituation $\beta\beta$ to the fituation $\gamma\gamma$. But thefe vibrations muft be greater in proportion as the plate is farther from A. It cannot be conceived otherwife: For fuppofe the plate $\alpha\alpha$ to make the *fame* excurfions with *aa*, and that the reft do the fame. Then they will all retain the fame diftances from each other; and thus there will be no force whatever acting on any particles to make them vibrate. But if every particle make excurfions proportional to its diftance from A, the *variation* of denfity will, in any inftant, be the fame through the whole pipe, and each particle in the vibrating plate $\beta\beta$ will be accelerated or retarded in proportion to its diftance from A; while the accelerations and retardations over all will, in any inftant, be proportional to the diftance of each particle from its place of reft. All this will appear to the mathematician, who attentively confiders any momentary fituation of the particles. In this manner all the particles will fupport each other in their vibrations.

It follows from this defcription that the air in the tube is alternately rarefied and condenfed. But thefe changes are very different in different parts of the tube. They muft be greateft of all at A; becaufe, while all the

the plates approach to A, they concur in condenfing the air immediately adjoining to A; while the air in *a a* and *α α* is lefs condenfed by the action of the plates beyond it. The air at B is always of its natural denfity, being in equilibrio with the furrounding air. At B, therefore, there is a fmall parcel of air, of its natural denfity, which is alternately going in and out.

This account is confirmed by many facts. If the bottom of the pipe be fhut by a fine membrane, ftretched acrofs it like a drumhead, with a wire ftretched over it, either externally or internally, in the fame manner as the catgut is ftretched acrofs the bottom of a drum, it will be thrown into ftrong vibrations, making a very loud noife, by rattling againft the crofs wire. The fame thing happens if the membrane be pafted over a hole clofe to the bottom, leaving a fmall fpace round the edge of the hole without pafte, fo that the membrane may play out and in, and rattle on the margin of the hole. This alfo makes a prodigious noife. Now, if the membrane be pafted 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 loweft note of which it is fufceptible.

Let us next confider 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 fhall have two pipes AB, AC, each of which may undulate in the manner now defcribed, if the undulations in each be in oppofite directions. It is evidently poffible, alfo, that thefe undulations may be the fame in point of ftrength in both, and that they may begin in the fame inftant. In this cafe, the air on each fide of the partition will be in the fame ftate, whether of condenfation or rarefaction, and the partition A itfelf will always be in equilibrio. It will perfectly refemble the point C of the mufical 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 fide are either both approaching it, or both receding from it, and the partition is either equally fqueezed from both fides, or equally drawn outwards. Confequently this partition may be removed, and the parcels of air on each fide will, in any inftant, fupport each other. There feems no other way of conceiving thefe vibrations in open pipes which will admit of an explanation by mechanical laws. The vibrations of all the plates muft be obtained without any mutual hinderance, in order to produce the tone which we really hear; and therefore fuch vibrations are impreffed by Nature on each plate of air.

But if this explanation be juft, it is plain that this pipe CB muft give the fame note with the pipe AB (fig. 2.) of half the length, fhut at one end. But the found, being doubled, with perfect confonance, muft be clear, ftrong, and mellow. Now this is perfectly agreeable to obfervation; and this fact is an unequivocal confirmation of the juftnefs of the theory. If we take a flender pipe, about fix inches long and one half of an inch wide, fhut at one end, and found it by blowing acrofs its mouth, as we whiftle on the pipe of a key, or acrofs a hole that is clofe to the mouth, and formed with an edge like the found-hole of a German flute, we fhall get a very diftinct and clear tone from it. If we now take a pipe of double the length, open at both ends, and blow acrofs its mouth, we obtain the fame note, but more clear and ftrong. And the note produced by blowing acrofs the mouth is not changed by a hole made exactly in the middle, in refpect of its mufical pitch, although it is greatly hurt in point of clearnefs and ftrength. Alfo a membrane at this hole is ftrongly agitated. All this is in perfect conformity to this mechanifm.

Thus we have, in a great meafure, explained the effect of an open and a fhut pipe. The fhut pipe is always an octave, graver than an open pipe of the fame length; becaufe the open pipe is in unifon with the fhut pipe of half the length.

Let AC (fig. 4.) be a pipe fhut at both ends. We may confider it as compofed of two pipes AB, BC, ftopped at A and C, and open at B. Undulations may be performed in each half precifely as in the pipe AB of fig. 2.; and they will not, in the fmalleft degree obftruct each other, if we only fuppofe that the plates in each half are vibrating at once in the *fame* direction. The condenfation in AB will correfpond with the rarefaction in BC, and the middle parcel B will maintain its natural denfity, vibrating to, and again acrofs the middle; and two plates *a a*, *α α*, which are equally diftant from B, will make equal excurfions in the fame direction.

We may produce found in this pipe by making an opening at B. Its note will be found to be the fame with that of BC of fig. 2. or of AB of fig. 2.

In the next place, let a pipe, fhut at one end, be confidered as divided into any odd number of equal parts, and let them be taken in pairs, beginning at the ftopped end, fo that there may be an odd one left at the open end. It is plain that each of thefe pairs may be confidered as a pipe ftopped at both ends, as in fig. 4.

For the partitions will, of themfelves, be in equilibrio, and may be removed, and vibrations may be maintained in the whole, confiftent with the vibration of the odd part at the open end; and thefe vibrations will all fupport each other, and the plates of air which are at the point of divifion will remain at reft. Conceive the pipe AB of fig. 2. to be added to the pipe AC of fig. 4. the part A of the firft being joined to A of the other. Now, fuppofe the vibrations to be performed in both, in fuch a manner that the fimultaneous undulations on each fide of the junction may be in oppofite directions. It is plain that the partition will be in equilibrio, and may be removed; and the plate of air will perform the fame office, being alternately the middle plate of a condenfed and of a rarefied parcel of air. The two pipes CA, AB will together give the fame note that AB would have given alone, but louder.

In like manner may another pipe, equal to AC, be joined to the fhut end of this compound pipe, as in fig. 5. and the three will ftill give the fame note that AB would have done alone.

And in the fame manner may any number of pipes, each equal to AC, be added, and the whole will give ftill the fame 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 found competent to it, as a fingle pipe AB (fig. 2.); or it may give the found 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 themfelves 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 rarefy 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 $\frac{1}{11}$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 $1\frac{5}{11}$ inches. Or, the length which gave any note being x, the length for its octave must be $\frac{x - 1\frac{5}{11}}{2}$.

Musical Trumpet.

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. part; 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, 1*st*, 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, 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.

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 alfo deduce from it a very compendious rule for determining the abfolute number of aereal pulfes made by an open pipe of any given length. When confidering the vibrations of cords, we found that the number of vibrations made in a fecond 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 atmofphere. We have its weight $= \frac{HW}{L}, = E$. Therefore fubftituting $\frac{HW}{L}$ for E in the above formula, we have the number of aereal pulfes made per fecond $= \sqrt{\frac{386\,H}{L^2}}$, or $= \frac{\sqrt{386\,H}}{L}$. Now $\sqrt{386}\,H$, computed in inches, is 11331. Therefore, if we alfo meafure the length of the pipe L in inches, the pulfes in a fecond are $= \frac{11331}{L}$. Thus, in the cafe before us, $\frac{11331}{86,4} = 131,12$, or this pipe produces 131 pulfes in a fecond. Dr Smith found by experiment that it produced 130,9, differing only about $\frac{1}{5}$th of a pulfe.

We fee that the pitch of a pipe depends on the height of the homogeneous atmofphere. This may vary by a change of temperature. When the air is warmer it expands, and the weight of the induced column is leffened, while it ftill carries the fame preffure. Therefore the pitch muft rife. Dr Smith found his organ a full quarter tone higher in fummer than in winter. The effect of this is often felt in concerts of wind inftruments with ftringed inftruments. The heat which fharpens the tone of the firft flattens the laft. The harpfichord foon gets out of tune with the horns and flutes.

Sir Ifaac Newton, comparing the velocity of found with the number of pulfes made by a pipe of given length, obferved that the length of a pulfe was twice the length of the open pipe which produced it. Divide the fpace paffed over in a fecond by the number of pulfes, and we obtain the length of each pulfe. Now it was found that a pipe of 21,9 inches produced 262 pulfes. The velocity of found (as computed by the theory on which our inveftigation 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 found, and its real velocity 1142 feet per fecond, remains ftill to be accounted for. We may juft obferve here, that when a pipe is meafured, and its length called 21,9 we do really allow it too little. The voice hole is equivalent to a portion, not inconfiderable 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 $\frac{1}{6}$th; and this is fufficient for reconciling thefe meafures of a pulfe with the real velocity of found.

The determination which we have given of the undulations of air in an organ pipe is indirect, and is but a fketch of the beautiful theory of Daniel Bernoulli, in which he ftates with accuracy the precife undulation of each plate of air, both in refpect of pofition, denfity, velocity, and direction of its motion. It is a pleafure to obferve how the different equations coincide with thofe which exprefs the vibrations of an elaftic cord. But this would have taken up much room, and would not have been fuited to the information of many curious readers, who can eafily follow the train of reafoning which we have employed.

Mr Bernoulli applies the fame theory to the explanation of the undulations in flutes, or inftruments whofe founds are modified by holes in the fides of the pipe. But this is foreign to our purpofe of explaining the mufic of the trumpet. We fhall only obferve, that a hole made in that part of a pipe where a node fhould form itfelf, in order to render practicable the undulations competent to a particular note, prevents its formation, and in its place we only get fuch undulations (and their correfponding founds) as have a loop in that place. The intelligent reader will perceive that this fingle circumftance will explain almoft every phenomenon of flutes with holes; and alfo the effects of holes in inftruments with a reed voice, fuch as the hautboy or clarionette.

We now fee that the found or mufical pitch of a pipe is inverfely as its length, in the fame manner as in ftrings. And we learn, by comparing them, that the found of a trumpet has the fame pitch with an open organ pipe of the fame length. A French horn, 16 feet long, has the found C *fa ut*, which is alfo the found of an open flute-pipe of that length.

The Trombone, great trumpet, or Sackbut, is an old inftrument defcribed by Merfennus, and other authors of the laft century. It has a part which flides (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; becaufe we can thus correct all the falfe notes of the trumpet, which are very offenfive, when they occur in an emphatical or holding note of a piece of mufic. We can even employ this contrivance for filling up the blanks in the lower octaves.

We muft not take leave of this fubject without taking notice of another difcovery of Mr Bernoulli's, which is exceedingly curious, and of the greateft importance in the philofophy of mufic.

Artifts had long ago obferved that the deep notes of mufical inftruments are fometimes accompanied by their harmonic founds. This is moft clearly perceived in bells, fome of which give thefe harmonics, particularly the 12th, almoft as ftrong as the fundamental. Muficians, by attending more carefully to the thing, feem now to think that this accompaniment is univerfal. If one of the fineft founding ftrings of the bafes of a harpfichord be ftruck, we can hear the 12th very plainly as the found is dying away, and the 17th major is the laft found that dies away on the ear. This will be rendered much more fenfible, if we divide the wire into five parts, and at the points of divifion tie round it a thread with a faft knot, and cut the ends off very fhort. This makes the ftring falfe indeed by the unequal loading; but, by rendering thofe parts fomewhat lefs moveable by this additional matter, the portions of the wire between thefe points are thus jogged, as it were, into fecondary vibrations, which have a more fenfible proportion to the fundamental vibration. This is ftill more

fenfible

fensible in the found of the ftrings of a violincello when fo loaded; but we muft be careful not to load them too much, becaufe this would fo much retard the fundamental vibration, without retarding the fecondary vibrations, that both cannot be maintained together. (*N. B.* This experiment always produces a beat in the found).—Liftening to a fine founding flute pipe of the organ, we can alfo very often perceive the fame thing. Mr Rameau, and moft other theorifts in mufic, now affert that this is the effence of a mufical found, and *neceffarily* exifts in all of them, diftinguifhing them from harfh noifes. Rameau has made this the foundation of his fyftem of mufic, afferting that the pleafure of harmony refults from the fuccefsful imitation of this harmony of Nature, (fee Music, *Encycl.*). But a little logic fhould convince thefe theorifts that they muft be miftaken. If a note is mufical becaufe it has thefe accompaniments, and by this compofition alone is a mufical note, what are thefe harmonics? Are they mufical notes? This is granted. Therefore they have the fame compofition; and a mufical note muft confift at once of every poffible found; yet we know that this would be a jarring noife. A little mathematics, too, or mechanics, would have convinced them. A fimple vibration is furely a moft poffible thing, and therefore a fimple found. No, fay the theorifts; for though the vibration of the cord may be fimple, it produces fuch undulations in the air as excite in us the perception of the harmonics. But this is a mere affertion, and leaves the queftion undecided. Is not a fimple undulation of the air as poffible as the fimple vibration of a cord?

It is, however, a very curious thing, that almoft all mufical founds really have this accompaniment of the octave, 12th, double octave, and 17th major; for thefe are the harmonics that we hear.

The jealoufy of Leibnitz and of John Bernoulli, and their unfriendly thoughts refpecting all the Britifh mathematicians, made John Bernoulli do every thing in his power to leffen the value of Dr Taylor's inveftigation of the vibration of a mufical cord. Taylor gave him a good opportunity. Perhaps a little vain of his inveftigation of this abftrufe matter, he thought too much of it. He affirmed that the harmonic curve was the effential form of a ftring giving a mufical note. This was denied without knowing at firft whether it was true or falfe. But as the analytic mathematics improved, it was at length found that there are an infinity of forms into which an elaftic cord can be thrown, which are confiftent both with ifochronous vibrations, whether wide or narrow, and alfo with the condition of the whole cord becoming a ftraight line at once. Euler, D'Alembert, and De la Grange, have profecuted this matter with great ingenuity, and it is one of the fineft problems of the prefent day.

Daniel Bernoulli, of a very different caft of mind from his illuftrious friends, admired both Newton and Taylor; and fo far from wifhing to eclipfe 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 faid. When he took a review of what he had done while explaining the partial vibrations of mufical cords, he thought it very poffible that while a cord is vibrating in three portions, with two nodes or points of reft, and founding the 12th to its fundamental, it might at the fame time be alfo vibrating as a fimple cord, and founding its fundamental note. It was poffible, he thought, that the three portions might be vibrating between the four points with a triple frequency, while the two middle nodes were vibrating acrofs the ftraight 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 fpecious, and when a little more attentively confidered, 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 thefe two points be laid hold of by hooks, and be drawn afide to β and γ, while the ftring is yet vibrating, this fhould not hinder the vibrations. If the hooks be annihilated in an inftant, the whole fhould vibrate between A and D; and this fhould be in a way very different from the fimple vibration. The queftion now is, will the cord *continue* to vibrate with the loops $\beta s \gamma$, $\beta q \gamma$, &c. in the 900th part of a fecond (for inftance), while the whole ftring vibrates from $A \beta \gamma D$ to $A \beta' \gamma' D$ in the 300th part of a fecond? or will it at once acquire the form of the fimple harmonic curve? The cafe in which it is moft likely to take the latter mode of vibration is when the points β and γ are let go at the inftant that each portion of the ftring is in the middle of its vibration, and therefore forms the line $A \beta \gamma D$. But a moment's confideration will fhew us that it cannot do this; for at that inftant the point v, for inftance, which had come from q, is moving outwards with a moft 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 muft differ greatly from a fimple one. On the other hand, let it be fuppofed that both fpecies of vibrations can be preferved, and that, at the moment of letting go the points β and γ, the cord has the form $Am\beta q\gamma nD$. Then, when β and γ have come to B and C, having made $\frac{1}{4}$ 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 fuch a manner, that if the points B and C were inftantly ftopped, the three portions would continue their partial vibrations without any new effort. The refult of this compound vibration muft be a compound pulfe of air, which will excite in us the perception of the fundamental found and of its 12th. The confequence will be the fame if the points β and γ are ftopped any where fhort of the axis; and therefore (faid Bernoulli) the ftring will really vibrate fo if not ftopped at all.

But this was refufed by Euler, who obferved that in the points β and γ of contrary flexure, having no curvature, there can be no accelerating force. This caufed Bernoulli to attempt a direct inveftigation, examining minutely the curvatures and accelerating forces in the different points.

He had the pleafure of finding that the accelerating forces arifing from the curvature in every point, were precifely fuch as would produce the accelerations neceffary in thofe 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, Musical Trumpet.

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.

Musical Trumpet ‖ Truro.

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.

Pamet

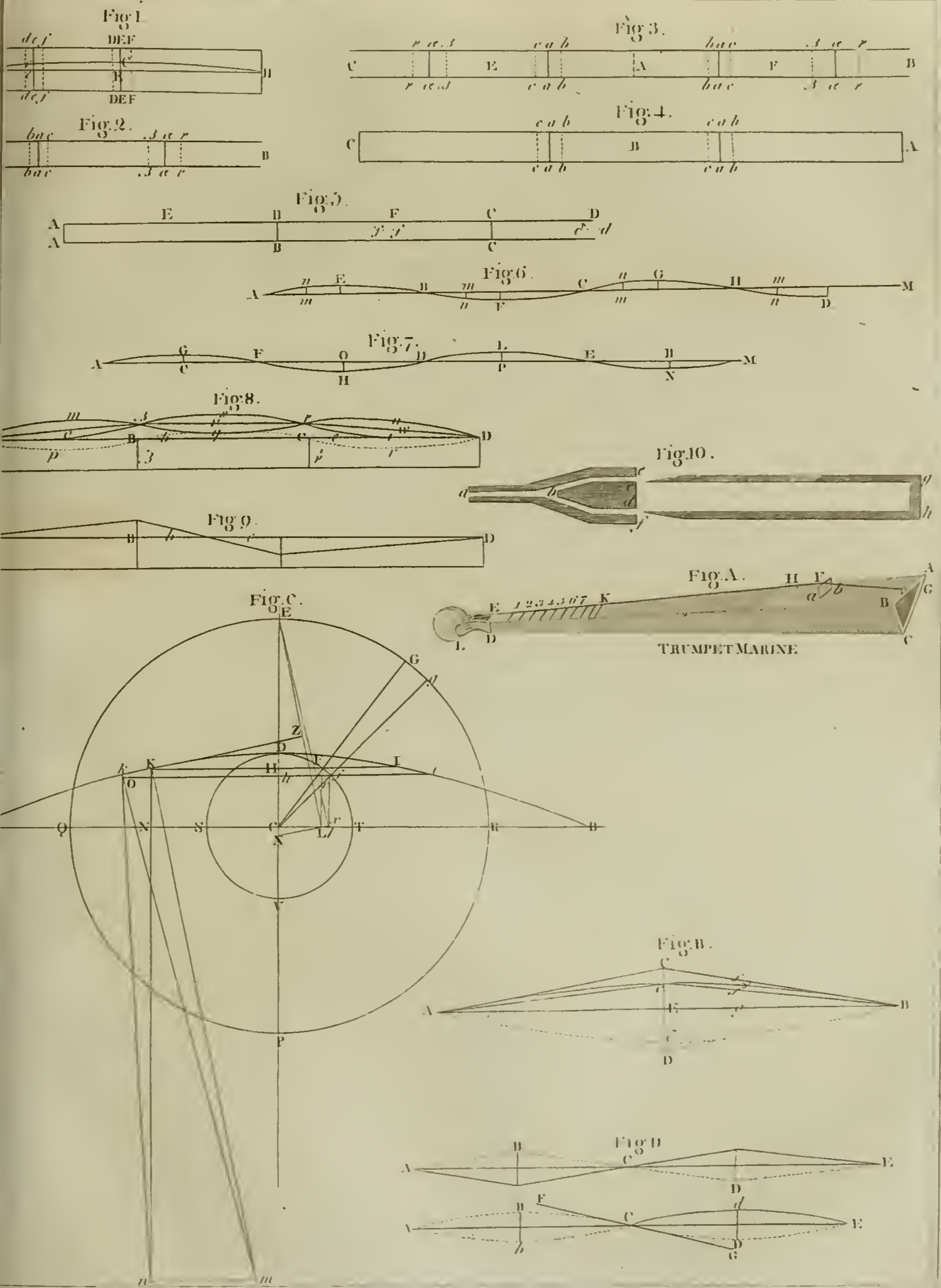
Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7.
Fig. 8.
Fig. 9.
Fig. 10.
Fig. A.
TRUMPET MARINE
Fig. C.
Fig. B.
Fig. D.

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-houfe ftands branches from the high land of Cape-Cod, well known to feamen. The mountain of clay in Truro, in the midft of fandy hills, feems to have been placed there by the God of Nature, to ferve as a foundation for a light-houfe, which if erected might fave the lives of thoufands, and millions of property. The foil of Truro is, in moft places, fandy, like Provincetown; and the inhabitants derive their principal fubfiftence from the fea, which here abounds with vaft variety of fifh. Great part of their corn and vegetables are procured from Bofton and the neighbouring towns. Two inhabitants of Truro, Captains David Smith and Gamaliel Collings, were the firft who adventured to Falkland Iflands in purfuit of whales. This voyage, which was crowned with fuccefs, was undertaken in 1774, by the advice of Admiral Montague of the Britifh navy. The whalemen of Truro now vifit the coaft of Guinea and Brazil. Many of the mafters of fhips employed from Bofton and other ports, are natives of Truro. The elderly men and fmall boys remain at home to cultivate the ground; the reft are at fea two-thirds of the year. The women are generally employed in fpinning, weaving, knitting, &c.—*ib.*

TRUXILLO, a bay, harbour, and town, at the bottom of St Giles's Bay, on the coaft of Honduras, in the gulf of that name. The bay is about 6 miles broad, being deep and fecure, and defended by a caftle; but it has little trade. The town ftands about a league from the North Sea, between two rivers, the mouths of which, with fome iflands before them, form the harbour. The country is exceedingly fruitful in corn and grapes, and notwithftanding the heat of the climate, very populous. The city is defended by a thick wall towards the fea, and is inacceffible but by a narrow, fteep afcent. The caftle joins to the wall, and ftands 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 firft diocefe in the audience of Lima, in Peru.—*ib.*

Truxillo, a bay or harbour, and one of the principal cities of the province of the fame 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 ftands in the valley of Chimo, on a fmall river, about half a league from the fea; is furrounded with a brick wall, and from its circuit may be claffed among cities of the third order. Two leagues to the northward is the port of Guanchaco, the channel of its trade. The houfes make an elegant appearance, being generally of brick, with ftately balconies and fuperb porticos.—*ib.*

Truxillo, or *Noftra Seniora de la Paz*, a town of New-Granada (Venezuela) and Terra Firma, in S. America, 125 miles fouth of Maracaibo Lake; on the fouthernmoft 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 Salifbury, on the borders of the State of Tenneffee.—*ib.*

Tfchirnhaus.

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 Kiflingfwald near Gorlitz in Upper Lufatia. His father was Erneft Chriftopher Von Tfchirnhaus, Baron Kiflingfwald and Stolzberg, and Obernfchonfeld, privy counfellor, and in various offices of rank under the Electors George I, and II. of Saxony, the firft of whom honoured him with the diftinction of the gold chain and portrait, as a mark of his fenfe of his merits and fervices. The mother of the young Von Tfchirnhaus was Maria Stirling, daughter of *Baron Stirling et Achil*, Stirling of Achil, or Achyle, in Scotland, an old and refpectable family, as appears by an epitaph which the Duke Chriftian, brother of the Elector George II. infcribed on the tomb of Johan Albert Stirling of Achil, in the cathedral of Marckfpurg. This gentleman had been prefident of the fenate of the electorate, privy counfellor, director of the impofts, and mafter of horfe to the Prince, and had, by his faithful and ufeful fervices, acquired his higheft efteem.

E. W. Von Tfchirnhaus was born, as has been obferved, at Kiflingfwald, the ufual refidence of the family, and poffeffed by it during more than 300 years. The family came originally from Bohemia, and appears to have been confiderable, feeing that, from the earlieft accounts of it in Lufatia, the Barons of Kiflingfwald are generally found in the moft refpectable civil offices.

The figure which Baron Von Tfchirnhaus, the fubject of this relation, has made in the fcientific and political world, makes it fuperfluous to fay that his early years were well employed. Quick apprehenfion, a clear perception of the fubject of his thoughts, and the moft ardent and infatiable thirft for knowledge, diftinguifhed him during his academical education. When 17 years of age, he was fent to Leyden. In 1672 all ftudy was interrupted in Holland by the din of war; and Mr Van Tfchirnhaus left the univerfity for the camp. His knowledge in mathematics, mechanics, and all phyfical fcience, found ample room in the military fervice for fhewing the importance of thofe fciences; and Tfchirnhaus fo diftinguifhed himfelf by his fervice in this way, that Baron Nieuland, a general officer of great merit, and at the fame time an accomplifhed fcholar, took delight in pufhing him into every fervice where he could fhew himfelf and his talents.

After two years fervice, he returned to his father's; but finding little to intereft him in the life of a mere country gentleman, and ftill burning with the fame thirft of knowledge, he prevailed on his father to allow him to travel. His younger brother George Albrecht Von Tfchirnhaus, Baron Obernfchonfeld, which he inherited from his grandfather Stirling, loved him with the warmeft affection, and fupplied him liberally with what was required for his appearance every where in a manner becoming his rank, and for fully gratifying his curiofity. He ufed often to fay, "Sorry was I to lofe the company of my dear brother, and I fometimes wifhed to accompany him; but not having his thirft for knowledge, I knew that his love for me would debar him of much happinefs, which I fhould thus have obftructed." *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.

Tſchirnhaus.

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 thoſe 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 conſtitutes 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 satisfaction 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 amount-

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ing 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 purchafed in the early part of his life. He married the daughter of Edward Barker, Efq; by whom he had two daughters; one of whom married Sir Henry St John, and died in his lifetime; the other furvived, and now lives at Betchworth-caftle. He loft his eyefight a few years before his death, which happened in 1775. To defcribe him as a neighbour, landlord, father, and magiftrate, it would be neceffary to mention the moft amiable qualities in each. It is unneceffary to add that he was very fincerely regretted by all who had the pleafure of his acquaintance, and who ftood connected with him in any of thofe relations.

Tucker (Jofiah, D. D.) well known as a political and commercial writer, was born at Langhorn, in Caermarthenfhire, in the year 1712. His father was a farmer, and having a fmall eftate left him at or near Aberyftwith, in Cardiganfhire, he removed thither; and perceiving that his fon had a turn for learning, he fent him to Ruthin fchool, in Denbighfhire, where he made fo refpectable a progrefs in the claffics, that he obtained an exhibition at Jefus College, Oxford. It is generally underftood that feveral of his journeys to and from Oxford were performed on foot, with a ftick on his fhoulder, and bundle at the end of it. Thus it might be faid by him, as by Simonides, "*Omnia mea mecum porto.*"

At the age of 23 he entered into holy orders, and ferved a curacy for fome time in Gloucefterfhire. About 1737 he became curate of St Stephen's church in Briftol, and was appointed minor-canon in the cathedral of that city. Here he attracted the notice of Dr Jofeph Butler, then Bifhop of Briftol, and afterwards of Durham, who appointed Mr Tucker his domeftic chaplain. By the intereft of this prelate Mr Tucker obtained a probendal ftall in the cathedral of Briftol; and on the death of Mr Catcott, well known by his treatife on the Deluge, and a volume of excellent fermons, he became rector of St Stephen. The inhabitants of that parifh confift chiefly of merchants and tradefmen; a circumftance which greatly aided his natural inclination for commercial and political ftudies.

When the famous bill was brought into the Houfe of Commons for the naturalization of the Jews, Mr Tucker, confidering the meafure rather as a merchant or politician than as a Chriftian divine, wrote in defence of it with a degree of zeal which, to fay no more, was at leaft indecent in a man of his profeffion. As fuch it was viewed by his brethren of the clergy, and by his parifhioners; for, while the former attacked him in pamphlets, newfpapers, and magazines, the latter burnt his effigy dreffed in canonicals, together with the letters which he had written in defence of the naturalization.

In the year 1753 he publifhed an able pamphlet on the "Turkey Trade;" in which he demonftrates the evils that refult to trade in general from chartered companies. At this period Lord Clare (afterwards Earl Nugent) was returned to Parliament for Briftol; which honour he obtained chiefly through the ftrenuous exertions of Mr Tucker, whofe influence in his large and wealthy parifh was almoft decifive on fuch an occafion. In return for this favour the earl procured for him the deanery of Gloucefter, 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 Bifhop of London, who was then tutor to his prefent majefty, applied to Dr Tucker to draw up a differtation on this fubject for the perufal of his royal pupil. It was accordingly done, and gave great fatisfaction. This work, under the title of "The Elements of Commerce," was printed in quarto, but never publifhed.

Dr Warburton, who became Bifhop of Gloucefter in the year 1760, thinking very differently from Dr Tucker of the proper ftudies of a clergyman, as well as of the project for naturalizing the Jews, faid once to a perfon who was praifing the Elements of Commerce, that "his Dean's trade was religion, and religion his trade." This farcafm, though not perhaps groundlefs, was certainly too fevere; for fome of the Dean's publications evince him to have devoted part of his time at leaft to the ftudy of theology, and to have been a man of genuine benevolence.

In the year 1771, when a ftrong attempt was made to procure an abolition of fubfcription to the 39 articles, Dr Tucker came forward as an able and moderate advocate of the church of England. About this time he publifhed "Directions for travellers;" in which he lays down excellent rules, by which gentlemen who vifit foreign countries may not only improve their own minds, but turn their obfervations to the benefit of their native country.

The Dean was an attentive obferver of the American conteft. He examined the affair with a very different eye from that of a party-man, or an interefted merchant; and he difcovered, as he conceived, that both fides would be better off by an abfolute feparation. Mr Burke's language in the Houfe of Commons, in confequence of his publifhing this opinion, was harfh, if not illiberal. In his famous fpeech on the American taxation bill, April the 13th, 1774, he called the Dean of Gloucefter the advocate of the court faction, though it is well known that the court difapproved of the propofal as much as the oppofition. This attack roufed the Dean to refentment; and he publifhed a letter to Mr Burke; in which he not only vindicates the purity of his own principles, but retorts upon his adverfary in very forcible and farcaftic terms. He afterwards fupported Lord Nugent's intereft in Briftol againft that of Mr Burke, and was certainly very inftrumental in making the latter lofe his election.

When the terrors of an invafion were very prevalent in 1779, Dr Tucker circulated, in a variety of periodical publications, fome of the moft fenfible obfervations that were ever made on the fubject, in order to quiet the fears of the people. In 1781 he publifhed, what he had printed long before, "A Treatife on Civil Government," in which his principal defign is to counteract the doctrines of Locke and his followers. The book made a confiderable noife, and was very fharply attacked by feveral writers on the democratic fide of the queftion, particularly by Dr Towers and Dr Dunbar of Aberdeen. This laft gentleman acted a part which, if not difhonourable, was at leaft uncommon. The Dean had thrown off thirty copies of his work long before he publifhed it; and thefe he fent to different men of eminence, that he might avail himfelf of their animadverfions before he fhould fubmit it to the public at large. Principal Campbell of Aberdeen received one copy for this purpofe; and Dr Dunbar having

ing 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.

pomania. Tulipomania.

	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 Liefken 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.

* perit is ... small ... ght less ... a ... n.

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 for

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

TURKS *Islands*, feveral fmall iflands in the Weft-Indies, about 35 leagues north-eaft of the ifland of St Domingo, and about 60 to the fouth-eaft of Crooked Ifland. The Bermudians frequently come hither and make a great quantity of falt, and the fhips which fail from St Domingo commonly pafs within fight of them. N. lat. 21 18, W. long. 71 5.—*ib.*

TURNER, a townfhip of the Diftrict of Maine, Cumberland county, on the weft bank of Androfcoggin river, which divides it from Green in Lincoln county. It was incorporated in 1786, contains 349 inhabitants. and lies 172 miles north of Bofton, and 31 fouth-weft of Hallowell.—*ib.*

TURNSOL, a dye-ftuff manufactured in Holland, the preparation of which was long kept a profound fecret. In order to miflead foreigners, the Dutch pretended that turnfol was made from rags dyed with the juice of the fun-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 difcovered, and the procefs 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-mofs, after being dried and cleaned, is reduced to powder, and by means of a kind of oil-prefs the powder is forced through a brafs fieve, the holes of which are fmall. The fifted powder is then thrown into a trough, and mixed with an alkali called *vetas*, which is nothing elfe than the afhes of wine lees, in the proportion of half a pound of afhes to one pound of powder. This mixture is moiftened with a little human urine, for that of other animals contains lefs ammonia, by which a fermentation is produced; and the moiftnefs is ftill kept up by the addition of more urine. As foon as the mixture affumes a red colour, it is poured into another trough; is again moiftened with urine, and then ftirred round in order that the fermentation may be renewed. In the courfe of a few days it acquires a bluifh colour, and is then carefully mixed with a third part of very pure pulverifed potafh; 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 pafte has acquired a confiderably dark blue colour, it is mixed with chalk or pulverifed marble, and ftirred well round that the whole may be completely united. This laft fubftance 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 fquare 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 fale.

TURPENTINE, a well known fubftance extracted from the pine. Under the article Pinus (*Encycl.*), we have given an account of one procefs by which this extract is made; but the following, which is taken from the 31ft volume of the *Journal de Phyfique*, 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. Incifions are made with an hatchet, beginning at the foot of the tree on one fide, and rifing fucceffively: they are repeated once or twice a week, the fize about one finger's breadth acrofs, and three or four inches long.

During the four years in which it is continued, the incifions have rifen to about eight or nine feet. Then the incifions are begun on the other fide; and during this time the old ones fill up, and may be again opened after fome years, fo that a tree on a good foil, and well managed, may yield turpentine for a century. At the bottom of the tree, under the incifion, a hole is dug in the ground to receive the refin which flows from the tree. This refin is called *terebinthine brut*, is of a milky colour, and is that which flows during the three fummer months; it requires further purification.

The winter crop is called *barras galipot*, or white refin: it fticks to the bark of the tree, when the heat has not been ftrong enough to let it flow into the trough in the ground. It is fcraped off with iron knives.

Two methods are practifed for purifying thefe refins. 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 ftrained through a ftraw-bafket made for the purpofe, and ftretched over a barrel, which receives the ftrained turpentine. This purification gives it a golden colour, and may be performed at all times of the year.

The fecond manner, which is practifed only in the mountain of De Buch, near Bordeaux, confifts in having a large tub, feven or eight feet fquare, and pierced with fmall holes at the bottom, fet upon another tub to catch the liquor. This is expofed to the hotteft fun 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 lefs golden-coloured, and is much more efteemed than the other. This procefs can only be done in the fummer.

To make *oil* of turpentine, an alembic, with a worm like what is ufed by the diftillers, is employed here. It generally contains 250 lb. of turpentine, which is boiled gently, and kept at the boiling point till no more oil paffes, when the fire is damped. This generally gives 60 lb. of oil, and the operation lafts one day.

The boiling turpentine, when it will give no more oil, is tapped off from the ftill and flows into a tub, and from thence into a mould of fand, which it fills, and is fuffered to cool for at leaft two days without difturbing it. This refidue 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 refin, by adding hot water to it before it is tapped off the ftill, and ftill boiling and ftirring the water well with it, which is done with a befom of wet ftraw; and it is then fold for rofin, but is little efteemed, as it contains no effential oil.

TURTLE, *Ifland*, in the South Pacific Ocean, is nearly a league long, and not half fo broad. It is furrounded by a reef of coral rocks, that have no foundings without them. S. lat. 19 49, W. long. 177 57.—*Morse.*

Turtle *Creek*, in Pennfylvania, a fmall ftream which empties through the E. bank of Monongahela river, about 12 miles from the mouth of that river, at Pittfburg. At the head of this creek, General Braddock engaged a party of Indians, the 9th of July, 1755, on his way to Fort du Quefne, now Pittfburg, where he was repulfed, himfelf killed, his army put to flight, and the remains of the army brought off the field by the addrefs and courage of Colonel, afterwards General Wafhington.—*ib.*

Turtle *River*, in Georgia, empties into St Simon's Sound, and its bar has a fufficiency of water for the largeft veffel that fwims. At its mouth is the town of Brunfwick, 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 faid to be excellent. —*ib.*

TURY, a river on the coaft of Brazil, in S. America, 40 leagues E. S. E. of the river Cayta. The ifland of St John lies juft off the river's mouth, and makes a very good harbour on the infide of it. But the paffage both in and out, is difficult, and no pilots are to be had.—*ib.*

TUSCARORA *Creek*, a fmall ftream of Pennfylvania, which empties through the S. W. bank of Juniatta river, 12 miles fouth-eaftward of Lewiftown.—*ib.*

Tuscarora *Villages*, lie a mile from each other, 4 miles from Queenftown, in Upper Canada, containing together about 40 decayed houfes. Veftiges of ancient fortifications are vifible in this neighbourhood. The Indian houfes are about 12 feet fquare; many of them are wholly covered with bark, others have the walls of logs, in the fame manner as the firft fettlers among white people built their huts, having chimnies in which they keep comfortable fires. Many of them, however, retain the ancient cuftom of having the fire in the centre of the houfe. The lands in the vicinity are of a good quality.—*ib.*

TUSCARORAS, a tribe of Indians in the ftate of New-York. They migrated from North Carolina, about the year 1712, and were adopted by the Oneidas, with whom they have fince lived, on the fuppofition that they were originally the fame tribe, from an affinity which there is in their language. They now confift of about 400 fouls, their village is between Kahnanwolohale and New-Stockbridge, on Tufcarora or Oneida Creek. They receive an annuity of about 400 dollars from the United States.—*ib.*

TUSCULANUM, a villa belonging to Cicero, near Tufculum, where he wrote his *Quæftiones Tufculanæ*, fo 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 *Tufculanum* (infcription), a town of the Tranfpadana, fituated on the weft fide of the Lacus Benatus. Now faid to be called *Tofcolano*, in the territory of Brefcia, fubject to Venice. Here many monuments of antiquity are dug up.

TUSCULUM (anc. geog.) a town of Latium, to the north of Alba, fituated on an eminence, and therefore called *Supernum* (Horace, Strabo). In fight of Rome, at about the diftance of 100 ftadia, or 12 miles. Adorned with plantations and princely edifices: The fpot remarkable for the goodnefs of the foil, and its plenty of water. Built by Telegonus, who flew his father Ulyffes (Ovid, Horace); called the grandfon of Ulyffes in Silius Italicus. A municipium (Cicero); the birth-place of the elder Cato (Nepos, Cicero). Now *Frefcati*, in the Campania of Rome.

TUSKARAWI, the ancient name of a head water of Mufkingum river. It is alfo called Tufcarawas. —*Morse.*

TUTAPAN, a large town on the W. coaft 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 fpeaking, zinc extracted from a rich ore, or calamine. The ore is powdered and mixed with charcoal-duft, and placed in earthen jars over a flow fire, by means of which the metal rifes in the form of vapour, in a common diftilling apparatus, and afterwards is condenfed in water. The calamine from which tutenag is thus extracted, contains very little iron, and no lead or arfenic, fo 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 Chinefe takes fo fine a polifh. See *White Copper*, in this *Supplement.*

TWELVE ISLES, or *Twelve Apoftles*, ifles on the S. fide of Lake Superior, and on the S. fide of the mouth of Weft Bay.—*Morse.*

TWENTY MILE *Creek*, an eaftern branch of Tombigbee river, in Georgia, which runs firft a S. by E. courfe, 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 fettlement in Lincoln county, Diftrict of Maine.—*ib.*

TWIGHTWEES, a tribe of Indians, in the N. W. Territory, inhabiting near Miami river and Fort. Warriors 200.—*ib.*

TYBEE *Ifland*, on the coaft of Georgia, lies at the mouth of Savannah river, to the fouthward of the bar. It is very pleafant, with a beautiful creek to the W. of it, where a fhip of any burden may lie fafe at anchor. A light-houfe ftands on the ifland, 80 feet high, and in lat. 32 N. and long. 81 10 W. The light-houfe is 7 miles E. S. E. ½ E. from Savannah, and 6 S. W. ¼ W. from Port Royal.—*ib.*

TYBOINE, a townfhip of Pennfylvania, in Cumberland county.—*ib.*

TYERS (Thomas), an author both in poetry and profe, the friend of Johnfon, and well known to moft of the eminent characters of the prefent time, was a ftudent of the Temple in 1753. His father intended him for the law, but the young man it feems penned a fonnet when he fhould engrofs. He was an accomplifhed, but not a profound man; and had tafte and elegance of mind, flightly tinged with gleams of genius. He wrote fome paftorals and political tracts, which probably will not furvive the partiality of his particular friends.

TYGART's *Valley*, in Pennfylvania, lies on Monongahela river.—*Morse.*

TYGER, a fmall river of S. Carolina, rifes in the Alleghany Mountains, and, taking a S. E. courfe nearly parallel to Enoree river, empties into Broad river, five miles above the Enoree.—*ib.*

TYNGSBOROUGH, a townfhip of Maffachufetts, Middlefex county, on Merrimack river, 31 miles north of Bofton.—*ib.*

TYPOGRAPHY, as the word imports, is the art of printing by types; but it is likewife ufed to fignify 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 στερεος 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.

* De- Philoso-.

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.

* See Plate XLVI.

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 being concentric, the developement of the fmall toothed wheel, of about two inches radius, will exhibit, in a fmall fpace (for example that of a foot), an accurate regifter of the relative pofitions of the punches with regard to the prefling-fcrew. To obtain this effect, nothing more is neceffary than to place a fixed index oppofite to the moveable rule, which laft is divided in the following manner:

The punch on which the firft letter of the alphabet is engraved, muft be brought under the centre of the prefling-fcrew; and a line of divifion then drawn upon the moveable rule, to which the letter itfelf muft be added to diftinguifh it. The index, already mentioned, being placed oppofite, and upon this firft divifion, will ferve to place immediately beneath the prefling-fcrew the punch or rather the character, correfponding with the divifion upon the rule, without its being afterwards neceffary to infpect the place either of the punch or the fcrew, with regard to each other. Confequently, as foon as the divifions which correfpond with all the punches inferted in the wheel are engraved upon the ftraight rule, the fixed index will immediately determine the pofition into which that wheel muft be brought, in order to place the punches under the prefling-fcrew in the order which the work may require.

This regifter, for this name diftinguifhes the rule and its index, has no other function in the machine than to guide the hand of the operator, and to fhew when the punch is very near its proper pofition beneath the prefling-fcrew. When this is the cafe, the required pofition is accurately obtained by means of a detent or catch.

The detent which he ufes for this operation is a lever with two tails, one of which is urged toward the circumference of the wheel by a fpring. To this extremity of the lever is fixed a piece of hardened fteel, of the figure of a wedge, which, by means of a fpring, is preffed towards the axis of the great wheel, but may be relieved, or drawn back, by preffure on the oppofite tail of the lever, fo as to permit the great wheel to revolve at liberty.

In the next place, it muft be explained how this detent takes hold of the wheel, fo as to retain it precifely in the fituation neceffary to caufe any one of the punches, at pleafure, to give its impreffion to the plate. For this purpofe there are a number of notches cut in the circumference of the wheel, for the purpofe of receiving the detent. Thefe notches may be about half an inch deep, wider towards the circumference than elfewhere, and it will be of advantage that this outer width fhould be as great as the circumference of the wheel can conveniently allow. By this contrivance, the wedge will not fail to prefent itfelf oppofite to one of the notches into which it will fall, and draw the wheel exactly to its due fituation, even though the index of the regifter fhould not be brought precifely to the line of divifion appropriated to any particular letter. For if this laft degree of precifion were required in working the machine, it would be very prejudicial to the requifite fpeed which, above all things, is required in its ufe. When the wedge is therefore left at liberty, it not only enters immediately into its place, and moves the wheel till its two fides apply fairly to the interior furfaces of the notch, but retains the wheel in this ftate with the neceffary degree of ftability.

The method of giving the proper figure to thefe notches is very eafy. For this purpofe it is neceffary, in the firft place, to imprefs all the characters contained in the wheel on a plate of copper or pewter. The fupport on which the plate is fixed muft be moved in a right line, after each ftroke of the punch, through fuch a fpace that the characters may be arranged one after the other without touching. Now, as the perfect linear arrangement (fuppofing every other part to be true) muft depend on the notches, it might feem fufficient to cut thefe according to the method ufed for the wheels of clock-work: but as it is very difficult to avoid fome obliquity on the face of the punch, and perhaps in the hole through which it paffes, it is in almoft every cafe neceffary to retouch the notch itfelf. The requifite degree of precifion may be eafily obtained, when, upon examining with attention the print of the characters engraved upon the plate, the inequalities fhall have been afcertained by a very fine line paffing exactly under the bafe of two fimilar letters, affumed as objects of comparifon: for the irregularity of linear pofition may, by this means, be determined with great exactnefs, and remedied to the moft extreme nicety. In this operation, the workman muft file away part of that furface of the notch which is oppofite to the direction of the motion the character requires. Great care muft be taken to file only a fmall portion at a time, in order that the inftant may be feized at which the wedge, by entering into the notch, brings the character to its due fituation.

Thefe details, refpecting the right-lined arrangement on the characters, muft not divert our attention from the very great celerity with which any letter is brought to its place under the prefs by means of the regifter and detent. This celerity is an object of fo much importance in the engraving of a great work, that every means ought to be purfued which may tend to increafe it. For this reafon it is that inftead of following the alphabetic order in the arrangement of punches on the furface of the wheel, we ought to prefer that in which the fum of the different motions to be given to the wheel, for engraving an entire work, fhall be the leaft poffible. This tedious enquiry may well be difpenfed with, by obferving the order in which printers difpofe their cafes of characters, that the letters of the moft frequent recurrence may be moft immediately under the hand of the workman.

If all the characters afforded an equal refiftance to impreffion in a plate of metal, a conftant force would never fail to drive the punches to the fame depth. But the faces of the letters are very unequal, and confequently it will be neceffary to ufe a variable force. Moft workmen ufe the hammer, and not a fcrew, as in this machine for ftamping. If the hammer had been ufed in this machine, it is evident, that if we fuppofed it to have fallen from the fame height upon every one of the punches, the force of the ftroke could be rendered variable according to the nature of the characters, by placing a capital, or head, upon each, of an height properly adjufted to receive the hammer after paffing through a greater or lefs fpace. But the heads of our punches are variable at pleafure, becaufe they are fcrewed on; and thus it is that, by experimentally adjufting the heads of all the punches, a fet of impreffions are obtained of equal depths from every one of them. When, for

PLATE.XLVI.

ROCHON'S MACHINE FOR ENGRAVING METALLIC PLATES

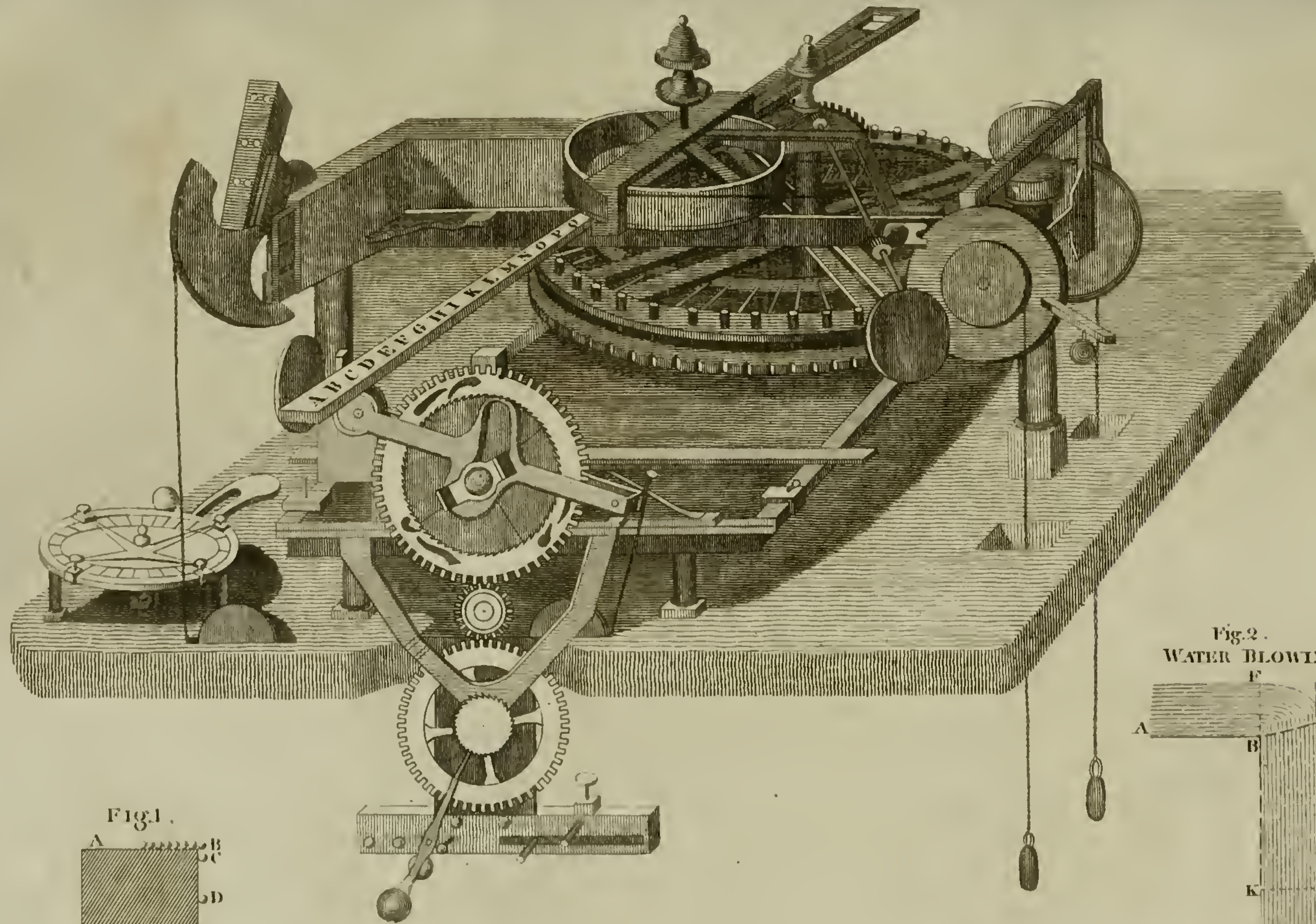


Fig.1.

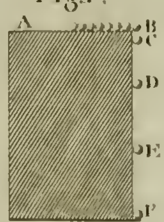
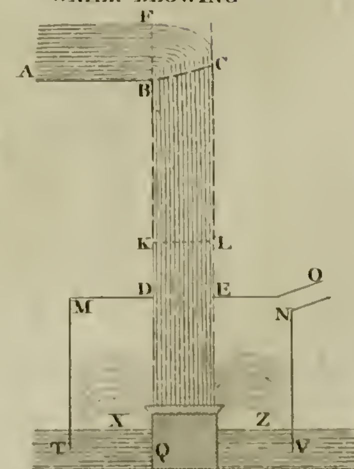


Fig.2.
WATER BLOWING



Lawson sculp.

for example, the letter *i* is placed under the hammer, the upper part of its head is at a fmall diftance from the head of the hammer, in order that its fall, which begins always at the fame place, may ftrike this letter weakly; but when the letter M is brought under the hammer, the upper part of its head being much lefs elevated than that of the letter *i*, will receive a much ftronger blow. The impreffions of the letters M and *i* will therefore always be equally deep, if the heads of the punches be once properly fixed by experiment.

Inftead of the ftroke of a hammer, however, our author makes ufe of the preffure of a fcrew, of which the threads are fo inclined that it runs through its female focket, and would fall out merely by its own weight. This conftruction affords the double advantage of preferving the impreffions from the effects of the circular motion, and of affording a fall in the fcrew of nearly nine lines for each revolution. The head of this fcrew is folidly fixed in the centre of a brafs wheel, of which the pofition is horizontal. The diameter of this wheel muft be fufficiently large, that its motion may not be perceptibly affected by the irregularities of friction in the fcrew. This confiderable diameter is alfo requifite, becaufe the preffure of the fcrew depends, not only upon the force which is applied, but the diftance of the place of application from the centre of movement.

It is effential that this wheel fhould have very little fhake; for which reafon it is advifable that the axis of the fcrew fhould be prolonged above the wheel itfelf, that it may flide in a focket firmly fixed to the frame of the machine. In this fituation, the wheel, which is fixed on the prolongation of the fcrew, will have its plane conftantly preferved in a fituation parallel to itfelf, without any libration, notwithftanding the rife and fall of near nine lines, or three quarters of an inch, which it undergoes for each revolution on its axis.

It has been ftated, as a requifite condition, that the fcrew fhould conftantly fall from the fame fixed point, or elevation, upon the heads of every one of the punches. To accomplifh this effential purpofe, a lever is firmly fixed to the fupport of the fcrew; which lever refembles the beam of a balance, having one of its extremities armed with a claw, and the other ferving to give it motion through a fmall vertical fpace. The claw falls into a notch in the upper furface of the wheel attached to the fcrew, as foon as that wheel has rifen to the defired elevation; and that lever itfelf is fo 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 defcend until it is delivered by preffure upon the oppofite tail of the lever. In this machine, the wheel which has the preffing fcrew for its axis does not perform an entire revolution. It was with a view that there might never be any fall capable of fhaking and difturbing the machine that the author determined to ufe only two-thirds of a revolution to ftrike thofe punches, which afford the ftrongeft refiftance. The fcrew confequently falls only through fix lines upon thofe heads which are leaft elevated, and about two lines upon thofe which ftand higheft. Whence the difference between the extreme heights does not exceed four lines.

It is obvious that fo fmall a difference is not fufficient to ftrike all the characters from M to the letter *i*, when the wheel which governs the fcrew is put in motion by a conftant weight, of which the impulfe, like that of a hammer, is increafed only by the acceleration of its fall. It is evident that this requifite variation of force might be had by changing the weight; but it is equally clear, that the numberlefs and inceffant changes which the engraving of an entire work would demand, would be incompatible with that degree of fpeed which forms one of the firft requifites. He was therefore obliged to render the force of the weight, which turns the fcrew, variable, by caufing it to act upon levers of greater or lefs lengths, according to the different quantities of impulfe required by the feveral punches. For this purpofe he adopted the following conftruction: He connected by a fteel chain to the wheel, which moves the fcrew, another wheel, having its axis horizontal, fo that the two wheels refpectively command each other. They are of equal diameter, and the chain is no longer than to make an entire turn round each wheel. This fecond wheel, or leading pully, is intended to afford the requifite variations of force, which it does by means of a fnail fixed upon its axis. The fnail is acted upon by a cord paffing over its fpiral circumference, or groove, and bearing a weight which is only to be changed when a new fet of punches for characters of a different fize are put into the great wheel. The fpiral is fo formed, that when the weight defcends only through a fmall fpace, the part of the cord, which is unwound, acts at a very fhort diftance from the centre of the pulley; but when the fall is greater, the part of the fnail upon which it acts is fo far enlarged as to afford a much longer lever, and, confequently, to give a proportionally greater effect to the ftroke. This conftruction, therefore, by giving the advantage of a longer lever to a greater fall of the fcrew, affords all the power which the nature of the work, and the different fpaces of the letters demand.

The fupport on which the plate is fixed muft, as has before been remarked, move fo as to form ftrait lines. This motion, which ferves to fpace the different characters with precifion, is obtained by means of a fcrew, the axis of which remains fixed, and carries a female fcrew or nut. The nut itfelf is attached to the fupport of the metallic plate, which receives the letters, and carries it in the right lined direction without any deviation; becaufe it is confined in a groove formed between two pieces of metal. The fcrew is moved by a lever, which can turn it in one direction only, becaufe it acts by a click upon a ratchet-wheel, which is fixed to the head of the fcrew. The action of this lever always begins from a fixed ftop; but the fpace through which it moves is variable, according to the refpective breadths of the letters. This new confideration induced M. Rochon to fix upon the rule or plate of the regifter, a number of pins, correfponding with the different divifions which anfwer to each punch: thefe pins determine the diftance to which the lever can move. It therefore becomes a condition, that its pofition in the machine fhould be oppofite to the fixed index which determines the character at any time beneath the preffing-fcrew. The lever and its pin are therefore the fole agents employed to fpace the characters. If the plate were not moved by the lever, the impreffions would fall upon each other; and thus, for example, the letter *i* would be totally obliterated by the impreffion of the letter *l*.

Whenever, therefore, it is required to difpofe the letters *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 Συζομινα, &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

Tytler.

Nor was it in opinion or argument only that this warmth and ardour of mind were confpicuous. They prompted him equally in action and conduct. His affection to his family, his attachment to his friends and companions, his compaffion for the unfortunate, were alike warm and active. He was in fentiment alfo what Johnfon (who felt it ftrongly in himfelf, and mentions it as the encomium of one of his friends) calls a *good hater*; but his hatred or refentment went no further than opinion or words, his better affections only rofe into action. In his opinions, or in his expreffion of them, there was fometimes a vehemence, an appearance of acrimony, which his friends might regret, and which ftrangers might cenfure; but he had no afperity in his mind to influence his actual conduct in life. He indulged oppofition, not enmity; and the world was juft to him in return. He had opponents; but two of his biographers, who knew him well, as well as the people with whom he moft affociated, declare their belief that he had not a fingle enemy. His contefts were on opinions, not on things; his difputes were hiftorical and literary. In converfation, he carried on thefe with uncommon intereft and vivacity; and the fame kind of impulfe which prompted his converfation (as is juftly obferved by an author, who publifhed fome 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 Rouffeau holds to be the only inducement to writing; he wrote to open his mind upon paper; to fpeak to the public thofe opinions which he had often fpoken in private; opinions on the truth of which he had firmly made up his own conviction, and was fometimes furprifed when he could not convince others: it was fair to try, if, by a fuller expofition of his arguments, he could convince the world.

With this view, he publifhed, in 1759, his "Inquiry, hiftorical and critical, into the Evidence againft *Mary Queen of Scots*, and an Examination of the Hiftories of Dr Robertfon and Mr Hume with refpect to that Evidence;" in which he warmly efpoufed the caufe of that unfortunate Princefs, attacked with feverity the conduct of her enemies, and expofed the fallacy, in many parts the fabrication, of thofe proofs on which the charges againft her had been founded.

This was a caufe worthy of an advocate who loved truth better than popular applaufe; and Mr Tytler evinced himfelf to be fuch an advocate. The problem of Mary's guilt or innocence, if confidered merely as a detached hiftorical fact, would appear an object which, at this diftance of time, feems hardly to merit that laborious and earneft inveftigation to which it has given rife; though, even in this point of view, the mind is naturally ftimulated to fearch out the truth of a dark myfterious event, difgraceful to human nature; and our feelings of juftice and moral rectitude are interefted to fix the guilt upon its true authors. But when we confider that this queftion involves a difcuffion of the politics of both England and Scotland during one of the moft interefting periods of their hiftory, and touches the characters, not only of the two fovereigns, but of their minifters and ftatefmen, it muft then be regarded in the light of a moft important hiftorical inquiry, without which our knowledge of the hiftory of our own country muft be obfcure, confufed, and unfatisfactory. In addition to thefe motives of inquiry, this queftion has exercifed fome of the ableft heads both of earlier and of latter times; and it is no mean pleafure to engage in a conteft of genius and of talents, and to try our ftrength in the decifion of a controverfy which has been maintained on both fides with confummate ability.

As we have elfewhere (fee Mary, *Encycl.*) given an abftract of the arguments on both fides of this difputed queftion, it would be altogether improper to repeat them here; but juftice to the fubject of this memoir requires us to fay, that by his manner of difcuffing it he acquired high reputation in the republic of letters. Before the appearance of the Inquiry, fays an ingenious writer, it was the fafhion for literary difputants to attack each other like mifcreants and banditti. The *perfon* was never feparated from the *caufe*; and whatever attached the *one*, was confidered as equally affecting the *other*; fo that fcurrility and abufe bloated the pages even of a Bentley and a Ruddiman. The Hiftorical Inquiry was free from every thing of that fort: and though the higheft name produced not a mitigation of the force of any argument, the meaneft never fuffered the fmalleft abufe. He confidered it as being greatly beneath the dignity of a man contending for truth, to overftretch even an argument in the fmalleft degree, far more to pervert a fact to anfwer his purpofe on any occafion. In the courfe of his argument, he had too often occafion to fhew that this had been done by others; but he difdained to imitate them. His reafoning was forcible and elegant; impartially fevere, but always polite, and becoming the gentleman and the fcholar.

When this book appeared, it was univerfally read in Britain, and very well tranflated into French, under the title of "Recherches Hiftoriques et Critiques fur les Principales Preuves del'Accufation intentée contre Marie Reine d'Ecoffe." The intereft it excited among literary men may be judged of from the character of thofe by whom it was reviewed on its publication, in the periodical works of the time. Dr Douglas, now bifhop of Salifbury, Dr Samuel Johnfon, Dr John Campbell, and Dr Smollet—all wrote reviews of Mr Tytler's book, containing very particular accounts of its merits, and elaborate analyfes of the chain of its arguments. As an argument on evidence, no fuffrage could perhaps be more decifive of its merit than that of one of the greateft lawyers, and indeed one of the ableft men that ever fat on the woolfack of England, the late Lord Chancellor Hardwicke, who declared Mr Tytler's Inquiry to be the beft concatenation of circumftantiate proofs brought to bear upon one point that he had ever perufed. What effect that body of evidence, or the arguments deduced from it, ought to have upon the minds of thofe to whom the fubject may become matter of inveftigation, we do not prefume to determine. The opinion of the late Dr Henry, author of the Hiftory of Great Britain on a New Plan, may perhaps be thought neither partial nor confident. He fays, in a letter to Mr Tytler, publifhed in the firft volume of Tranfactions of the Antiquarian Society of Scotland, That he would be a bold man who fhould now publifh an hiftory of Queen Mary in the fame ftrain with the two hiftorians (Mr Hume and Dr Robertfon), whofe opinions on the fubject the Inquiry had examined and controverted.

The moft 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-

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 Queir*, 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, ‖ Valgus.

VACCAS, *Cayo*, one of the Tortugas, or Florida Keys, to the eaftward of Bahia Honda; the diftance between them is 4 leagues, and the coaft in its direction turns to the northward. On the S. fide of Cayo Vaccas, about 8 miles from the W. end, there are wells of frefh water. A thick range of ifles go by this name. Bahia Honda is in lat. 24 35 N.—*Morse.*

VACCA, called alfo the *Cow's*, or *Neat's Tongue*, a low point on the W. coaft of Chili, in S. America, which bounds the bay of Tonguey to the weftward. —*ib.*

VACHE, or *Cows Ifland*, lies on the fouth coaft of the fouthern peninfula of the ifland of St Domingo, and is about 4½ leagues long, and in the broadeft part a league and a half from N. to S. The fouth 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 foil, with 2 or 3 tolerable ports, and lies very conveniently for trade with the Spanifh colonies on the continent, and with Cayenne. The feamen call this Afh Ifland, a corruption from Vafh, as it is pronounced.—*ib.*

VACH ET LE TORREAU, or *Cow and Bull Rocks*, on the fouth coaft of Newfoundland ifland, 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 eaft. 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 moft complete vacuum which we can make by means of the torricellian tube. See Barometer, and Pneumatics, *Encycl.*

VADE-mecum, the title given to fuch books as men of particular profeffions, having frequent occafion to confult, may eafily carry about with them. Thus a fmall volume, publifhed in the beginning of the 18th century, giving an account of the ancient and prefent church of England, and of the duties, rights, privileges, and hardfhips of the clergy, is known by the title of *the Clergyman's Vade-mecum.*

VAE'S *Ifland, Anthony*, a fmall ifland on the E. coaft of Brazil, in S. America. It lies to the fouthward of the fandy Receif, and oppofite to it, which is joined to the continent by a bridge.—*Morse.*

VAKEEL, a minifter, agent, or ambaffador.

VALADOLID or *Valladolid*, called by the Indians *Comayagua*, is the chief city of the province of Honduras, in New Spain. It is the feat of the Governor, and is a bifhop's fee fuffragant of Mexico, fince the year 1558. It is feated 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 fo from fetting them on their feet too early. The tibia of fome is crooked; the knees of others are diftorted; from a fault in the ankle, the feet of fome are turned inwards, thefe are called *vari;* and in others they turn outwards, thefe are called *valgi.* The beft method of preventing thefe diforders in weakly children, is to exercife them duly, but not violently; by dancing or toffing them about in one's arms, and not fetting them much on their feet, at leaft not without properly fupporting them: if the diforder attends at the birth, or increafes after it is begun, apply emollients, then apply boots of ftrong leather, wood, &c. as required to difpofe the crooked legs gradually to a proper form: or other inftruments may be ufed inftead of boots, which, when not too coftly, are ufually to be preferred. Slighter inftances of the diforders yield to careful nurfing without inftruments.

Valley, ‖ Vandá.

VALLEY *Forge*, a place on Schuylkill river, 15 miles from Philadelphia. Here General Wafhington remained with his army, in huts, during the winter of 1777, after the Britifh had taken poffeffion 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 ifland of Juan Fernandes. It carries on a confiderable trade with the port of Callao.—*ib.*

VANCOUVER'S *Fort*, in Kentucky, ftands at the junction of the two branches of Big Sandy river, 20 miles N. of Harmar's ftation.—*ib.*

VANDA', the Indian name of a plant of the genus Epidendrum; which fee, *Encycl.* The *vandá* is thus defcribed by Sir William Jones.

" Cal. *Spathes* minute, ftraggling. Cor. *Petals* five, diverging, oval-oblong, obtufe, wavy; the two loweft larger; the three higheft equal, bent towards the nectary. *Nectary* central, rigid: *Mouth* gaping, oblique: *Upper lip* fhorter, three-parted, with a polifhed honey-cup; *under lip* concave in the middle, keeled above, with two fmaller cavities below, two proceffes at the *bafe*, incurved, hollow, oval pointed, converging, honey-bearing. Stam. *Filaments* very fhort. *Anthers* round, flattifh, margined, covered with a lid, eafily deciduous from the *upper lip* of the nectary. Pist. *Germ.* beneath long, ribbed, contorted with curves of oppofite flexure. *Style* very fhort, adhering to the *upper lip.* *Stigma* fimple. Per. *Capfule* oblong-conic, wreathed, fix-keeled, each with two fmaller keels, three-celled, crowned with the dry corol. Seeds innumerable, like fine duft affixed to the *receptacle* with extremely fine hairs, which become thick wool. *Scapes* incurved, folitary, from the cavity of the leaf, at moft feven-flowered; pedicles alternate. *Petals* milk-white externally, tranfparent; brown within, yellow-fpotted. *Upper lip* of the nectary fnow-white; *under lip* rich purple, or light crimfon, ftriated at the bafe, with a bright yellow gland, as it feems, on each procefs. The flowers gratefully fragrant, and exquifitely beautiful, looking as if compofed of fhells, or made of enamel; crifp elaftic, vifcid internally. *Leaves* fheath-

ing,

ing, oppofite, equally curved, rather flefhy, fword-form, retufe in two ways at the fummit, with one acute point. *Roots* fibrous, fmooth, flexible; fhooting even from the top of the leaves."

This lovely plant attaches itfelf chiefly to the higheft *Amras* and *Bilvas* (the *Mangifera* and *Crataeva* of Lin.); but it is an air-plant, and lives (fays the Prefident) in a pot *without earth or water:* its leaves are excavated upwards, to catch and retain dew.

VANDALIA, a duchy of Farther Pomerania, fubject to the king of Pruffia. Stolpen is the capital.

VANDALIA, a country in Germany, in the circle of Lower Saxony and duchy of Mecklenburg. It lies between the bifhopric and duchy of Schwerin, the lordfhips of Stocrock and Stargard, Pomerania, and the marquifate of Brandenburg; and is 75 miles in length and 7 in breadth. It contains feveral fmall lakes, and the principal town is Guftrow.

VANDERMONDE, member of the National Inftitute of Sciences and Arts, was born at Paris in the year 1735. He devoted his youth to felf-inftruction; and even at the age of thirty was far enough from fufpecting that he was deftined to inftruct others in his turn. Chance brought him near to the celebrated Fontaine. That fexagenary geometrician eafily divined the progrefs which Vandermonde would one day make in the mathematics; in him he anticipated, as it were, a fucceffor to himfelf; he patronifed and careffed him, let him into the fecret of his refearches, calculations, inventions, of that lively enjoyment which profound fpeculation gives to an elevated attentive mind; and which, blended with the fweets of tranquillity, the charms of retreat, and the confcioufnefs of fuccefs, becomes often a fort of paffion, as felicitous as durable. All that time Fontaine, whofe attention was again directed to the refearches which he had added to thofe of Jean Bernoulli, relative to the then famous queftion *of the toutocrenes*, had the glory to be vanquifhed only by D'Alembert and La Grange. Vandermonde, a witnefs to this combat, neceffarily illuftrious, animated by the honour which he faw annexed to that glorious defeat, enchanted with the fight of Fontaine, as happy, in fpite of his age, from his love of geometry, as a youth of twenty could be with a fentiment lefs tranquil, thought he fhould infure his happinefs for ever, by yielding to a paffion which the ice of age could not extinguifh; in a word, he devoted himfelf to geometry.

His labours, however, were for fome time fecret; and perhaps the public would never have enjoyed the benefit of any of his works, if another geometrician (whofe name, fays Lacepede, cannot be pronounced, in this place, without a mixture of intereft and regret) had not infpired him with a confcioufnefs of his own ftrength, and courage to difplay it. Fontaine had already devoted him to geometry; Dufejour exhorted him to penetrate even into its fanctuary. In brief, he prefented himfelf to the Academy of Sciences, into which he was admitted in 1771; and in that very year juftified the fuffrages of his affociates, by a paper which he publifhed relative to the refolution of equations.

From the 16th century the method of refolving equations of the four firft degrees has been known, and fince that time the general theory of equations has received great improvements. In fpite, however, of the recent labours of many great geometricians, the folutions of equations of the fifth degree had in vain been attempted. Vandermonde wifhed to confolidate his labours with thofe of other illuftrious analyfts; and he propofed a new theory of equations, in which he feems to have made it particularly his bufinefs to fimplify the methods of calculation, and to contract the length of the *formulae*, which he confidered as one of the greateft difficulties of the fubject.

This work was quickly followed by another on the problems called by geometricians *problems of fituation*. It feems to have been the deftiny of Vandermonde, as well as of Fontaine, who firft initiated him into the myfteries of mathematical fcience, to labour frequently upon fubjects already handled by the greateft mafter. In his firft memoir he had ftarted, fo to fpeak, in competition with La Grange and Euler; in his fecond, with Euler and Leibnitz. This laft was of opinion that the analyfis made ufe of in his time, by the geometricians, was not applicable to all queftions in the phyfical fciences; and that a new geometry fhould be invented, to calculate the relations of pofitions of different bodies, in fpace: this he called *geometry of fituation**. Excepting, however, one application, made by Leibnitz himfelf, to the game of *folitaire*, and which, under the appearance of an object of curiofity, fcarcely worthy the fublimity and ufefulnefs of geometry, is an example for folving the moft elevated and important queftions, Euler was almoft the only one who had practifed this geometry of fituation. He had reforted to it for the folution of a problem called the *cavalier*, which alfo appeared very familiar at firft fight, and was alfo pregnant with ufeful and important applications. This problem, with the vulgar, confifted merely in running through all the cafes of the chefs-board with the *knight* of the game of chefs; to the profound geometrician, however, it was a precedent for tracing the route which every body muft follow, whofe courfe is fubmitted to a known law, by conforming to certain required conditions, through all the points difpofed over a fpace in a prefcribed order. Vandermonde was chiefly anxious to find in this fpecies of analyfis a fimple notation, likely to facilitate the making of calculations; and he gave an example of this, in a fhort and eafy folution of the fame problem of the cavalier, which Euler had rendered famous.

* See Position, Suppl.

His tafte for the high conceptions of the fpeculative fciences, as blended with that which the *amor patriae* naturally infpires for objects immediately ufeful to fociety, had led him to turn his thoughts towards perfecting the arts converfant in weaving, by indicating a manner of noting the points through which are to pafs the threads intended to form the lines which terminate the furface of different regular bodies: accordingly a great part of the above memoir is taken up with this fubject.

In the year following (1772) he printed a third memoir; in which he traced out a new path for geometers, difcovering, by learned analytical refearches, *irrational* quantities of a new fpecies, fhewing the fequels of which thefe *irrationals* are the terms or the fum, and pointing out a direct and general method of making in them all the poffible reductions.

In the fame year appeared his work on the Elimination of unknown Quantities in Algebra. This elimination is the art of bringing back thofe equations which include many unknown quantities, to equations which only der- nde, ‖ enius. only contain one. The perfection of refearches in this art would confift in obtaining a general and particular *formula* of elimination in a form the moft concife and convenient, in which the number of equations and their degrees fhould be defigned by indeterminate letters. Vandermonde, while he confidered the geometers as very diftant from this point, had fome glimpfe of a poffibility of reaching it, and propofed fome new methods of approaching nearer it.

In 1778, he prefented in one of the public fittings of the Academy, a new fyftem of harmony, which he detailed more fully in another public fitting of 1780. In this fyftem, Vandermonde reduces the modes of proceeding adopted until his time, to two principal rules, which thus become eftablifhed on effects admitted by all muficians. Thefe two general rules, one on the fucceffion of according founds, the other on the arrangement of the parts, depend themfelves on a law more elevated, which, according to Vandermonde, ought to rule the whole fcience of harmony.

By the publication of this work, he fatisfactorily attained the end he had propofed to himfelf, and obtained the fuffrages of three great men, reprefentatives, fo to fpeak, of the three great fchools of Germany, France, and Italy; Gluck, Philidor, and Piccini.

With thefe labours, intermingled with frequent refearches 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 refounded over the whole furface of France, and fuddenly all the thoughts, as well as all the affections, of Vandermonde, were engaged on the fide of what he called liberty.

He became fo furious a democrate, fo outrageous an enemy to every thing eftablifhed, that he concurred in the abolition of the Royal Academy, of which he had been fo ambitious of becoming a member, and affociated himfelf clofely with Robefpierre, Marat, and the reft of that atrocious gang of villains, who covered France with ruins, with fcaffolds, and with blood. This part of Vandermonde's hiftory is fuppreffed by his eulogift Lacepede, becaufe, forfooth, difcuffions on *political opinions* ought not, in his opinion, to be admitted into the fanctuary of the fciences.

In that fanctuary he did not long remain. Soon after his atrocities, he was attacked by a diforder in his lungs, which almoft taking away his breath, manifefted itfelf by alarming fymptoms, and conducted him by rapid fteps to the tomb. He died in the end of the year 1795; a ftriking inftance of the wayward violence of the human mind, which even the love of fcience could not keep at a diftance from tumult and uproar.

VAN DYKES, *Joft* and *Little*, two of the fmaller Virgin Iflands, fituated 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 phyfician of the 17th century, who was author of the beft mathematical treatife on geography intitled *Geographia Univerfalis, in qua affectiones generalis Telluris explicantur*. This excellent work has been tranflated into all languages, and was honoured by an edition, with improvements, by Sir Ifaac Newton, for the ufe of his academical ftudents at Cambridge.

Variable, ‖ Variolæ Vaccinæ.

VARIABLE, in geometry and analytics, is a term applied by mathematicians to fuch quantities as are confidered in a variable or changeable ftate, either increafing or decreafing. Thus the abfciffes and ordinates of an ellipfis, or other curve line, are variable quantities; becaufe thefe vary or change their magnitude together, the one at the fame time with the other. But fome quantities may be variable by themfelves alone, or while thofe connected with them are conftant: as the abfciffes of a parallelogram, whofe ordinates may be confidered as all equal, and therefore conftant; alfo the diameter of a circle, and the parameter of a conic fection, are *conftant*, while their abfciffes are *variable*. See Fluxions, *Encycl*.

VARIATION of Curvature, in geometry, is ufed for that inequality or change which takes place in the curvature of all curves except the circle, by which their curvature is more or lefs in different parts of them; and this variation conftitutes the quality of the curvature of any line.

1 Variolæ Vaccinæ long known in Gloucefterfhire.

VARIOLÆ Vaccinæ, or *Cow pox*, is the name commonly, though, as fome people think, improperly, given to a very fingular difeafe, which, for two or three years paft, has occupied a great fhare of the attention of medical men. It has been many years prevalent in fome of the great dairy counties in England, particularly Gloucefterfhire; and it has been long underftood by the farmers and others in thefe counties, that it for ever exempts all perfons who have been infected with it from the contagion of fmall-pox.

It is very furprifing that, though they knew this fact, and although no perfon had ever been known to die of the cow-pox, they never thought of having recourfe to a voluntary infection of this kind, in order to free themfelves and their families from the poffibility of being infected with the variolous poifon, which fo often proves mortal. In one cafe, indeed, communicated to Dr Pearfon by Mr Downe of Bridport, the experiment was long ago tried by a farmer upon his own perfon, and with complete fuccefs: But this only makes it the more wonderful that his example fhould not have been followed.

2 And in the duchy of Holftein.

In the town of Kiel, however, in the duchy of Holftein, where the difeafe is faid to be well known, as frequently affecting cows, we are told that children are fometimes inoculated with cow-pox *(Die Finnen)*, with a view to preferve their beauty; but that the people in the country do not like this inoculation, becaufe they pretend that it leaves behind it feveral diforders.

3 Vaccine inoculation introduced by Dr Jenner.

With thefe exceptions Dr Jenner was the firft perfon who introduced the vaccine inoculation; and to him the public are alfo indebted for the firft careful and accurate inveftigation of this interefting fubject. The following is his account of the origin and hiftory of the difeafe, and of its characteriftic fymptoms.

4 Origin of the difeafe, according to him.

"There is a difeafe to which the horfe, from his ftate of domeftication, is frequently fubject. The farriers have termed it *the greafe*. It is an inflammation and fwelling in the heel, from which iffues matter poffeffing properties of a very peculiar kind, which feems capable of generating a difeafe in the human body (after it has undergone the modification which I fhall prefently fpeak of), which bears fo ftrong a refemblance to the fmall-pox, that I think it highly probable that it may be the fource of that difeafe.

Variolæ Vaccinæ.

“ 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

5 Its appearance on the cow and the perſon who milks her.

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.

Variolæ Vaccinæ.

7 Though is ſometimes confounded 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

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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 Miller, 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
8 the farmer's wife; but there was a peculiarity in her situation which prevented my making the experiment."

Jenner's opinion of the origin of the disease controverted.

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?

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-

9 A previous attack of this disease renders the body unsusceptible of small-pox.

10 Difficulties explained.

 ble

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 of 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.

12 A ſeemingly well authenticated exception.

"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; bad 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 iolæ inæ. 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.

3 bly ited 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.

4 nta- the prac- 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. Variolæ Vaccinæ.

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.

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der. There is fome curious information on this fubject, contained in a letter from Mr Stromeyer of Hanover to Mr Hannehmaun.

"This year (fays he) we have inoculated 40 perfons, as well with the vaccine matter received of Dr Pearfon as with that from Dr Jenner; all of whom underwent the difeafe properly.

"Betwixt the London and Gloucefter vaccine matter, it appears to me there fubfifts an effential difference. The London matter produces frequently an eruption of fmall pimples; but they difappear within a day or two at fartheft. Dr Pearfon calls thefe eruptions *puftules*.—The Gloucefter matter has never produced this effect here; but *frequently occafioned ulcerations of the inoculated part, of a tedious and long duration; which the latter never did*: on account of which I now only make ufe of Dr Pearfon's vaccine matter. The nettle-fever-like eruptions I have obferved feveral times, but never that fort of eruption, repeatedly noticed in London, which fo much refembles the fmall-pox."

If thefe obfervations of Mr Stromeyer fhould be confirmed by the experience of others, they would go far to explain the difference which the London practitioners have found in this difeafe from the account given of it by Dr Jenner, notwithftanding the abfence of the eruption refembling fmall-pox at Hanover. We believe an interchange of vaccine matter has once or twice taken place between London and Gloucefterfhire. Is it fince that period that the eruption has been lefs frequent at London? Dr Pearfon is inclined to fuppofe, that the comparative feverity of the difeafe at London, during the firft winter, arofe rather from the difference in the human conftitution at the different feafons of the year, than from any change in the ftate 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 arifing from the inoculated fmall-pox, we are convinced that Dr Pearfon greatly over-rates the mortality in the latter diforder. He fuppofes it to be no lefs than one in 200. Dr Mofeley, on the other hand, who is a violent opponent of the vaccine inoculation, afferts, that he has inoculated feveral thoufands with variolous matter, in Europe and the Weft Indies, without ever lofing a patient and that feveral other perfons, whom he knows, have done the fame, with the fame fuccefs. We are afraid, however, that the experience of other inoculators does not afford fo favourable a refult. We believe that in this country the mortality is often occafioned by improper treatment; and from comparing the accounts which we have received from practitioners of extenfive experience, and undoubted veracity, we believe that, where the treatment is proper from the beginning, the fymptoms very rarely arife to an alarming height, and that the mortality is not fo great as one in 600. And this eftimate nearly correfponds with Dr Woodville's very great experience. It muft be allowed, that patients in an hofpital are fubject to fome difadvantages, which may be avoided in private practice; yet, out of the laft 5000 cafes of variolous inoculation at the inoculation hofpital, prior to the publication of the Doctor's reports, the mortality did not exceed one in 600.

Notwithftanding this ftatement, however, we are happy to fay, that the danger in the vaccine difeafe is ftill much lefs. Dr Pearfon tells us, that in little more than fix months after the new inoculation was introduced into London, which includes the period at which the cow-pox affumed the moft unfavourable appearance, 2000 perfons at leaft underwent the operation; of thefe, one only, an infant at the breaft, under the care of Dr Woodville, died. In this folitary fatal cafe, the local tumor was but very inconfiderable; and the eruptive fymptoms took place on the feventh day, when the child was attacked with fits of the fpafmodic kind, which recurred at fhort intervals, with increafed 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 puftules had appeared.

17
Great fuccefs of new inoculation.

Since that time a much greater number, amounting certainly to feveral thoufands have been inoculated with cow-pox in different parts of Great Britain and on the continent. Among thefe, not one fatal inftance, that we have heard of, has occurred.

But even if the danger to the individual from the fmall-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 fufficient to intitle it to a preference—It is not capable of being propagated by the effluvia arifing from the bodies of perfons infected with it. There are many fituations in which a prudent furgeon will be reftrained from inoculating with fmall-pox, left the contagion fhould fpread to other people, who may be either prevented by prejudice from fubmitting to the operation, or in whom it would be obvioufly improper, from the circumftances of age, teething, or the prefence of fome other difeafe. Here the cow-pox virus may be fubftituted with great propriety. It is chiefly from this quality that the cow-pox bids fair to extirpate the fmall-pox entirely.

This valuable property of the vaccine diforder is not, however, to be admitted without fome limitation. When it produces numerous puftules on the body, Dr Woodville tells us, that the exhalations they fend forth are capable of affecting others in the fame manner as the fmall-pox. Two inftances of cafual infection in this way have fallen under his obfervation. In one, the difeafe was fevere, and the eruption confluent; in the other, the difeafe was mild, and the puftules few. It has been remarked, that the inoculated cow-pox is little if at all, different from the difeafe when cafually caught. But, ftrictly fpeaking, the above are the only two cafes in which the difeafe has been communicated otherwife than by inoculation.

18
Whether the cow-pox and fmall-pox ought to be confidered as different difeafes.

The writers upon this fubject are divided in opinion, whether the cow-pox and fmall-pox ought to be confidered as different difeafes, or whether they are merely varieties of the fame difeafe.

They certainly, notwithftanding the ftrong analogy which fubfifts between them, differ from each other in feveral ftriking 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 refpect, then, thefe two morbid poifons 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 confequence of inoculation with variolous matter: for if the inoculation of the cow-pox be performed by a fimple puncture, the confequent tumor, in the proportion of three times out of four, according riolæ cinæ. cording 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, neverthele ſs 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."

19 ...are ...ably varie- ...f the dis- 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. Variolæ Vaccinæ.

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.

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. 20 Practical remarks.

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."

"The

(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 efflorescence 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 efflorescence 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 efflorescence is more frequent in young infants than in children advanced to three or four years of age; and the former have the efflorescence, 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,

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

Ventilation.

or put out of order by rough ufage, the copper pipes fhould be made of confiderable ftrength, placed againft the fides of the veffel, and even incafed in wood.

In the Letters and Papers of the Bath Society, &c. we have the following defcription of a ventilator for preferving corn on fhip board, by Thomas South, Efq:

Plate XLVII.

Fig. 1. is a cylindrical air-veffel, 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 pifton to work with, and an iron nofle, *viz.* a hollow inverted cone, two feet long, to condenfe the air, and increafe its power in its paffage downwards. This cylinder fhould be rivetted or fcrewed, by means of an iron collar or ftraps, to the deck it paffes through, both above and below, as at *a a*; and fhould be farther fecured by fome holdfaft near *b*, to keep it fteady in working.

Fig. 2. is a bottom of wood, four inches and a half thick, with a projecting rim at its bafe, for the metal cylinder to reft on when cemented and fcrewed to the wood. The centre of this bottom is excavated, for the reception of the crown of the nofle. In the fame figure the nofle is reprefented with its crown like a bowl difh, to condenfe the air gradually, without refiftance, in its advance to the more contracted bafe of the inverted cone, *i. e.* the top of the entrance of the nofle. About two-thirds down this nofle may be fixed a male fcrew, as *c c*, for the purpofe hereafter mentioned.

N. B. The forcing-pump fhould be cafed in wood, to protect it from outward bruifes, which would prevent the working of the pifton, and ruin its effects. The leather round the embolus fhould be greafed when ufed.

Fig. 3. is a crutch-handle, faftened to the embolus A by its iron legs B, B. A is a cylinder of wood, cafed with leather, fo as to fit well, but glide fmoothly, in the metal cylinder; having an opening as large as its ftrength will permit, for the free accefs of atmofpheric air. C is a valve well leathered on its top, and yielding downwards to the preffure of the air when the pifton is raifed up. D is a crofs bar of iron, to confine the valve, fo that it may clofe inftantly on the return of the pifton downwards.

Fig. 4. is a tin pipe or tube, of lefs than four inches diameter, and of fuch length, as when fixed to the bafe of the cylinder, fig. 1. fhall admit the nofle *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 preffure of air condenfed in its paffage through the nofle, and deliver it into the pipes below. This valve muft be well leathered on its upper furface, and faftened with an hinge of leather to the cylinder it is meant to clofe: affixed to its bottom is the fpindle G, paffing through a fpiral fpring H, which, being compreffed on the defcent of the valve, will, by its elafticity, caufe it to rife again, clofe the aperture above, and retain the air delivered beneath it. On connecting this cylinder with the upper end of the nofle, at *e e*, fig. 2. we muft carefully prevent any lapfe of air that way, by a bandage of oakum fmeared with wax, on which to fcrew the cylinder, like the joints of a flute, air-tight. I is a bar of iron, having a rifing in its centre, wide enough for the fpindle to play through, but at the fame time fufficiently contracted to prevent the paffage of the fpiral fpring.

Fig. 5. is an affemblage of tin pipes, of any lengths, fhaped fuitably and conveniently to their fituation in the fhip, to the form of which, when fhut into one another, they muft be adapted; obferving only, that the neck be ftraight for a length fufficient 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, fhould 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 reprefented in the Plate, perforated with a fmaller punch to prevent the air from efcaping too haftily. In large cargoes, two or three of thefe perpendiculars may be neceffary; and each fhould be well fecured by an iron bar *g*, fcrewed down to prevent their being injured by the fhifting of the cargo in ftormy weather or a rolling fea. The top of the conical cap of thefe pipes may reach two-thirds up the cargo.

Fig. 7. is a valve of the fame conftruction as that reprefented in fig. 4. but inclofed in a tube of brafs, having a female fcrew at *f f*, adapted to the male fcrew *c c*, on the nofle fig. 2. and may then be inferted into the head of the pipe fig. 5. This will add to the expenfe; but in a large apparatus is to be preferred, as a more certain fecurity from lapfe 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 fecure the tube fig. 4. when applied to the nofle. The joints of the pipes, when put together for ufe, fhould be made air-tight, by means of bees wax or fome ftronger cement, till they reach the bottom of the veffel, when there is no farther need of this precaution. The horizontal pipes fhould run by the fide of the kelfon the whole length of the hold. The tin plates of which K is made, fhould be punched in holes, like the rofe of a watering-pot, in two or three lines only at moft, and then formed into a tube, with the rough fide outwards. L may have four or five lines of the like perforations. M, and the reft, fhould gradually increafe in their number as they advance towards the middle of the hold, and continue fully perforated to the laft pipe which fhould be clofed at its end to prevent the ingrefs of the corn. It is the centre of the cargo which moft requires ventilating, yet air fhould pervade the whole. Like the trade winds, it will direct its courfe to the part moft heated, and, having effected its falutary purpofe there, will difperfe itfelf to refrefh the mafs.

Where the hatches are clofe-caulked, to prevent the influx of water, vent-holes may be bored in convenient parts of the deck, to be bunged up, and opened occafionally, from whence the ftate of the corn may be known by the effluvia which afcend when the ventilator is working.

The power of the ventilator is determined by the fquare of its diameter multiplied into the length of the ftroke, and that again by the number of ftrokes in any given time.

The air-veffel or forcing-pump, with the reft of the apparatus here defcribed, is adapted to a veffel of 120 tons burden; but by lengthening the air-veffel, extending its diameter to 14 inches, and adding 10 inches more to the length of the ftroke, a power may be obtained of ventilating a cargo of 400 tons within the hour.

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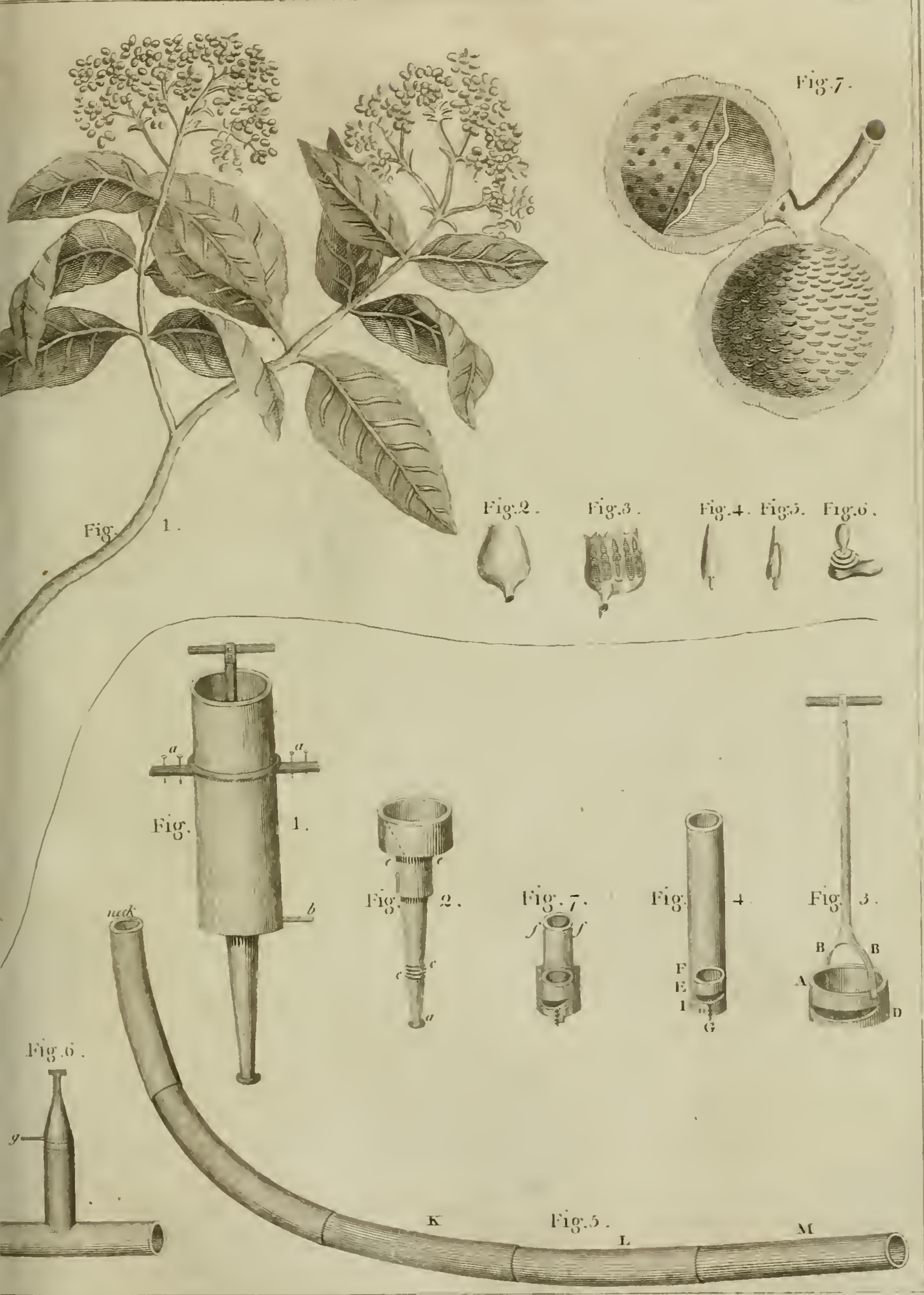
URCEOLA ELASTICA. PLATE XLVII.



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

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 Montpellier 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 southwest 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

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 recommendatiun 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, bears a strong analogy to the coraline of Corsica. 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 *Barrycras*, 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 Massachusetts 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

(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.

Vermont. 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 Whitehall, 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(B). 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

(B) 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 Epfom falts.

There is alfo a curious mineral fpring on fome low land over againft the great Ox Bow, difcovered about the year 1770.

Vermont is divided, from north to fouth, 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 ftate. The fouthern extremity is called Weft Rock, a precipice about three miles from New Haven, in Connecticut; thence the mountain ranges northward, rifing in height, as it advances through Connecticut, Maffachufetts and Vermont. The hills in Fairfield county are a principal branch, on the coaft of the Green Mountains. Towards Lake Memphremagog it fpreads into a high plain country, exceedingly fertile, and paffes 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 Maffachufetts line, more than 80 miles to the north, the weftern verge of the Green Mountain is from twenty to thirty miles on a ftraight line from Connecticut river. Almoft the whole of this country is formed with mountains ranging parallel with the courfe of Connecticut river. The weft range, which continues unbroken, with few exceptions, nearly through the ftate, is, in general, much the higheft. On the eaft they decreafe gradually to the meadows, and fometimes to the edge of the river. Thefe laft are interfected by the rivers which run into the Connecticut, in a direction nearly from the northweft to the foutheaft. The vallies, or rather glens, which feparate thefe ranges, are generally narrow, and moftly covered with hemlock, fir and fpruce.

About 100 miles from Maffachufetts line, between the waters of White river and Winoufki, or Onion river, there paffes off to the northeaft, a range of high lands, frequently rifing into very elevated mountains. This runs parallel with Connecticut river; the height being from ten to fifteen miles diftant, as far as the north line of the ftate. The weftern range continues northward, fometimes falling below the clouds, fometimes rifing above them. Between thefe two ranges, extending from twenty to thirty miles in breadth, is a beautiful champaign country, fecond in fertility, perhaps, to none in Vermont.

The moft remarkable mountains in the ftate, are Mount Anthony, between Bennington and Pownal, Stratton Mountain, Danby Mountain, Kellington Peaks, Kingfton 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 ftate, and Afcutney, between Windfor and Weatherfield. On the weft of the Green Mountain, there is one, and in fome places, two or three ranges of fmaller mountains, though frequently interrupted. Thefe 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 eaft fides with what is called hard wood, fuch as birch, beach, maple, afh, elm, and butternut; the weft fide is generally covered with evergreens.

The climate, foil, productions, and animals differ little from thofe in New England.

The trade from this ftate is principally to Hartford, Bofton and New York. Some little trade is carried on with the province of Quebec. The remittances to Quebec are moftly made in lumber, fuch as boards, plank, fquare timber and ftaves, by Lake Champlaine and the St Lawrence. The articles of export to Hartford, Bofton, Portland and New York, are horfes, beef, pork, butter, cheefe, wheat, wheat flour, iron, nails, pot and pearl afhes. Of the two laft articles, one thoufand tons were made in the ftate in the year 1791.

The number of people in Vermont, according to the cenfus taken in 1790, was 85,589. The inhabitants of Vermont confift principally of emigrants from Maffachufetts and Connecticut, and their defcendants. There have been fome from Rhode Ifland, New Hampfhire, New York, and New Jerfey. Two towns in Caledonia county are moftly peopled from Scotland, and are Prefbyterians, partly of the Seceffion, and partly of the covenanted Church. The manners of the people are the fame as thofe of the ftates from whence they emigrated. The body of the inhabitants are congregationalifts. The other denominations are baptifts, epifcopalians, quakers, and a few methodifts. The ftate is rapidly peopling. In 1788, the townfhip of Danville, in the county of Orange, was a wildernefs without a fingle family. In 1792 they had two confiderable companies of militia; befide a company of light infantry, dreffed in uniform.

The inhabitants of this ftate are an affemblage of people from various places, of different fentiments, manners and habits. They have not lived together long enough to affimilate and form a general character. Affemble together, in imagination, a number of individuals of different nations; confider them as living together amicably, and affifting each other through the toils and difficulties of life, and yet rigoroufly oppofed in particular religious and political tenets; jealous of their rulers, and tenacious of their liberties, (difpofitions which originate naturally from the dread of experienced oppreffion, and the habit of living under a free government)—and you have a pretty juft idea of the character of the people of Vermont. Indolence is never a characteriftical feature of the fettlers of a new country. Emigrants in general are active and induftrious. The oppofite characters have neither fpirit nor inclination to quit their native fpot. The inference is, that Vermont is peopled with an active, induftrious, hardy, frugal race; as is really the cafe. And as it is a maxim that the inhabitants of all new countries grow virtuous before they degenerate, it will moft probably be fo in Vermont.

The inhabitants of the feveral towns feem generally difpofed, as foon as they are able, to fettle a minifter of the gofpel among them. Miffionaries, from Connecticut and Maffachufetts, to the new and fcattered fettlements, have been generally well received and treated with grateful refpect and kindnefs.

In 1796 there were, on the militia rolls, 19,500 men. Thefe were formed into 4 divifions, confifting of 8 brigades

Vermont. gades 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

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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 subftance 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 horfe-fhoe bat, which had the ufe of its fight, were filled with tinder mixed with water. It was uneafy under the operation, and appeared afterwards reftlefs and ftunned; but it conducted itfelf tolerably well. On being blinded, it rufhed with its head againft the ceiling, and made the air refound with ftrokes which it gave itfelf on the muzzle. This experiment was repeated on other bats with the like effects.

The tympanum of a large horfe-fhoe bat was pierced with a pin (*trois quart*). The animal appeared to fuffer much from the operation, and fell down in a perpendicular direction when thrown into the air. It died next morning. The fame effect was produced on piercing the tympanum of a long-eared bat with a needle.

The author then made very accurate refearches on the difference between the organifation of the brain of thefe two kinds of bats; and, after a careful diffection, found that the eye of the long-eared bat is much larger than that of the horfe-fhoe 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 fmaller.

The horfe-fhoe bat is indemnified for this difference by a greater extenfion of the organ of fmell, as evidently appears when the external elevations and irregularities of its muzzle are examined. When it is about to take flight, it agitates its nofe much more than the long-eared bat.

From thefe experiments, the author concludes: *Firft*, That the eyes of the bat are not indifpenfably neceffary to it for finding its way; *fecondly*, That the organ of hearing appears to fupply that of fight in the difcovery of bodies, and to furnifh thefe animals with different fenfations to direct their flight, and enable them to avoid thofe obftacles which may prefent themfelves.

VESSEL *Bay*, on the eaft fhore of Lake Champlain, fets up to the N. E. in the townfhip of Charlotte, in Vermont.—*Morse.*

VIBRATION Figures, are certain figures formed by fand or very dry faw-duft, on a vibrating furface, which is connected with the fenfation of found in our organs of hearing. If the furface, on which the figures are to be formed, be ftrewed over with bodies eafily put in motion, thefe, during the vibration, remain on the parts at reft, and are thrown from the parts in motion. The form of the parts at reft, which will be fhewn by the fand that remains unmoved, and which, in general, is fymmetric, is called a *vibration figure*. To produce fuch a figure, nothing is neceffary but to know the method of bringing that part of the furface which you wifh not to vibrate into a ftate of reft, and of putting in motion that which you wifh to vibrate. On this depends the whole expertnefs of producing vibration figures.

Thus take a fquare piece of glafs, pretty thin, and very fmooth, fuch as that ufed for windows, about four or five inches over, or even more. Smooth it at the edges on a grinding-ftone; ftrew a little faw-duft over its furface, 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 foftly againft one of its edges, drawing the bow either up or down in a direction almoft perpendicular to the furface of the glafs, and you will fee a tremulous movement, and the whole duft leap about. If the bow be exactly in the middle of one of the fides, the duft will arrange itfelf almoft in the direction of the two diagonals, dividing the fquare into four ifofceles triangles. If the bow be applied at a quarter only of the diftance of the one corner from the other, the duft will arrange itfelf in fuch a manner as to be found in the two diameters of the fquare, dividing it into four equal fquares. At other times, when the bow deviates a little, the duft forms a figure like a double C, when the two letters are joined back to back. If the fquare be held by the two extremities of the diameter oppofite to that againft which the bow is applied, the duft will form a kind of oval, one of the axes of which will be the fame diameter. If the glafs be of a circular figure, and be held by the middle, the duft will arrange itfelf in fuch a manner as to form the fix radii of a regular hexagon. Thefe difcoveries were made by Dr Chladni, about the time that he invented the mufical inftrument, to which he gave the name of EUPHON (fee that article, *Suppl.*); and as he found the vibration figures to vary in form with the various tones produced by the vibrating fubftances, a profecution of his experiments may probably contribute to throw new light on the philofophy of mufical founds. We fhall therefore give, from the 3d volume of *Neues Journal der Phyfik*, by Profeffor Gren, a few directions for making fuch experiments.

Any fort of glafs may be employed, provided its furface be fmooth; and when the plate has acquired the proper vibration, it fhould be kept in that ftate for fome feconds, by continuing to rub it with the bow. The figures will thus be accurately formed.

Such plates fhould be procured as are pretty equal in thicknefs. It may be faid, in general, that a plate the thinner it is will be fo much the fitter for thefe experiments, though in this refpect there is a certain minimum. In fmall plates, fuch as thofe that are circular, and not above fix inches in diameter, the obfervation is general; but in larger plates too great thinnefs is prejudicial. Befides, it will be found that very thin glafs is commonly very uneven, and muft therefore be unfit for the experiments.

In practifing the experiments, it will be proper to have plates of different fizes; and the fand employed fhould not be too fine. In other words, it muft be of fuch a nature that when you incline the glafs-plate it may readily roll off; becaufe, in that cafe, it will be eafily thrown from the vibrating parts. It will be of advantage that it be mixed with fine duft, which fhews peculiar phenomena during the experiments, as it collects itfelf at one place of the vibrating part.

The plate muft be equally beftrewed with fand, and not too thick, as the lines will then be exceedingly fine, and the figures will acquire a better defined appearance.

VICIOSAS *Iflas*, ifles of the Bay of Honda, on the coaft of Honduras, or the Spanifh Main.—*Morse.*

VICTORIA, an ifland on the coaft of Brazil, eaftward of St Sebaftian's Ifland.—*ib.*

VICTORY, *Cape*, is the extreme N. W. point of the ftraits 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.*

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

between 2908881959
and 2908882056;

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 Cœleſte*, 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 *Nooa*, 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, ftands on the eaft fide of Wabafh river, 150 miles from its mouth. It was erected in the year 1787, in order to repel the incurfions of the Wabafh Indians, and to fecure the weftern lands from intruding fettlers. It has four fmall brafs cannon, and is garrifoned by a Major and 2 companies. The town of Vincents contained, in 1792, about 1,500 fouls, principally of French extraction. It is 300 miles S. W. of Fort Recovery. N. lat. 39 15, W. long. 90 7. They raife Indian corn, and wheat; and tobacco of an extraordinary good quality; fuperior, it is faid, to that produced in Virginia. They have a fine breed of horfes, brought originally by the Indians from the Spanifh fettlements, on the weftern fide of the Miffiflippi. Here are large herds of fwine, and black cattle, and the fettlers deal with the Indians for furs and deer-fkins. Hemp of a good quality grows fpontaneoufly in the low lands of the Wabafh; as do grapes, of which the inhabitants make a fufficient quantity, for their own confumption, of well tafted 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 captainfhips of Brazil, in S. America, and the moft foutherly one. The capital is an inconfiderable place, with only about 60 houfes, and the harbour will not receive large veffels. It has 5 or 6 fugar-mills, and lies 76 leagues fouth-weft of Rio Janeiro. S. lat. 23 40, W. long. 45 10.—*ib.*

VINCENT, *St*, a town on the coaft of Brazil; fituated on Amiaz Ifland, in the Bay of All Saints or Sanctos; in which ifland is the city of Dos Sanctos, the ifland lying on the weft fide of the entrance into the ifland. 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 eaftward of San Sebaftian, with a port where canoes from Carthagena and St Martha unload their merchandize. —*ib.*

VINCENT, a townfhip of Pennfylvania, fituated in Chefter county.—*ib.*

VINCENT, *Port St*, on the coaft of Chili, in the S. Pacific Ocean, is 6 miles N. N. E. of the mouth of the river Biobio, having a fafe harbour and fecure againft all winds but the weft, which blows right in. Talcaguama Port is 6 miles to the northward of it.—*ib.*

VINCENTO, a channel which goes in on the weft fide of the channel of Amiaz Ifland, in the Bay of All Saints, on the coaft of Brazil.—*ib.*

VINER'S *Ifland*, in Hudfon's Bay, lies N. E. of the mouth of Albany river.—*ib.*

VINEYARD, *New*, a plantation in Lincoln county, Diftrict of Maine, on the two north-eafternmoft branches of Sandy river, about 59 miles N. by W. of Brunfwick, and 37 N. W. of Hallowell.—*ib.*

VINEYARD *Sound*, on the fouth-eaftern coaft of Maffachufetts, is the ftrait or paffage between the Elizabeth Iflands 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 fituated about two miles up a creek on the fouthern fide of the river Gambia. It is much reforted to by Europeans, on account of the great quantities of bees-wax which are brought hither for fale. The wax is collected in the woods by the Feloops, a wild and unfociable race of people. Their country, which is of confiderable extent, abounds in rice; and the natives fupply the traders, both on the Gambia and Caffamanfa rivers, with that article, and alfo with goats and poultry, on very reafonable terms. The honey which they collect is chiefly ufed by themfeves in making a ftrong intoxicating liquor, much the fame 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 fpeaks a little Englifh, 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 himfelf as a reward for his trouble. Vintain, according to Mr Park, from whofe valuable travels this account of the Feloops is taken, is fituated in 13° 9′ North Lat. and 15° 56′ Long. Weft from Greenwich.

VIPER *Key*, one of the Tortugas, on the coaft of Florida; 5 miles N. eaftward of Duck Key, and 3½ E. of Old Matacombe.—*Morfe.*

VIRGIL, a military townfhip of Onondago county, New-York, having Dryden on the W. Cincinnatus E. Homer N. and on the S. 230,000 acres of land on Sufquehannah river, ceded to the State of Maffachufetts. It is under the jurifdiction of Homer, which was incorporated in 1794.—*ib.*

VIRGIN GORDA, one of the principal of the Virgin Ifles, in the Weft-Indies. It lies 4 leagues to the E. of Tortula, and of a very irregular fhape. Its greateft length from E. to W. is about 18 miles; is worfe watered than Tortula, and has fewer inhabitants. A mountain which rifes in the centre, is affirmed to contain a filver mine. N. lat. 18 18, W. long. 64.—*ib.*

VIRGIN *Iflands*, a group of fmall iflands in the Weft-Indies, to the eaftward of the ifland of Porto Rico, belonging to different European powers. They extend for the fpace of 24 leagues, from E. to W. and about 16 leagues from N. to S. and nearly approach the eaft coaft of Porto Rico. They are every way dangerous to navigators, though there is a bafon in the midft of them of 6 or 7 leagues in length, and 3 or 4 in breadth, in which fhips may anchor and be fheltered and land-locked from all winds; which is named the Bay of Sir Francis Drake, from his having paffed through them to St Domingo. Thofe which are occupied and inhabited appear under their refpective names; but others are deftitute both of names and inhabitants. The Britifh and Danes poffefs moft of them; but the Spaniards claim thofe near Porto Rico. The ifland of *Virgin Gorda*, on which depend Anegada, Nicker, Prickley Pear, Mofquito Iflands, Camanoes, Dog-Iflands, the Fallen City, the Round Rock, Ginger, Cooper's, Salt, Peter's and Dead Cheft, belong to the *Britifh;* as alfo *Tortola*, on which depend Joft Van Dykes, Little Van Dykes, Guana, Beef, and Thatch Iflands. To the *Danes* belong *St Thomas's Ifland*, on which Brafs, Little Saba, Buck Ifland, Great and Little St James, and Bird Ifland are dependant; with *St John's*, to which depend Lavango, Cam, and Witch Iflands; and they have alfo Santa Ifland, or St Croix.

The

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 smallest

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 $\frac{3}{20}$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 Ramfden, from computations grounded on the principles of optics and general ftate of the facts, eftimates that the increafe 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 vifion, fufficiently account for the other two-thirds of the quantity of adjuftment neceffary to make up the whole.

The following obfervations on Vifion by Doctor David Hofack of New-York, were read before the Royal Society, May 1, 1794, and the author has politely permitted their infertion in this work.

"By what power is the eye enabled to view objects diftinctly at different diftances? As the pupil is enlarged or diminifhed according to the greater or lefs quantity of light, and in a certain degree to the diftance of the object, it would readily occur that thefe different changes of the pupil would account for the phænomena in queftion. Accordingly anatomifts and philofophers, who have written upon this fubject, have generally had recourfe to this explanation.

"Amufing myfelf with thefe changes of the pupil, as a matter of curiofity, by prefenting to the eye different objects at different diftances, I foon perceived that its contraction and dilatation were irregular and more limited than had been fuppofed; *i. e.* that approaching the object nearer the eye, within a certain diftance, the pupil not only ceafed to contract, but became again dilated; and that beyond a few yards diftance, it alfo ceafed to dilate: thefe circumftances immediately occurred as objections to the above explanation; for were it from the contraction and dilatation of the iris alone that we fee objects at different diftances, I naturally concluded it fhould operate regularly to produce its effects; but if to view an object at a few yards diftance it be enlarged to the utmoft extent, furely it muft of itfelf be infufficient to view one at the diftance of feveral miles; for example, the heavenly bodies.

"Another difficulty here prefents itfelf: in viewing the fun, inftead of dilating, according to the diftance, it contracts, obeying rather the quantity or intenfity of the light, than the diftance of the object. Knowing no other obvious power in the eye itfelf of adapting it to the different diftances of objects, it occurred to me to inquire, whether the combined action of the external mufcles could not have this effect. I firft propofed this query to an optician of eminence in London, and who has written exprefsly on this fubject. I repeated the fame queftion to a celebrated teacher of anatomy. Encouraged by their replies, I have fince attended more particularly to the fubject, and hope my inquiries have not been altogether unfuccefsful. As introductory to a more diftinct view of what I have to advance, it appears neceffary to premife the following obfervations, relative to thofe general laws of vifion which are more particularly connected with this part of the fubject, and to which we fhall have occafion of frequent reference.

"1ft. Let ABC, (plate 3 appendix fig. 1.) be an object placed before the double convex lens DE, at any diftance greater than the radius of the fphere whereof the lens is a fegment; the rays which iffue from the different points of the object, and fall upon the lens, will be fo bent by the refractive power of the glafs as to be made to convene at as many other points behind the lens, and at the place of their concourfe they will form an image or picture of the object. The diftance of the image behind the glafs varies in proportion to the diftance of the object before the glafs; the image approaching as the object recedes, and receding as that approaches. For if we fuppofe, (fig. 2.), A and B two radiating points, from which the rays AC, AD, and BC, BD, fall upon the lens CD, it is manifeft that the rays from the neareft point A diverge more than thofe from the more diftant point B, the angle at A being greater than that of B (A); confequently the rays from A, whofe direction is AE and AF when they pafs through the glafs, muft convene at fome point (as G) more diftant from the lens than the point H, where the lefs diverging rays BK and BL from the point B are made to convene; which may alfo be proved by experiment with the common convex glafs (B).

"It will be neceffary to have this propofition in view, as we fhall afterwards have occafion to ufe it in fhewing, that by varying the diftance between the retina and the anterior part of the eye we are enabled to fee objects at different diftances.

"2d. If an object, as AB, (fig. 3.) be placed at a proper diftance before the eye (E), the rays which fall from the feveral points of the object falling upon the cornea pafs through the pupil, and will be brought together by the refractive power of the different parts of the eye on as many correfponding points of the retina, and there paint the image of the object, in the fame manner as the images of objects placed before a convex lens are painted upon the fpectrum, placed at a proper diftance behind it; thus the rays which flow from the point A are united on the retina at C, and thofe 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 diftinct vifion. But fuppofing the eye of a given form, fhould the point of union lie beyond the retina, as muft be the cafe with thofe from the lefs diftant object, agreeable to the preceding propofition; or fhould they be united before they arrive at the retina, as from the more diftant object, it is evident that the picture at the retina muft be extremely confufed. Now as the rays which fall upon the eye from radiating points at different diftances have different degrees of divergence, and the divergence of the rays increafing as the diftance of the radiating point leffens, and, *vice verfa*, leffening as that increafes; again, as thofe rays which have greater degrees of divergence, viz. from the nearer objects, require a ftronger refractive power to bring them together at a given diftance than what is neceffary to make thofe meet which diverge lefs, it is manifeft, that to fee objects diftinctly at different diftances, either the refractive power of the eye muft be increafed or diminifhed, or the diftance between the iris and retina be varied, correfponding with the different diftances of the objects; both

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(A) *Euclid*, Book I. Prop. 21.
(B) See *Kepler* Diopt. Poftul. *Smith's Optics*, *Gravefande*, &c.

both of which probably take place, as will hereafter appear (c).

"Having then eftablifhed thefe as our premifes, we fhall next examine the different principles which have been employed for explaining vifion at different diftances.

"Moft writers upon this fubject refer this power of the eye to the contraction and dilatation of the iris. Within certain limits this would, upon firft examination, as already obferved, appear to be the cafe, fince 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 fufpect we alfo err in attributing to the difference of diftance what are only effects of different quantities of light, a circumftance in which it is the more eafy to commit error as they are generally proportionate one to the other; *i. e.* as the object is near we require a lefs degree of light, and to exclude what is fuperfluous the iris contracts; but as it is more diftant, a greater quantity of light becomes neceffary, and the iris dilates: thus far we fee the ufe of the enlargement or diminution of the pupil, as the object is more or lefs diftant. But diftinct vifion does not confift in the quantity of light alone, though too much or too little would obfcure the image.

"It is alfo neceffary that the rays which flow from the object fhould fall upon the retina in a certain direction, to form a diftinct picture; but furely the greater or lefs quantity of light, the greater or lefs number of rays, which it is only the property of the iris to diminifh or increafe, cannot alter the direction.

"But there is ftill another argument to prove, that the contraction or enlargement of the pupil is not of itfelf fufficient to produce diftinct vifion at different diftances, viz. that the myopes, whofe pupil contracts and dilates as in other eyes, are ftill unable to adapt the eye to different diftances; and the means by which this is remedied certainly does not confift in a larger or fmaller aperture for the rays to pafs through, but a power of altering their direction, which the change in the fhape of the eye had rendered too convergent. The fame fact is alfo obfervable in thofe who fquint; the pupil in both eyes equally contracts and dilates, but ftill the vifion of one eye is lefs perfect than the other. Another principle upon which it has been attempted to explain this power of the eye, is a fuppofed change in the convexity of the cryftalline lens; the ancients had fome obfcure notion of it, but it has been lately purfued by Mr Thomas Young, in a paper publifhed in the Philofophical Tranfactions of London for 1793. He has endeavoured to demonftrate the exiftence of mufcles in the cryftalline lens, and by their action to account for diftinct vifion at different diftances. This opinion deferves here the more particular examination, having met the attention of the Royal Society, and thereby likely to influence the general opinion upon this fubject.

"That we may not miftake the meaning of the author, I beg leave to premife his defcription of the ftructure of the lens. 'The cryftalline lens of the ox,' he obferves, 'is an orbicular convex tranfparent body, compofed of a confiderable number of fimilar coats, of which the exterior clofely adhere to the interior; each of thefe coats confifts of fix mufcles, intermixed with a gelatinous fubftance, and attached to fix membranous tendons. Three of thefe tendons are anterior, three pofterior; their length is about two-thirds of the femidiameter of their coat; their arrangement is that of three equal and equidiftant rays meeting in the axis of the cryftalline; one of the anterior is directed towards the outer angle of the eye, and one of the pofterior towards the inner angle; fo that the pofterior are placed oppofite to the middle of the interftices of the anterior, and planes paffing through each of the fix, and through the axis, would mark on either furface fix regular equidiftant rays. The mufcular fibres arife from both fides of each tendon, they diverge till they reach the greateft circumference of the coat, and having paffed it, they again converge till they are attached refpectively to the fides of the neareft tendons of the oppofite furface. The exterior or pofterior portion of the fix, viewed together, exhibits the appearance of three penniformiradiated mufcles.'

"In the firft place, to fay nothing of the tranfparency of mufcles, as an argument againft their exiftence, we muft unavoidably fuppofe, as they have *membranous tendons*, which Mr Young informs us he diftinctly obferved, that thefe tendons cannot poffefs the fame degree of tranfparency and denfity with the bellies of thefe mufcles; that is, they muft poffefs fome degree of opacity, or certainly he could not have pointed out their membranous ftructure, nor even the tendon itfelf, as diftinct from the body of the mufcle; and if they have not the fame denfity, from their fituation, and being of a penniform fhape, muft there not be fome irregularity from the difference in the refraction of thofe rays which pafs through the bellies of thofe mufcles, and thofe again which pafs through their membranous tendons? This ftructure then, of confequence, cannot be well adapted for a body whofe regular fhape and tranfparency are of fo much confequence.

"Again, Mr Young defcribes fix mufcles in each layer; but Leeuwenhoek, whofe authority he admits as accurate, relative to the mufcularity of the lens, is certainly more to be attended to in his obfervation of bodies lefs minute, viz. as to the layers themfelves, in which thefe mufcles are found, and which of courfe are larger, and more eafily obferved; but, with his accuracy of obfervation, he has computed, that there are near 2000 laminæ; and according to Mr Young, fuppofing each layer to contain fix mufcles, we have neceffarily, in all, 12,000 mufcles; the action of which certainly exceeds human comprehenfion. I hope this will not be deemed trifling minutenefs, as it is a neceffary and regular confequence, if we admit their exiftence as defcribed.

"But

(c) "Facile enim intelligitur, quo longius radii adveniunt, eo magis effe parallelos; eo minus ergo differre ab axi, et eo minoribus viribus corneæ et lentis cryftallinæ in focum cogi. Ut enim corpus magis diftat, ita fub minori angulo radii adveniunt. Contra fi corpus confpicuum valde vicinum fuerit, radiorum ab eo advenientium angulus eft major, et adeo magis divergentes in oculum incidunt, et viribus egent refringentibus majoribus omnibus denfioribus."—*Haller*, *Elem. Phyf.* lib. xvi.

" But fecondly, as to the exiftence of thefe mufcles, I cannot avoid expreffing a doubt. With the utmoft accuracy I was capable of, and with the affiftance of the *beft* glaffes, to my difappointment, I cannot bear witnefs to the fame circumftances related by Mr Young, but found the lens perfectly tranfparent; at the fame time, left it might be attributed to the want of habit in looking through glaffes, I beg leave to obferve, that I have been accuftomed to the ufe of them in the examination of the more minute objects of natural hiftory. After failing with the glaffes in the natural vifcid ftate of the lens, I had recourfe to another expedient; I expofed different lenfes before the fire to a moderate degree of heat, by which they became opaque and dry; in this ftate it is eafy to feparate the layers defcribed by Mr Young; but although not fo numerous as noticed by the accurate Leeuwenhoek, ftill they were too numerous to fuppofe each to have contained fix mufcles; for I could have fhewn diftinctly at leaft fifty layers, without the affiftance of a glafs, as was readily granted by thofe to whom I exhibited them.

" But a circumftance which would feem to prove that thefe layers poffefs no diftinct mufcles is, that in this opaque ftate they are not vifible, but confift rather of an almoft infinite number of concentric fibres (if the term be at all appropriate) not divided into particular bundles, but fimilar to as many of the fineft hairs of equal thicknefs, arranged in fimilar order: fee 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 affiftance of a glafs. To obferve this fact, any perfon may try the experiment at pleafure, and witnefs the fame with the naked eye, even feparating many layers and their fibres with the point of a penknife.

" This regular ftructure of layers, and thofe confifting of concentric fibres, is unqueftionably better adapted for the tranfmiffion of the rays of light, than the irregular ftructure of mufcles. It may, perhaps, be urged, that the heat to which I expofed the lens may have changed its ftructure: in anfwer to that I obferve, it was moderate in degree, and regularly applied; of confequence we may prefume, 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 obferve the fame ftructure.

" Thirdly, that it is not from any changes of the lens, and that this is not the moft effential organ in viewing objects at different diftances, we may alfo 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 muft be deftroyed, capfule, ciliary proceffes, mufcles, &c.

" Mr Young afferts, from the authority of Dr Porterfield, that patients, after the operation of couching, have not the power of accommodating the eye to the different diftances of objects; at prefent, I believe the contrary fact is almoft univerfally afferted (D).

" Befides, if the other powers of the eye are infufficient to compenfate for the lofs of this denfe medium, the lens, a glafs of the fame fhape anfwers the purpofe, and which certainly does not act by changing its figure. I grant their vifion is not fo perfect; but we have other circumftances upon which this can be more eafily explained; which will be particularly noticed under the next head. It may not be improper alfo to obferve, that the fpecific gravity of the cryftalline compared with that of the vitreous humour, and of confequence, its denfity and power of refraction, is not fo great as has been generally believed. Dr Bryant Robinfon, by the hydroftatic balance, found it to be nearly as 11 to 10. I have alfo examined them with the inftrument of Mr Schmeiffer, lately prefented to the Royal Society, and found the fame refult; of confequence the cryftalline lens is not fo effentially neceffary for vifion as has been reprefented; efpecially as it is alfo probable, that upon removing it, the place which it occupied is again filled by the vitreous humour, whofe power of refraction is nearly equal. At the fame time we cannot fuppofe the lens an unneceffary organ in the eye, for nature produces nothing in vain; but that it is not of that indifpenfable 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 cryftalline; and grants, that from the fpherical form of it in the fifh, fuch a change as he attributes to the lens in quadrupeds cannot take place in that clafs of animals. The lenfes which I have examined in the manner abovementioned were the human, thofe of the ox, the fheep, the rabbit, and the fifh, and in all the fame lamellated ftructure is obfervable; even in the fpherical lens of the fifh thefe lamellæ are equally diftinct, but without the fmalleft appearance of a mufcle.

" From thefe circumftances I cannot avoid the conclufion, that they do not exift; at the fame time I am perfuaded that Mr Young met with appearances which he fuppofed were mufcles; but I am fatisfied he will readily acknowledge, that the examination of the cryftalline lens in its vifcid glutinous ftate, is not only attended with much difficulty, but that the fmalleft change of circumftances might lead to error; which I apprehend may, probably, have been the cafe in that inftance.

" Upon examining it after boiling, or expofing it to a gradual degree of heat before the fire, when it may be handled with freedom, he will readily obferve (without a glafs) the numerous lamellæ, and the arrangement of their fibres, which I have defcribed.

" Another opinion has been fanctioned by many refpectable writers, of the effects of the ciliary proceffes in changing the fhape and fituation of the lens; fome fuppofed

(D) " Et lente ob cataractam extracta vel depofita oculum tamen ad varias diftantias videre, ut in nobili viro video abfque ullo experimento quo eam facultatem recuperaverit. Etfi enim tunc ob diminutas vires quæ radios uniunt, æger lente vitrea opus habet, eadem tamen lens in omni diftantia fufficit."—*Haller, El. Phyf.*

" La lentille criftalline n'eft cependant point de première neceffité pour la vifion. Aujourd'hui, dans l'opération de la catarac̄te on l'enlève entièrement, et la vifion n'en fouffre point."—*De la Metherie Vues Phyfiologiques.* See alfo *De la Hire, Hamberger Phyfiolog.*

fuppofed it to poffefs the power of changing the figure of the cryftalline, rendering it more or lefs 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 thefe different opinions all agree in attributing thefe effects to a fuppofed mufcularity of the ciliary proceffes.

"Of the ftructure of thefe proceffes Haller obferves, 'In omni certe animalium genere proceffus ciliares abfque ulla mufculofa funt fabrica, mere vafculofi vafculis ferpentinis percurfi molli facti membrana.' Which ftructure, I believe, at prefent is univerfally admitted. But even fuppofing them mufcular, fuch is their delicacy of ftructure, their attachment, and direction, that we cannot poffibly conceive them adequate to the effects afcribed to them. Befide, what we obferved of the mufcles of the lens itfelf, alfo applies to the proceffes, viz. that they may be deftroyed, as in couching or extraction, and yet the eye be capable of adapting itfelf to the different diftances of objects. For a more full refutation of thefe opinions, fee Haller's large work.

The Situation, Structure, and Action of the external Mufcles (H).

"Upon carefully removing the eyelids, with their mufcles, we are prefented with the mufcles of the eye itfelf, which are fix in number; four called recti, or ftraight; and two oblique; fo named from their direction, (fee Pl. 3. Appen. fig. 4.) AAAA, the tendons of the recti mufcles, where they are inferted into the fclerotic coat, at the anterior part of the eye. B, the fuperior oblique, or trochlearis, as fometimes called, from its paffing through the loop or pulley connected to the lower angle of the orbiter notch in the os frontis; it paffes under the fuperior rectus mufcle, and backwards to the pofterior part of the eye, where it is inferted by a broad flat tendon into the fclerotic coat. C, the inferior oblique, arifing tendinous from the edge of the orbiter procefs of the fuperior maxillary bone, paffes ftrong and flefhy over the inferior rectus, and backwards under the abductor to the pofterior part of the eye, where it is alfo inferted by a broad flat tendon into the fclerotic coat. DDD, the fat in which the eye is lodged. In fig. 5. we have removed the bones forming the external fide of the orbit, with a portion of the fat, by which we have a diftinct view of the abductor. ABC, three of the recti mufcles, arifing from the back part of the orbit, paffing ftrong, broad, and flefhy over the ball of the eye, and inferted by flat, broad tendons into the fclerotic coat, at its anterior part. D, the tendon of the fuperior oblique mufcle. E, the inferior oblique, fig. 6. A, the abductor of the eye. B, the flefhy belly of the fuperior oblique, arifing ftrong, tendinous, and flefhy from the back part of the orbit. C, the optic nerve. D and E, the recti mufcles.

"The ufe afcribed to thefe different mufcles, 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 fituation of objects, or to exprefs the different paffions of the mind, for which they are peculiarly adapted. But is it inconfiftent with the general laws of nature, or even with the animal œconomy, that from their combination they fhould have a different action, and thus an additional ufe? To illuftrate this we need only witnefs the action of almoft any fet of mufcles in the body; for example, in lifting a weight, the combined action of the mufcles of the arm, fhoulder, and cheft, is different from the individual action of either fet, or of any individual mufcle; or an inftance nearer our purpofe may be adduced, viz. the actions of the mufcles of the cheft and belly, making a compreffion upon the vifcera, as in the difcharge of urine, fæces, &c. But to queftion this fact would be to queftion the influence of the will in any one of the almoft infinite variety of motions in the human body.

"I prefume, therefore, it will be admitted that we have the fame power over thefe mufcles of the eye as of others, and I believe we are no lefs fenfible of their combined action; for example, after viewing an object at the diftance of half a mile, if we direct our attention to an object but ten feet diftance, every perfon muft be fenfible of fome exertion; and if our attention be continued but for a fhort time, a degree of uneafinefs and even pain in the ball of the eye is experienced; if again we view an object within the focal diftance, *i. e.* within fix or feven inches, fuch is the intenfity of the pain that the exertion can be continued but a very fhort time, and we again relieve it by looking at the more diftant objects; this, I believe, muft be the experience of every perfon, whofe eyes are in the natural and healthy ftate, and accordingly has been obferved by almoft every writer upon optics.

"But the power of this combination, even from analogy, appears too obvious to need further illuftration. I fhall therefore next endeavour to point out their precife action.

"Suppofing the eye in its horizontal natural pofition; I fee an object diftinctly at the diftance of fix feet, the picture of the object falls exactly upon the retina; I now direct my attention to an object at the diftance of fix inches, as nearly as poffible in the fame line; although the rays from the firft object ftill fall upon my eye, while viewing the fecond, it does not form a diftinct picture on the retina, although at the fame diftance as before, which fhews that the eye has undergone fome change; for while I was viewing the firft object I did not fee the fecond diftinctly, although in the fame line: and now, *vice verfa*, I fee the fecond diftinctly, and not the firft; the rays from the firft, therefore, as they ftill fall upon the eye, muft either meet before or behind the retina; but we have fhewn that the rays from the more diftant object convene fooner than thofe from the lefs

(E) *Des Cartes*, *Scheinerus*, *Bidious*, *Mollinettus*, *Sanctorius*, *Jurin*.

(F) *Kepler*, *Zinn*, *Porterfield*.

(G) *La Chariere*, *Perrault*, *Hartfocker*, *Briffeau*, and *Derham*.

(H) For the accuracy of the reprefentation I have annexed (in Pl. 3. Appen.) I can vouch, having been at much pains in the diffection; from which I had the painting taken by a moft accurate hand, Mr S. Edwards, a gentleman well known for his abilities in the plates of that admirable work, the Flora Londinenfis.

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 compression

(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,

(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 tafte for true fcience and elegant letters. Erafmus, with whom he lived upon the footing of intimate friendfhip, fpeaking of Vives when he was only 26 years of age, fays, that there was no part of philofophy in which he did not excel; and that he had made fuch proficiency in learning, and in the arts of fpeaking and writing, that he fcarcely knew his equal. He wrote a commentary upon Auguftine's treatife *De Civitate Dei*, which difcovers an extenfive acquaintance with ancient philofophy. Henry VIII. of England, to whom he dedicated this work, was fo pleafed with it, that he invited the author to his court, and made him preceptor to his daughter Mary. Though he difcharged his office with great fidelity, yet in confequence of his oppofition to the king's divorce, he fell under his difpleafure; and it was not without difficulty that he efcaped to Bruges, where he devoted the remainder of his days to ftudy. He died in the year 1537, or, according to Thuanus, in 1541. With Erafmus and Buddæus he formed a triumvirate of literature which did honour to the age. He wrote *De Prima Philofophia*, "On the Firft Philofophy;" *De Explanatione Effentiarum*, "On the Explanation of Effences;" *De Cenfura Veri*, "On the Teft of Truth;" *De Initiis, Sectis, et Laudibus Philofophiæ*, "On the Origin, Sects, and Praifes of Philofophy;" and *De Corruptis Artibus et Tradendis Difciplinis*; "On the Corruption of Science, and on Education." Thefe writings, of which the two laft are the moft valuable, difcover great ftrength of judgment, an extenfive knowledge of philofophy, much enlargement of conception, uncommon fagacity in detecting the errors of ancient and modern philofophers, particularly of Ariftotle and his followers, and, in fine, a mind capable of attempting things beyond the ftandard of the age in which he lived. To all this he added great perfpicuity and elegance of ftyle, not unworthy of the friend of Erafmus.

ULIETEA, one of the Society Iflands in the S. Pacific Ocean, is about 7 or 8 leagues from the ifland of Huaheine, at S. W. by W. There are 9 uninhabited iflands weft of it. The fouth 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 eafterly by the middle of Hudfon's river, foutherly by the county of Orange, wefterly by the ftate of Pennfylvania, and the weft branch of Delaware river, and northerly by the county of Albany. In 1790, it contained 29,397 inhabitants, including 2,906 flaves. In 1796, there were 4,429 of the inhabitants qualified to be electors. It is divided into 16 townfhips. Chief town, Kingfton. A part of this county and that of Otfego, were erected into a feparate county, January, 1797.—*ib.*

ULTRAMARINE is a very fine blue powder, almoft of the colour of the corn flower or blue-bottle, which has this uncommon property, that, when expofed to the air or a moderate heat, it neither fades nor becomes tarnifhed. On this account it is ufed in painting; but it was employed formerly for that purpofe much more than at prefent, as fmalt, 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 feparating them as much as poffible 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 eaftward from the Cafpian fea, and particularly at Kalab and Budukfchu. It is fent thence to the Eaft Indies, and from the Eaft Indies to Europe. Good ultramarine muft be of a beautiful dark colour, and free from fand as well as every other mixture. It muft unite readily with oil; it muft not become tarnifhed on a red-hot tile or plate of iron, and it ought to diffolve in ftrong acids, almoft like the zeolite, without caufing an effervefcence. In the year 1763, an ounce of it at Paris coft four pounds fterling, and an ounce of *cendre d'outremer* which is the refufe, two pounds. The bafis of this colour was long fufpected to be copper, but the experiments of Margraff fhewed that it was iron, in fome unknown ftate of combination. New light has been thrown on this fubject by Morveau, who has difcovered that felenite loaded with iron, when decompofed by carbonaceous matter, yields a blue fulphuret of iron of equal permanency with the true ultramarine.

At prefent, fmalt of a good colour is often purchafed at a dear rate and fubftituted 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 analyfis of lapis lazuli, fee Mineralogy, n° 69. *Suppl.*

ULYSSES, one of the military townfhips in Onondago county, New-York, fituated at the fouthern end of Cayuga Lake, having Hector on the weft, and Dryden on the eaft, which laft townfhip is included within the jurifdiction of Ulyffes, which was incorporated in 1794. In 1796, 38 of the inhabitants were electors.—*Morse*.

UMBAGOG, a large lake of New-Hampfhire, next in fize to Lake Winipifeogee. It lies in Grafton county, and a fmall part of it in the Diftrict of Maine.—*ib.*

UNADILLA, a river of the ftate of New-York, called alfo *Tianaderha*, runs fouthward, and joining the Main Branch, forms Chenengo river.—*ib.*

Unadilla, a townfhip of New-York, Otfego county, on the northern fide of the main branch of Chenengo river. It is about 110 miles fouth-weft of Albany; and, in 1796, 502 of its inhabitants were electors. In the fame year, the townfhips of Suffrage, Otfego, and Butternuts, were taken from this townfhip, and incorporated.—*ib.*

UNAMI, a tribe of the Delaware Indians, confidered to be the head of that nation.—*ib.*

UNDERHILL, a townfhip of Vermont, Chittenden county, 12 miles eaft of Colchefter, and contains 65 inhabitants.—*ib.*

UNION, a county of South-Carolina, Pinckney diftrict, containing 7,693 inhabitants, of whom 6,430 are whites, and 1,215 flaves. It fends two reprefentatives and one fenator to the ftate legiflature. Chief town, Pinckneyville.—*ib.*

Union, a rocky townfhip in Tolland county, Connecticut, weft of Woodftock, and about 12 miles N. E. of Tolland.—*ib.*

Union, a townfhip of the Diftrict of Maine, Lincoln county, containing 200 inhabitants. It was incorporated in 1786, and lies 290 miles from Bofton.—*ib.*

Union, a poft-town of the ftate of New-York, Tioga county, on the N. fide of Sufquehannah river, and weft of the mouth of the Chenengo, 122 miles S. E. by E. of of Williamfburg, on Geneffee river, 24 E. N. E. of Athens, or Tioga Point, 92 S. W. of Cooperftown, and 340 N. by W. of Philadelphia. In 1796, there were in the townfhip, 284 of the inhabitants qualified electors. —*ib.*

Union *River*, or *Plantation No.* 6, in the Diftrict of Maine, is fituated in Hancock county, 25 miles N. E. of Penobfcot.—*ib.*

Union *River*, in the county of Hancock, Diftrict of Maine, empties into Blue Hill Bay, on the E. fide of Penobfcot Bay. Long-Ifland, in this bay, is in lat. 44 25, and long 67 45.—*ib.*

UNION-TOWN, a poft-town of Pennfylvania, Fayette county, on Redftone Creek. It contains a church, a ftone gaol, and a brick court-houfe, and about 80 dwelling-houfes. Near it are two valuable merchant mills. It is the feat of the county courts, and is 14 miles S. by E. of Brownfville, where Redftone Creek enters the Monongahela, 58 miles S. of Pittfburg, 24 N. E. of Morgantown, in Virginia, and 327 W. of Philadelphia.—*ib.*

UNITAS, a village of N. Carolina, fituated at the head of Gargal's Creek.—*ib.*

UNITED STATES of America, fituated 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 eaft, by Britifh America, or the Provinces of Upper and Lower Canada, and New Brunfwick; fouth-eaft, by the Atlantic Ocean; fouth by Eaft and Weft Florida; weft, by the river Miffiffippi.

The American Republic, confifts of three grand divifions, denominated the *Northern*, or more properly *Eaftern*, *Middle* and *Southern* States. The *firft* divifion, (the Northern or Eaftern States) comprehends Vermont, New Hampfhire, Diftrict of Maine, (belonging to Maffachufetts) Maffachufetts, Rhode Ifland, and Connecticut. Thefe are called the New England States, and comprehend that part of America, which, fince the year 1614, has been known by the name of New England. The *fecond* divifion (the Middle States) comprehends New York, New Jerfey, Pennfylvania, Delaware, and Territory N. W. of Ohio. The *third* divifion (the Southern States) comprehends Maryland, Virginia, Kentucky, North Carolina, Tenneffee, South Carolina, Georgia, and Miffiffippi 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 difputes which might arife in future on the fubject of the boundaries of the faid United States may be prevented, it is hereby agreed and declared, that the following are and fhall be their boundaries, viz. From the north-weft angle of Nova Scotia, viz. that angle which is formed by a line drawn due north from the fource of St Croix River to the Highlands, along the faid Highlands, which divide thofe rivers that empty themfelves into the river St Lawrence from thofe which fall into the Atlantic Ocean, to the north-wefternmoft 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 weft on faid latitude, until it ftrikes the river Iroquois or Cataraquie; thence along the middle of the faid river into Lake Ontario; through the middle of faid lake, until it ftrikes the communication by water between that lake and Lake Erie; thence along the middle of faid communication into Lake Erie, through the middle of faid lake, until it arrives at the water communication between that lake and Lake Huron; thence through the middle of faid lake to the water communication between that lake and Lake Superior; thence through Lake Superior, northward of the Ifles Royal and Phillipeaux, to the Long Lake; thence through the middle of faid Long Lake, and the water communication between it and the Lake of the Woods, to the faid Lake of the Woods; thence through the faid lake to the moft northweftern point thereof, and from thence, on a due weft courfe, to the River Miffiffippi; thence by a line to be drawn along the middle of faid River Miffiffippi, until it fhall interfect the northernmoft part of the thirty-firft degree of north latitude.

"South, by a line to be drawn due eaft from the determination of the line laft 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 ftraight to the head of St Mary's River; and thence down along the middle of St Mary's River to the Atlantic Ocean.

"Eaft, by a line to be drawn along the middle of the River St Croix, from its mouth, in the Bay of Fundy, to its fource, and from its fource directly north, to the aforefaid Highlands, which divide the rivers that fall into the Atlantic Ocean from thofe which fall into the River St Lawrence; comprehending all iflands within twenty leagues of any part of the fhores of the United States, and lying between lines to be drawn due eaft from the points where the aforefaid boundaries between Nova Scotia on the one part, and Eaft Florida on the other, fhall refpectively touch the Bay of Fundy and the Atlantic Ocean, excepting fuch iflands as now are, or heretofore have been, within the limits of the faid province of Nova Scotia."

The territory of the United States, according to Mr Hutchins, contains, by computation, a million of fquare miles, in which are

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 weft boundary line of Pennfylvania, on the eaft; the boundary line between Great Britain and the United States, extending from the northweft corner of Pennfylvania, to the northweft extremity of the Lake of the Woods, on the north; the river Miffiffippi, to the mouth of the Ohio, on the weft; and the river Ohio on the fouth, to the aforementioned bounds of Pennfylvania, contains, by computation, about 411,000 fquare miles, in which are

fquare miles, in which are	263,040,000 acres
Deduct for water	43,040,000
To be difpofed of by order of Congrefs, when purchafed of the Indians	220,000,000

The whole of this immenfe extent of unappropriated weftern territory, containing as above ftated, 220,000,000 of acres, and feveral large tracts fouth 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.

Rainy

(A) Ceded by North Carolina, South Carolina, and Georgia, with certain reſervations for the Indians and other purpoſes.

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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 Michilimakkinac 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

(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.]

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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.

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 $15\frac{1}{2}$ 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,

(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.*]

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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

(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 thefe fhoals being feveral miles, the voyage is longer, and in fome parts more dangerous than in the fpring. The merchandife neceffary for the commerce of the upper fettlements on or near the Miffiffippi, is conveyed in the fpring 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 iflands, fome of which are of great extent, interfperfe that mighty river. Its waters, after overflowing its banks below the river Ibberville on the eaft, and the river Rouge on the weft, never return within them again, there being many outlets or ftreams, by which they are conducted into the Bay of Mexico, more efpecially on the weft fide of the Miffiffippi, dividing the country into numerous iflands. Thefe fingularities diftinguifh it from every other known river in the world. Below the Ibberville, the land begins to be very low on both fides of the river, acrofs the country, and gradually declines as it approaches nearer to the fea. The ifland of New Orleans, and the lands oppofite, are to all appearance of no long date; for in digging ever fo little below the furface, you find water and great quantities of trees. The many beaches and breakers as well as inlets, which have arifen out of the channel fince 1650, at the feveral mouths of the river, are convincing proofs that this peninfula was wholly formed in the fame manner. And it is certain that when La Salle failed down the Miffiffippi to the fea, the opening of that river was very different from what it is at prefent.

The nearer you approach to the fea, this truth becomes more ftriking. The bars that crofs moft of thefe fmall channels, opened by the current, have been multiplied by means of the trees carried down with the ftreams; one of which, ftopped by its roots or branches in a fhallow part, is fufficient to obftruct the paffage of thoufands more, and to fix them at the fame place. Aftonifhing collections of trees are daily feen in paffing between the Balize and the Miffouri. No human force is fufficient to remove them, and the mud carried down by the river ferves 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 lefs than ten years time, canes, fhrubs and aquatic timber grow on them, and form points and iflands, which forcibly fhift the bed of the river.

Nothing can be afferted with certainty, refpecting the length of this river. Its fource is not known, but fuppofed to be upwards of three thoufand miles from the fea as the river runs. We only know, that from St Anthony's Falls in lat. 45° it glides with a pleafant clear current, and receives many large and very extenfive tributary ftreams, before its junction with the Miffouri, without greatly increafing the breadth of the Miffiffippi, though they do its depth and rapidity. The muddy waters of the Miffouri difcolour the lower part of the river, till it empties into the Bay of Mexico. The Miffouri is a longer, broader, and deeper river than the Miffiffippi, and affords a more extenfive navigation; it is in fact the principal river, contributing more to the common ftream than does the Miffiffippi. It has been afcended by French traders about twelve or thirteen hundred miles, and from the depth of water, and breadth of the river at that diftance, it appeared to be navigable many miles further.

From the Miffouri river, to nearly oppofite the Ohio, the weftern bank of the Miffiffippi is (fome few places excepted) higher than the eaftern. From Mine-au-fer to the Ibberville, the eaftern bank is higher than the weftern, on which there is not a fingle difcernible rifing or eminence, the diftance of feven hundred and fifty miles. From the Ibberville to the fea, there are no eminences on either fide, though the eaftern bank appears rather the higheft of the two, as far as the Englifh turn. Thence the banks gradually diminifh in height to the mouths of the river, where they are but a few feet higher than the common furface of the water.

The flime which the annual floods of the river Miffiffippi leave on the furface of the adjacent fhores, may be compared with that of the Nile, which depofits a fimilar manure, and for many centuries paft has infured the fertility of Egypt. When its banks fhall have been cultivated, as the excellency of its foil and temperature of the climate deferves, its population will equal that of any other part of the world. The trade, wealth and power of America, may, at fome future period, depend, and perhaps centre upon the Miffiffippi. This alfo refembles the Nile in the number of its mouths, all iffuing into a fea that may be compared to the Mediterranean, which is bounded on the north and fouth by the two continents of Europe and Africa, as the Mexican Bay is by North and South America. The fmaller mouths of this river might be eafily ftopped up, by means of thofe 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 caft his eye over a map of the town of New Orleans, and the immenfe country around it, and view its advantageous fituation, muft be convinced that it or fome place near it, muft in procefs of time become one of the greateft marts in the world.

The Falls of St Anthony, in about lat. 45°, received their name from Father Lewis Hennipin, a French miffionary, who travelled into thefe parts about the year 1680, and was the firft European ever feen by the natives. The whole river, which is more than 250 yards wide, falls perpendicularly about thirty feet, and forms a moft pleafing cataract. The rapids below, in the fpace of three hundred yards render the defcent confiderably greater; fo that when viewed at a diftance, they appear to be much higher than they really are. In the middle of the falls is a fmall ifland, about forty feet broad, and fomewhat longer, on which grow a few cragged hemlock and fpruce trees; and about half way between this ifland and the eaftern fhore is a rock, lying at the very edge of the fall, in an oblique pofition, five or fix feet broad, and thirty or forty long. Thefe falls are peculiarly fituated, as they are approachable without the leaft obftruction from any intervening hill or precipice, which cannot be faid of any other confiderable falls perhaps in the world. The country around is exceedingly beautiful. It is not an uninterrupted plain, where the eye finds no relief, but compofed of many gentle afcents, which, in the fpring and fummer, are covered with verdure, and interfperfed with little groves, that give a pleafing variety to the profpect.

 A little

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 Miſſiſſippi, 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.*

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defcent of about eight hundred feet, by meafurement, from the foot of the mountains to the fea board. This defcent continues, as is demonftrated by foundings, far into the fea.

4. It is worthy of obfervation, that the foil on the banks of the rivers is proportionably coarfe or fine according to its diftance from the mountains. When you firft leave the mountains, and for a confiderable diftance, it is obfervable, that the foil is coarfe, with a large mixture of fand and fhining heavy particles. As you proceed toward the fea, the foil is lefs coarfe, and fo on, in proportion as you advance, the foil is finer and finer, until, finally, is depofited a foil fo fine, that it confolidates into perfect clay; but a clay of a peculiar quality, for a great part of it has intermixed with it reddifh ftreaks and veins, like a fpecies of *ochre*, brought probably from the *red lands* which lie up towards the mountains. This clay, when dug up and expofed to the weather, will diffolve into a fine mould, without the leaft mixture of fand or any gritty fubftance whatever. Now we know that running waters, when turbid, will depofit, firft, the coarfeft and heavieft particles, mediately, thofe of the feveral intermediate degrees of finenefs, and ultimately, thofe which are the moft light and fubtle; and fuch in fact is the general quality of the foil on the banks of the fouthern rivers.

5. It is a well known fact, that on the banks of Savannah river, about ninety miles from the fea, in a direct line, and one hundred and fifty or two hundred, as the river runs, there is a very remarkable collection of oyfter-fhells of an uncommon fize. They run in a north-eaft and fouth-weft direction, nearly parallel to the fea coaft, in three diftinct ridges, which together occupy a fpace of feven miles in breadth. The ridges commence at Savannah river, and have been traced as far fouth as the northern branches of the Alatamaha river. They are found in fuch quantities, as that the Indigo planters carry them away in large boat loads for the purpofe of making lime water, to be ufed in the manufacture of indigo. There are thoufands and thoufands of tons ftill remaining (G). The queftion is, how came they here? It cannot be fuppofed that they were carried by land. Neither is it probable that they were conveyed in canoes or boats to fuch a diftance from the place where oyfters are now found. The uncivilized natives, agreeably to their roving manner of living, would rather have removed to the fea fhore, than have been at fuch immenfe labour in procuring oyfters. Befides, the difficulties of conveying them would have been infurmountable. They would not only have had a ftrong current in the river againft them, an obftacle which would not have been eafily overcome by the Indians, who have ever had a great averfion to labour; but could they have furmounted this difficulty, oyfters conveyed fuch a diftance, either by land or water, in fo warm a climate, would have fpoiled on the paffage, and have become ufelefs. The circumftance of thefe fhells being found in fuch quantities, at fo great a diftance from the fea, can be rationally accounted for in no other way, than by fuppofing that the fea fhore was formerly near this bed of fhells, and that the ocean has fince, by the operation of certain caufes not yet fully inveftigated, receded. Thefe phenomena, as they cannot be otherwife accounted for, prove as far as it can be proved, that a great part of the flat country which fpreads eafterly of the Allegany mountains, had, in fome paft period, a fuperincumbent fea or water; but it is beyond the abilities of man to account for the change in a fatisfactory manner.

The tract of country eaft of Hudfon's river, comprehending part of the State of New York, the four New England States, and Vermont, is rough, hilly, and in fome parts mountainous. In all parts of the world, and particularly on this weftern continent, it is obfervable, that as you depart from the ocean or from a river, the land gradually rifes: and the height of land, in common, is about equally diftant from the water on either fide. The *Andes*, in South America, form the height of land between the Atlantic and Pacific Oceans. The Highlands between the diftrict of Maine and the Province of Lower Canada, divide the rivers which fall into the St Lawrence, north, and into the Atlantic, fouth. The Green Mountains, in Vermont, divide the waters which flow eafterly into Connecticut river from thofe which fall wefterly into Lake Champlaine, Lake George, and Hudfon's river.

Between the Atlantic, the Miffiffippi, and the Lakes, runs a long range of mountains, made up of a number of ridges. Thefe mountains extend north-eafterly and fouth-wefterly, nearly parallel to the fea coaft, about nine hundred miles in length, and from fixty to one hundred and fifty, and two hundred miles in breadth. Mr Evans obferves, with refpect to that part of thefe mountains which he travelled over, viz. in the back parts of Pennfylvania, that fcarcely one acre in ten is capable of culture. This, however, is not the cafe in all parts of this range. Numerous tracts of fine arable and

(G) " On the Georgia fide of the river, about 15 miles below Silver Bluff, the high road croffes a ridge of high fwelling hills of uncommon elevation, and perhaps 70 feet higher than the furface of the river. Thefe hills are from three feet below the common vegetative furface, to the depth of 20 or 30 feet, compofed entirely of foffil oyfter-fhells, internally of the colour and confiftency 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 thicknefs, and their hollows fufficient to receive an ordinary man's foot. They appear all to have been opened before the period of petrifaction; a tranfmutation they feem evidently to have fuffered. They are undoubtedly very ancient, or perhaps antediluvian. The adjacent inhabitants burn them to lime, for building, for which purpofe they ferve very well; and would undoubtedly afford an excellent manure, when their lands require it, thefe hills now being remarkably fertile. The heaps of fhells lie upon a *ftratum* of yellowifh fand mould, of feveral feet in depth, upon a foundation of foft white rocks, that has the outward appearance of free ftone, but on ftrict examination is really a teftaceous concrete, or compofition of fand and pulverifed fea fhells. In fhort, this teftaceous rock approaches near in quality and appearance to the Bahama or Bermudian white rock." [*Bartram's Travels*, *p*. 318.]

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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.

States. Dr Barton, of Philadelphia, has been collecting materials for a work of a fimilar nature, to comprehend the middle and fouthern ftates; when finifhed, both together, will form a complete Natural Hiftory of the American States.

The birds of America, fays Catefby, generally exceed thofe of Europe in the beauty of their plumage, but are much inferior to them in the melody of their notes.

The middle ftates, including Virginia, appear to be the climates, in North America, where the greateft number and variety of birds of paffage celebrate their nuptials and rear their offspring, with which they annually return to more fouthern regions. Moft of our birds are birds of paffage from the fouthward. The eagle, the pheafant, grous and partridge of Pennfylvania, feveral fpecies of woodpeckers, the crow, blue jay, robin, marfh wren, feveral fpecies of fparrows or fnow birds, and the fwallow, 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 fouth or maritime parts of Virginia, in Carolina, Georgia and Florida; yet all thofe numerous tribes, particularly of the foft billed kind, which breed in Pennfylvania, pafs, in the fpring feafon, through thefe regions in a few weeks time, making but very fhort ftages by the way; and again, but few of them winter there on their return fouthwardly.

It is not known how far to the fouth they continue their route, during their abfence from the northern and middle ftates.

Among amphibious reptiles are the mud tortoife or turtle (Teftudo denticulata.) Speckled land tortoife (Teftudo carolina.) Great foft fhelled tortoife of Florida (Teftudo nafo cylindracea elongato, truncato. Bartram.) When full grown it weighs from 30 to 40 pounds, (fome fay 70 pounds) extremely fat and delicious food. Great land tortoife, called gopher; its upper fhell is about 18 inches long, and from 10 to 12 broad.—Found fouth of Savannah river.

Two fpecies of frefh water tortoifes inhabit the tide water rivers in the fouthern States; one is large, weighing from 10 to 12 pounds, the back fhell nearly of an oval form; the other fpecies fmall; but both are efteemed delicious food. The tortoifes of the northern ftates are of feveral fpecies, but have not been fcientifically defignated.

Of the frog kind there are many fpecies and in great numbers. Alfo of lizards, from the alligator to the fmall blue lizard.

Snakes are numerous, and of a great variety of kinds, fome of which, as the rattle fnake, are venomous and others not. They are not fo numerous nor fo venomous in the northern as in the fouthern ftates. In the latter, however, the inhabitants are furnifhed with a much greater variety of plants and herbs, which afford immediate relief to perfons bitten by thefe venomous creatures. It is an obfervation worthy of perpetual and grateful remembrance, that wherever venomous animals are found, the God of nature has kindly provided fufficient antidotes againft their poifon.

Of fifhes a vaft variety are found in the feas and rivers of the United States, from the whale down to the fmalleft fpecies.

A vaft variety of infects are found in the United States, of which fome catalogues have been publifhed by Dr Belknap and others.

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According to the cenfus, taken by order of Congrefs, in 1790, the number of inhabitants in the United States of America, was three millions, nine hundred thirty thoufand, 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 Tenneffee were included. Thefe added would undoubtedly have increafed the number to 3,950,000, at the period the cenfus was taken. According to the cenfus taken in 1800, the total number of inhabitants in the United States was five millions three hundred and five thoufand fix hundred and fixty fix, including eight hundred and ninety three thoufand fix hundred and five flaves.

The American Republic is compofed of almoft all nations, languages, characters and religions which Europe can furnifh; the greater part however, are defcended from Britain and Ireland.

The Americans, collected together from various countries, of different habits, formed under different governments, and of different languages, cuftoms, manners and religion, have not yet affimilated to that degree as to form a *national* character. We are yet an infant empire, rifing faft to maturity, with profpects of a vigorous and powerful manhood.

Until the revolution of 1783, Europeans were ftrangely ignorant of America and its inhabitants. They concluded that the new world *muft* be inferior to the old. The count de Buffon fuppofed that the animals in this country were uniformly lefs than in Europe, and thence concluded, that, "on this fide of the Atlantic there is a tendency in nature to diminifh the fize of her productions." The Abbe Raynal, in a former edition of his works, fuppofed this tendency or influence had its effect on the race of whites tranfplanted from Europe, and thence had the prefumption to affert that "America had not yet produced one good poet, one able mathematician, one man of genius in a fingle art or fcience." Had the Abbe been juftly informed, we prefume he would not have hazarded an affertion fo falfe, 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 fcience of war, in phyfics, aftronomy and mathematics; in mechanic arts, in government, in fifcal fcience, in divinity, in hiftory, in oratory, in poetry, in painting, in mufic, and the plaftic art. So many have diftinguifhed themfelves in fome of thefe branches of fcience, and fuch numbers are now living, that it would be an impracticable and invidious tafk to attempt an enumeration of them.

The two late important revolutions in America, which have been fcarcely exceeded in any former period of the world, viz. that of the declaration and eftablifhment of independence, and that of the adoption of a new and excellent form of government without blood fhed, have called to hiftoric fame many great and diftinguifhed characters who might otherwife have flept in oblivion.

One of the moft unamiable traits in the character of Americans, has been produced by the unjuftifiable practice of enflaving the negroes. The influence of flavery upon the morals, manners, induftry and liberties of a peo-

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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

(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.*

ted tes. 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 tranquillity, 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. United States.

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 proceed-

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ings, punifh its members for diforderly behaviour, and, with the concurrence of two-thirds, expel a member.

Each houfe fhall keep a journal of its proceedings, and from time to time publifh the fame, excepting fuch parts as may in their judgment require fecrecy; and the yeas and nays of the members of either houfe on any queftion, fhall, at the defire of one-fifth of thofe prefent, be entered on the journal.

Neither houfe, during the feffion of Congrefs, fhall, without the confent of the other, adjourn for more than three days, nor to any other place than that in which the two houfes fhall be fitting.

Sect. 6. The Senators and Reprefentatives fhall receive a compenfation for their fervices to be afcertained by law, and paid out of the treafury of the United States. They fhall in all cafes except treafon, felony and breach of the peace, be privileged from arreft during their attendance at the feffion of their refpective houfes, and in going to and returning from the fame; and for any fpeech or debate in either houfe, they fhall not be queftioned in any other place.

No Senator or Reprefentative fhall, during the time for which he was elected, be appointed to any civil office under the authority of the United States, which fhall have been created, or the emoluments whereof fhall have been increafed during fuch time; and no perfon holding any office under the United States, fhall be a member of either houfe during his continuance in office.

Sect. 7. All bills for raifing revenue fhall originate in the Houfe of Reprefentatives; but the Senate may propofe or concur with amendments as on other bills.

Every bill which fhall have paffed the Houfe of Reprefentatives and the Senate fhall, before it becomes a law, be prefented to the Prefident of the United States; if he approve, he fhall fign it, but if not, he fhall return it, with his objections, to that houfe in which it fhall have originated, who fhall enter the objections at large on their journal, and proceed to re-confider it. If, after fuch re-confideration, two-thirds of that houfe fhall agree to pafs the bill, it fhall be fent, together with the objections to the other houfe, by which it fhall likewife be re-confidered, and if approved by two-thirds of that houfe it fhall become a law. But in all fuch cafes the votes of both houfes fhall be determined by yeas and nays, and the names of the perfons voting for and againft the bill fhall be entered on the journal of each houfe refpectively. If any bill fhall not be returned by the Prefident within ten days, (Sundays excepted) after it fhall have been prefented to him, the fame fhall be a law, in like manner as if he had figned it, unlefs the Congrefs, by their adjournment, prevent its return, in which cafe it fhall not be a law.

Every order, refolution, or vote, to which the concurrence of the Senate and Houfe of Reprefentatives may be neceffary (except on a queftion of adjournment) fhall be prefented to the Prefident of the United States; and before the fame fhall take effect, fhall be approved by him, or, being difapproved by him, fhall be re-paffed by two-thirds of the Senate and Houfe of Reprefentatives, according to the rules and limitations prefcribed in the cafe of a bill.

Sect. 8. The Congrefs fhall have power

To lay and collect taxes, duties, impofts and excifes; to pay the debts and provide for the common defence and general welfare of the United States; but all duties, impofts and excifes fhall 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 feveral ftates, and with the Indian tribes;

To eftablifh an uniform rule of naturalization, and uniform laws on the fubject of bankruptcies throughout the United States;

To coin money, regulate the value thereof, and of foreign coin, and fix the ftandard of weights and meafures;

To provide for the punifhment of counterfeiting the fecurities and current coin of the United States;

To eftablifh poft offices and poft roads;

To promote the progrefs of fcience and ufeful arts, by fecuring for limited times, to authors and inventors, the exclufive right to their refpective writings and difcoveries;

To conftitute tribunals inferior to the fupreme court;

To define and punifh piracies and felonies committed on the high feas, and offences againft the law of nations;

To declare war, grant letters of marque and reprifal, and make rules concerning captures on land and water;

To raife and fupport armies, but no appropriation of money to that ufe fhall 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, fupprefs infurrections, and repel invafions;

To provide for organizing, arming, and difciplining the militia, and for governing fuch part of them as may be employed in the fervice of the United States, referving to the ftates refpectively the appointment of the officers, and the authority of training the militia according to the difcipline prefcribed by Congrefs;

To exercife exclufive legiflation in all cafes whatfoever over fuch diftrict (not exceeding ten miles fquare) as may by ceffion of particular ftates, and the acceptance of Congrefs, become the feat of the government of the United States, and to exercife like authority over all places purchafed by the confent of the legiflature of the ftate in which the fame fhall be, for the erection of forts, magazines, arfenals, dockyards, and other needful buildings:—And

To make all laws which fhall be neceffary and proper for carrying into execution the foregoing powers, and all other powers vefted by this conftitution in the government of the United States, or in any department or officer thereof.

Sect. 9. The migration or importation of fuch perfons as any of the ftates now exifting fhall think proper to admit, fhall not be prohibited by the Congrefs prior to the year one thoufand eight hundred and eight, but a tax or duty may be impofed on fuch importation, not exceeding ten dollars for each perfon.

The privilege of the writ of habeas corpus fhall not be fufpended, unlefs when in cafes of rebellion or invafion the public fafety may require it.

No bill of attainder or ex poft facto law fhall be paffed.

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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 Vice 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 eſtabliſhed

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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.

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

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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

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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 o the world superior advantages for trade. Our commerce, including our exports, imports, shipping, manufactures and fisheries, may properly be considered

(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.*]

confidered as forming one intereft. This has been confidered as the great object, and the moft important intereft of the New England States.

The late war, which brought about our feparation from Great Britain, threw our commercial affairs into great confufion. The powers of the old confederation were unequal to the complete execution of any meafures, calculated effectually to recover them from their deranged fituation. Through want of power in the old Congrefs to collect a revenue for the difcharge of our foreign and domeftic debt, our credit was deftroyed, and trade of confequence greatly embarraffed. Each ftate, in her defultory regulations of trade, regarded her own intereft, while that of the union was neglected. And fo different were the interefts of the feveral ftates, that their laws refpecting trade often clafhed with each other, and were productive of unhappy confequences. The large commercial ftates had it in their power to opprefs their neighbours; and in fome inftances this power was directly or indirectly exercifed. Thefe impolitic and unjuftifiable regulations, formed on the impreffion of the moment, and proceeding from no uniform or permanent principles, excited unhappy jealoufies between the clafhing ftates, and occafioned frequent ftagnations in their trade, and in fome inftances, a fecrecy in their commercial policy. But the wife meafures which have been adopted by Congrefs, under the prefent government, have extricated us from thefe embarraffments, and put a new and pleafing face upon our affairs. Invefted with the adequate powers, Congrefs have formed a fyftem of commercial regulations, which has placed our commerce on a refpectable, uniform and intelligible footing, adapted to promote the general interefts of the union, with the fmalleft injury to the individual ftates.

The value of the exports of thefe ftates before the revolution is not precifely afcertained; but the whole exportation of North America, including the remaining Britifh Colonies, and Newfoundland, (whofe fifhery alone was eftimated 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 thefe were comprifed the fhipments between thofe iflands and the main, and from province to province, as every veffel which departed from one American port to another, was obliged to clear out her cargo as if deftined for a foreign country.

The amount of exports of the United States in the year 1799 was 33,142,187 dollars in domeftic produce, and 45,523,335 dollars in foreign produce, total 78,665,522 dollars. In time of peace however, fo great an amount cannot be expected.

In refpect to the commercial intercourfe between the United States and foreign nations, as regulated by exifting treaties, or by the laws of the land, the fubject is too extenfive, complex and important to be embraced to advantage within a compafs proportioned to the nature of this work.

It is afferted that the value of the manufactures of the United State is more than double the value of their exports in native commodities, and alfo much greater than the grofs value of all their imports, including the value of goods exported again. The American manufacturers confine their attention chiefly to articles of neceffity, comfort and utility. Since the eftablifhment of the prefent federal government the manufactures have increafed with great rapidity; and particularly thofe of the houfehold kind, which are carried on more or lefs in the families of almoft all the farmers and planters in the feveral ftates.

Standing armies are deemed inconfiftent with a republican government; we of courfe have none. Our military ftrength lies in a well difciplined militia. According to the cenfus of 1790, there were in the United States, 814,000 men of 16 years old and upwards, whites. Suppofe that the fuperannuated, the officers of government, and the other claffes of people who are excufed from military duty, amounted to 114,000, there remained at that period a militia of 700,000 men. The increafe of this number has been in proportion to the increafe of the whole number of inhabitants fince the year 1790. Of the militia a great proportion are well-difciplined, vetran troops. No nation or kingdom in Europe, can bring into the field an army of equal numbers, more formidable than can be raifed in the United States.

The Revenue of the United States is raifed from duties on the tonnage of veffels entered in the United States, and on imported goods, wares and merchandize, and from an excife on various articles of confumption. The amount of the duties arifing on the tonnage of veffels, for the year commencing October 1ft, 1790, and ending September 30th, 1791, amounted to 145,347 dollars. The duties arifing on goods, wares and merchandize, for the fame year amounted to 3,006,722 dollars. The amount of the revenue from the excife was then eftimated in round numbers at 400,000 dollars.

	Dols.	Cts.
Amount of the *Permanent* Revenue of the United States, 1795, arifing from duties on imports and tonnage, on diftilled fpirits, poftage of letters, patent fees, and intereft of bank ftock,	4,692,673	83
Temporary Revenue for the fame period,	1,859,626	91
Total,	6,552 300	74
The Expenditures for the fame year, for intereft of foreign and public debt, civil and naval departments, &c.	5,481,843	84
Excefs of Revenue beyond Expenditure,	1,070,456	90

At the clofe of the year 1794, the debt of the United States amounted to 64,825,538 dollars and 70 cents, exclufive of the public ftock purchafed by means of the finking fund, and fome other debts hereafter mentioned, which, if added, would have increafed it to about 74,000,000 dollars.

The act, making provifion for the debt of the United States, has appropriated the proceeds of the weftern lands as a fund for the difcharge of the public debt. And the act, making provifion for the reduction of the public debt, has appropriated all the furplus of the duties on imports and tonnage, to the end of the year 1790, to the purpofe of purchafing the debt at the market price; and has authorifed the Prefident to borrow the further fum of two millions of dollars for the fame object. Thefe meafures ferve to indicate the intention of the

United States.

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, (K) "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 $6\frac{1}{4}$ 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.

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(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*.

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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

(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.

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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.

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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 caufe of the rebellion in that ftate, in 1786. But a heavy debt lying on the ftate, added to burdens of the fame nature, upon almoft every corporation within it; a decline, or rather an extinction of public credit; a relaxation and corruption of manners, and a free ufe of foreign luxuries; a decay of trade and manufactures, with a prevailing fcarcity of money; and, above all, individuals involved in debt to each other;—thefe were the real, though more remote caufes of the infurrection. It was the tax which the people were required to pay, that caufed them to feel the evils which we have enumerated: This called forth all their other grievances; and the firft act of violence committed, was the burning or deftroying of the tax-bill. This fedition threw the ftate into a convulfion which lafted about a year; courts of juftice were violently obftructed; the collection of debts was fufpended; and a body of armed troops under the command of general Lincoln, was employed, during the winter of 1786, to difperfe the infurgents. Yet fo numerous were the latter in the counties of Worcefter, Hampfhire and Berkfhire, and fo obftinately combined to oppofe the execution of law by force, that the governor and council of the ftate thought proper not to entruft general Lincoln with military powers, except to act on the defenfive, and to repel force with force, in cafe the infurgents fhould attack him. The leaders of the rebels, however, were not men of talents; they were defperate, but without fortitude; and while they were fupported with a fuperior force, they appeared to be impreffed with that confcioufnefs of guilt, which awes the moft daring wretch, and makes him fhrink from his purpofe. This appears by the conduct of a large party of the rebels before the magazine at Springfield; where general Shepard, with a fmall guard was ftationed to protect the continental ftores. The infurgents appeared upon the plain, with a vaft fuperiority of numbers, but a few fhot from the artillery made the multitude retreat in diforder, with the lofs of four men. This fpirited conduct of general Shepard, with the induftry, perfeverance and prudent firmnefs of general Lincoln, difperfed the rebels—drove the leaders from the ftate, and reftored tranquillity. An act of indemnity was paffed in the legiflature for all the infurgents, except a few of the leaders, on condition they fhould become peaceable fubjects, and take the oath of allegiance. The leaders afterwards petitioned for pardon, which, from motives of policy, was granted by the legiflature (N).

But the lofs of public credit, popular difturbances and infurrections, were not the only evils which were generated by the peculiar circumftances of the times. The emiffions of bills of credit and tender laws, were added to the black catalogue of political diforders.

The expedient of fupplying the deficiencies of fpecie, by emiffions 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 increafing, the farmer finds an advantage in paying legal intereft for money; for if he can pay the intereft by his profits, the increafing value of his lands will in a few years difcharge the principal.

In no colony was this advantage more fenfibly experienced than in Pennfylvania. The emigrations to that province were numerous; the natural population rapid; and thefe circumftances combined, advanced the value of real property to an aftonifhing degree. As the firft fettlers there, as well as in other provinces, were poor, the purchafe of a few foreign articles drained them of fpecie. Indeed for many years the balance of trade muft have neceffarily been greatly againft the colonies.

But bills of credit, emitted by the ftate and loaned to the induftrious inhabitants, fupplied the want of fpecie, and enabled the farmer to purchafe ftock. Thefe bills were generally a legal tender in all colonial or private contracts, and the fums iffued did not generally exceed the quantity requifite for a medium of trade; they retained their full nominal value in the purchafe of commodities. But as they were not received by the Britifh merchants, in payment of their goods, there was a great demand for fpecie and bills, which occafioned the latter at various times to appreciate. Thus was introduced a difference between the Englifh fterling 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 Britifh government, fuggefted to Congrefs, in 1775, the idea of iffuing bills for the purpofe of carrying on the war. And this was perhaps their only expedient. Money could not be raifed by taxation; it could not be borrowed. The firft emiffions had no other effect upon the medium of commerce, than to drive the fpecie from circulation. But when the paper fubftituted for fpecie, had, by repeated emiffions, augmented the fum in circulation much beyond the ufual fum of fpecie, the bills began to lofe their value. The depreciation continued in proportion to the fums emitted, until feventy, and even one hundred and fifty nominal paper dollars, were hardly an equivalent for one Spanifh milled dollar. Still, from the year 1775 to 1781, this depreciating paper currency was almoft the only medium of trade. It fupplied the place of fpecie, and enabled Congrefs to fupport a numerous army; until the fum in circulation amounted to two hundred millions of dollars. But about the year 1780, fpecie began to be plentiful, being introduced by the French army, a private trade with the Spanifh iflands, and an illicit intercourfe with the Britifh garrifon at New York. This circumftance accelerated the depreciation of paper bills, until their value had funk almoft to nothing. In 1781, the merchants and brokers in the fouthern ftates, apprehenfive of the approaching fate of the

(N) See a well written impartial Hiftory of this rebellion, by the late George Richards Minot, Efq.

(O) A Dollar in fterling money, is 4/6. But the price of a dollar rofe in New England currency to 6f. in New York to 8f. in New Jerfey, Pennfylvania and Maryland to 7/6. in Virginia to 6f. in North Carolina to 8f. in South Carolina and Georgia to 4/8. This difference, originating between paper and fpecie, or bills, continued afterwards to exift in the nominal eftimation of gold and filver.

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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

(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 succesfsfully 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.

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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;

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 confideration 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

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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,

3 Q 2

(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,					

dent, it was found that GEORGE WASHINGTON was *unanimoufly* elected to that dignified office, and that JOHN ADAMS was chofen Vice Prefident. The annunciation of the choice of the firft and fecond magiftrates of the United States, occafioned a general diffufion of joy among the friends to the union, and fully evinced that thefe eminent characters were the choice of the people.

On the 30th of April, 1789, George Wafhington was inaugurated Prefident 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 thoufand fpectators. The oath was adminiftered by Chancellor Livingfton. Several circumftances concurred to render the fcene unufually folemn—The prefence of the beloved Father and Deliverer of his country—the impreffions of gratitude for his paft fervices—the vaft concourfe of fpectators—the devout fervency with which he repeated the oath, and the reverential manner in which he bowed to kifs the facred volume—thefe circumftances, together with that of his being chofen to the moft dignified office in America, and perhaps in the world, by the unanimous voice of more than three millions of enlightened *freemen*, all confpired to place this among the moft auguft and interefting fcenes which have ever been exhibited on this globe. For feveral years after the eftablifhment of the new conftitution, the United States were happily diftinguifhed by affording a few materials for hiftory.

The deliberations of the legiflature of the union were marked with wifdom, and the meafures they adopted productive of great national profperity. The wife appointments to office, which in general were made—the eftablifhment of a revenue and judiciary fyftem, and of a national bank—the affumption of the debts of the individual ftates, and the encouragement given to manufactures, commerce, literature, and to ufeful inventions, opened the faireft profpects of the peace, union and increafing refpectability of the American States. Thefe profpects have been realized.

The account of the United States which is here prefented to our readers, is extracted from that valuable work, the American Univerfal Geography, by the Rev. Dr Morfe.—To give a regular hiftory, or even a fketch, of the progrefs of things under the adminiftration of the Federal government—of the wifdom and firmnefs exhibited by the Prefident and Congrefs, in their meafures in times the moft critical and trying—of the intrigues and collifions of contending parties—of the dangers, domeftic and foreign which we have fo happily efcaped—and of the exifting ftate of our political affairs, does not fall in with the plan of this work.

UNITY, a fettlement in Lincoln county, Diftrict of Maine, between the Weft Ponds, 7 or 8 miles weft of Sidney, oppofite to Vaffalborough, and 15 miles northweft of Hallowell. It lies on Sandy river, about 16 miles from its mouth.—*Morse.*

UNITY, a townfhip of New-Hampfhire, fituated in Chefhire county, a few miles north-eaft of Charlefton. 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-houfe, and 24 N. of the city of Wafhington.—*ib.*

VOLCANIC *Ifland*, between Swallow Ifland and *Santa Cruz*, about 8 leagues north of the latter, in the Pacific Ocean, in which Mendana, in 1595, faw a volcano, which flamed continually. S. lat. 10 30.—*ib.*

VOLUNTOWN, a townfhip 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 fettled in 1696, having been granted to volunteers in the Narraganfet war; hence its name. It was incorporated in 1719. It is 20 miles long, and between 3 and 4 broad, and has a large fwamp abounding with white pine, fufficient to fupply the neighbouring towns with materials for building.—*ib.*

VORTICES of Des Cartes are now juftly exploded; but being the fiction of a very fuperior mind, they are ftill an object of curiofity, as being the foundation of a great philofophical romance. According to the author of that romance, the whole of infinite fpace was full of matter; for with him matter and extenfion were the fame, and confequently there could be no void. This immenfity of matter he fuppofed to be divided into an infinite number of very fmall cubes; all of which, being whirled about upon their own centres, neceffarily gave occafion to the production of two different elements. The firft confifted of thofe angular parts which, having been neceffarily rubbed off, and grinded yet fmaller by their mutual friction, conftituted the moft fubtle and moveable part of matter. The fecond confifted of thofe little globules that were formed by the rubbing off of the firft. The interftices betwixt thefe globules of the fecond element were filled up by the particles of the firft. But in the infinite collifions, which muft occur in an infinite fpace filled with matter, and all in motion, it muft neceffarily happen that many of the globules of the fecond element fhould be broken and grinded down into the firft. The quantity of the firft element having thus been increafed beyond what was fufficient to fill up the interftices of the fecond, it muft, in many places, have been heaped up together, without any mixture of the fecond along with it. Such, according to Des Cartes, was the original divifion of matter. Upon this infinitude of matter thus divided, a certain quantity of motion was originally impreffed by the Creator of all things, and the laws of motion were fo adjufted as always to preferve the fame quantity in it, without increafe, and without diminution. Whatever motion was loft by one part of matter, was communicated to fome other; and whatever was acquired by one part of matter, was derived from fome other: and thus, through an eternal revolution from reft to motion, and from motion to reft, in every part of the univerfe, the quantity of motion in the whole was always the fame.

But as there was no void, no one part of matter could be moved without thrufting fome other out of its place, nor that without thrufting fome other, and fo on. To avoid, therefore, an infinite progrefs, he fuppofed that the matter which any body pufhed before it rolled immediately backwards to fupply the place of that matter which flowed in behind it; as we may obferve in the fwimming of a fifh, that the water which it pufhes before it immediately rolls backwards to fupply the place of what flows in behind it, and thus forms a fmall circle or vortex round the body of the fifh. It was in the fame manner that the motion originally impreffed by the Creator upon the infinitude of matter neceffarily produced in it an infinity of greater and fmaller vortices,

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 fide. *Stipulus* none. *Panicles* terminal, brachiate, very ramous. *Flowers* numerous, minute, of a dull greenifh colour, and hairy on the outfide. *Bracts* lanceolate, one at each divifion and fubdivifion of the panicle. *Calyx* perianth, one-leafed, five-toothed, permanent. *Corol* one petaled, pitcher-fhaped, hairy, mouth much contracted, five-toothed, divifions erect, acute, nectary entire, cylindric, embracing the lower two-thirds of the germs. *Stamens*, filaments five, very fhort from the bafe of the corol. Anthers arrow-fhaped, converging, bearing their pollen in two grooves on the infide, near the apex; between thefe grooves and the infertions of the filaments they are covered with white foft hairs. *Piftil*, germs two; above the nectary they are very hairy round the margins of their truncated tops. Style fingle, fhorter than the ftamens. Stigma ovate, with a circular band, dividing it into two portions of different colours. *Per.* Follicles two, round, laterally compreffed into the fhape of a turnip, wrinkled, leathery, about three inches in their greateft diameters—one celled, two valved. *Seeds* very numerous, reniform, immerfed in firm flefhy pulp.

See Plate XLVII. where fig. 1. is a branchlet in flower of the natural fize. 2. A flower magnified. 3. The fame laid open, which expofes to view the fituation of the ftamens inferted into the bottom of the corol, the nectarium furrounding the lower half of the two germs, their upper half with hairy margins, the ftyle and ovate party coloured; ftigma appearing above the nectary. 4. Outfide of one of the ftamens; and, 5. Infide of the fame, both much magnified. 6. The nectarium laid open, expofing to view the whole of the piftil. 7. The two feed veffels (called by Linnæus *follicles*), natural fize; half of one of them is removed, to fhew the feed immerfed in pulp. A portion thereof is alfo cut away, which more clearly fhews the fituation and fhape of the feed.

From wounds made in the bark of this plant there oozes a milky fluid, which on expofure to the open air feparates into an elaftic coagulum, and watery liquid, apparently of no ufe, after the feparation takes place. This coagulum is not only like the American caoutchouc or Indian rubber, but poffeffes the fame properties; for which, fee CAOUTCHOUC, both in the *Encycl.* and *Suppl.*

The chemical properties of this vegetable milk, while frefh, were found by Mr Howifon, late furgeon on Prince of Wales's Ifland, furprifingly to refemble thofe of animal milk. From its decompofition, in confequence of fpontaneous fermentation, or by the addition of acids, a feparation takes place between its cafeous and ferous parts, both of which are very fimilar to thofe produced by the fame proceffes from animal milk. An oily or butyrous matter is alfo one of its component parts, which appears upon the furface of the gum fo foon as the latter has attained its folid form. He endeavoured to form an extract of this milk fo as to approach to the confiftence of new butter, by which he hoped to retard its fermentative ftage, without depriving it of its ufeful qualities; but as he had no apparatus for diftilling, the furface of the milk, that was expofed to the air, inftantly formed into a folid coat, by which the evaporation was in a great degree prevented. He, however, learned, by collecting the thickened milk from the infide of the coats, and depofiting it in a jelly pot, that, if excluded from the air, it might be preferved in this ftate for a confiderable 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 obferved that the common nettle, though it has a place in the *materia medica*, is now very little ufed. It has lately been recommended, however, by *Zannetini*, a phyfician who attended the French army in Italy, as a good fubftitute in fevers for cinchona. The fuccefs of fome experiments, which he made with it in tertian and quartan malignant fevers, furpaffed, he fays, his moft fanguine expectation. The nettle often produces a fpeedier effect than bark; for it heats in a great degree, and when the dofe is pretty ftrong, occafions a lethargic fleep. The dofe muft never exceed a dram, and is given in wine two or three times in the courfe of 24 hours. Zannetini found this medicine of great fervice to guard againft that total exhauftion which forms the principal character of malignant fevers; and he recommends a flight infufion of it in wine as an excellent prefervative for thofe who refide in marfhy and infalubrious diftricts. In employing the nettle in fever, Zannetini gives the fame caution as ought to be obferved in regard to cinchona, that is, that it muft not be employed where there is an inclination to inflammation, or where a continued fever, arifing from obftructions, exifts. This difcovery is not unworthy the attention of phyficians, and deferves at leaft to be farther inveftigated, as a great deal would be faved if cinchona could be entirely difpenfed with.

URVAIG, or *Urvaiga*, a province of South-America; bounded by Guayra on the north, the mouth of Rio de la Plata on the fouth, the captainry of del Rey on the eaft, and Parana on the weft, from which it is divided by the river of that name. Its extent is from lat. 25 to 33 20 fouth; the length from north-eaft to fouth-eaft being fomewhat above 210 leagues, and the breadth from eaft to weft, where broadeft, 130, but much narrower in other parts. It is divided by the river Urvaiga, or Uruguay, into the eaft and weft parts. This river runs above 400 leagues, the upper part with a prodigious noife among rocks and ftones, and falls into the La Plata almoft oppofite to Buenos Ayres.—*Morse.*

UTAWAS, a river which divides Upper and Lower Canada, and falls into Jefus Lake, 118 miles fouth-weft of Quebec. It receives the waters of Timmifkamain 360 miles from its mouth: 85 miles above it is called Montreal river.—*ib.*

UTRECHT, *New*, a townfhip of New-York, King's county, Long-Ifland. It has a Dutch church, and contains 562 inhabitants; of whom 76 are electors, and 206 are flaves. It is 7 or 8 miles fouthward of New-York city.—*ib.*

UXBRIDGE, a townfhip of Maffachufetts, Worcefter county, 41 miles fouth-weft of Bofton. It was taken from Mendon, and incorporated in 1727, and Northbridge was afterwards taken from it. It contains 180 dwelling houfes, and 1,308 inhabitants. It is bounded fouth by the State of Rhode-Ifland. Not far from Shoe-log Pond, in the fouth-weft part of the town, there is an iron mine which is improved to confiderable 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, 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.

Wales.

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

Wales. pally compoſed it. Drunkenneſs, theft, 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 be-

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Wales. 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,

(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.

Wales.

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

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.

"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,

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 of degrees by external influence.—Waring, before his election, gave a fmall fpecimen of his abilities, as proof of his qualification for the office which he was then foliciting; and a controverfy on his merits enfued: Dr Powell, the mafter of St John's college, attacking, in two pamphlets, the Profeffor; and his friend, afterwards Judge Wilfon, defending. The attack was fcarcely warranted by the errors in the fpecimen; and the abundant proofs of talents in the exercife of the profefforial office are the beft anfwers to the farcafms which the learned divine amufed himfelf in cafting on rifing merit. An office held by a Barrow, a Newton, a Whifton, a Cotes, and a Sanderfon, muft excite an ingenuous mind to the greateft exertions; and the new Profeffor, whatever may have been his fuccefs, did not fall behind any of his predeceffors, in either zeal for the fcience, or application of the powers of his mind, to extend its boundaries. In 1762, he publifhed his Mifcellanea Analytica; one of the moft abftrufe books written on the abftrufeft parts of algebra. This work extended his fame over all Europe. He was elected, without folicitation on his part, member of the focieties of Bononia and Gottingen; and received flattering marks of efteem from the moft eminent mathematicians at home and abroad. The difficulty of this work may be prefumed from the writer's own words, "I cannot fay 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, engrofs the whole of his attention. He could dedicate fome time to the ftudy of his future profeffion; and in 1767, he was admitted to the degree of doctor of phyfic; but, whether from the incapacity of uniting together the employments of active life with abftrufe fpeculation, or from the natural diffidence of his temper, for which he was moft peculiarly remarkable; the degree which gave him the right of exercifing his talents in medicine was to him merely a barren title. Indeed he was fo embarraffed in his manners before ftrangers, that he could not have made his way in a profeffion in which fo much is done by addrefs; and it was fortunate that the cafe of his circumftances permitted him to devote the whole of his time to his favourite purfuit. His life paffed on, marked out by difcoveries, chiefly in abftract fcience; and by the publication of them in the Philofophical Tranfactions, or in feparate volumes, under his own infpection. He lived fome years after taking his doctor's degree, at St Ives, in Huntingdonfhire. While at Cambridge he married—quitted Cambridge with a view of living at Shrewfbury; but the air or fmoke of the town being injurious to Mrs Waring's health, he removed to his own eftate at Plaifley, about 8 miles from Shrewfbury, where he died in 1797, univerfally efteemed for inflexible integrity, modefty, plainnefs, and fimplicity of manners. They who knew the greatnefs of his mind from his writings looked up to him with reverence everywhere: but he enjoyed himfelf in domeftic circles with thofe chiefly among whom his purfuits 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 whofe habits were of a very oppofite nature; and he was too much occupied in fcience to attend to the intrigues of the univerfity. There, in all queftions of fcience, his word was the law; and at the annual examination of the candidates for the prize inftituted by Dr Smith, he appeared to the greateft advantage. The candidates were generally three or four of the beft 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 anfwering, *viva voce*, or writing down anfwers to the profeffor's queftions, from the firft rudiments of philofophy to the deepeft parts of his own and Sir Ifaac Newton's works. Perhaps no part of Europe affords an inftance of fo fevere a procefs; and there was never any ground for fufpecting the Profeffor of partiality. The zeal and judgment with which he performed this part of his office cannot be obliterated from the memory of thofe who paffed through his fiery ordeal.

Wifhing to do ample juftice to the talents and virtue of the Profeffor, we feel ourfelves fomewhat at a lofs in fpeaking of the writings by which alone he will be known to pofterity. He is the difcoverer, according to his own account, of nearly 400 propofitions in the analytics. This may appear a vain-glorious boaft, efpecially as the greater part of thofe difcoveries are likely to fink into oblivion; but he was, in a manner, compelled to make it by the infolence of Lalande, who, in his life of Condorcet, afferts that, in 1764, there was no firft-rate analyft in England. In reply to this affertion, the Profeffor, in a letter to Dr Mafkelyne, firft mentions, with proper refpect, the inventions and writings of Harriot, Briggs, Napier, Wallis, Halley, Bruncker, Wren, Pell, Barrow, Mercator, Newton, De Moivre, Maclaurin, Cotes, Stirling, Taylor, Simpfon, Emerfon, Landen, and others; of whom Emerfon and Landen were living in 1764. He then gives a fair and full detail of his own inventions, of which many were publifhed anterior to 1764; and concludes his letter in thefe words.

"I know that Mr Lalande is a firft-rate aftronomer, and writer of aftronomy; but I never heard that he was much converfant in the deeper parts of mathematics; for which reafon I take the liberty to afk him the following queftions:

"Has he ever read or underftood the writings of the Englifh mathematicians: and, as the queftion comes from me, I fubjoin, particularly of mine? If the anfwer be in the negative, as it is my opinion, if his anfwer be the truth, that it will, then there is an end of all further controverfy;—but if he afferts 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 fome fubfequent ones added, that they are faid to amount to more than 400 of one kind or other. Let him try to reduce thofe to as low a number as he can, with the leaft 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 prefent or paft times, and there will refult a comparifon (if I miftake not) not much to his liking; and, further, let him compare fome of the firft inventions of the French mathematicians with fome of the firft contained in my works, both as to utility, generality, novelty, difficulty, and elegance, but wifely as to utility, there is little contained in the deep parts of any fcience; he will find their difficulty

difficulty and novelty from his difficulty of underftanding them, and his never having read any thing fimilar before; their generality, by the application of them; principles of elegance will differ in different perfons.— I muft fay, that he will probably not find the difference expected. After or before this inquiry is inftituted for mine, let him perform the fame for the other Englifh mathematicians; and when he has completed fuch inquiries, and not before, he will become a judge of the juftice of his affertion; but I am afraid that he is not a fufficient adept in thefe ftudies to inftitute fuch inquiries; and if he was, fuch inquiries are invidious, troublefome, and of fmall utility."

By mathematical readers this account, which was not publifhed by the Profeffor himfelf, is allowed to be very little, if at all, exaggerated. Yet if, according to his own confeffion, "few thought it worth their while to read even half of his works," there muft be fome grounds for this neglect, either from the difficulty of the fubject, the unimportance of the difcoveries, or a defect in the communication of them to the public. The fubjects are certainly of a difficult nature, the calculations are abftrufe; yet Europe contained many perfons not to be deterred by the moft intricate theorems. Shall we fay then, that the difcoveries were unimportant? If this were really the cafe, the want of utility would be a very fmall difparagement among thofe who cultivate fcience with a view chiefly to entertainment and the exercife of their rational powers. We are compelled, then, to attribute much of this neglect to a perplexity in ftyle, manner, and language; the reader is ftopped at every inftant, firft to make out the writer's meaning, then to fill up the chafm in the demonftration. He muft invent anew every invention; for, after the enunciation of the theorem or problem, and the mention of a few fteps, little affiftance is derived from the Profeffor's powers of explanation. Indeed, an anonymous writer, certainly of very confiderable abilities, has aptly compared the works of Waring to the heavy appendages of a Gothic building, which add little of either beauty or ftability to the ftructure.

A great part of the difcoveries relate to an affumption in algebra, that equations may be generated by multiplying together others of inferior dimenfions. The roots of thefe latter equations are frequently terms called *negative* or *impoffible*; and the relation of thefe terms to the coefficients of the principal equation is a great object of inquiry. In this art the profeffor was very fuccefsful, though little affiftance is to be derived from his writings in looking for the real roots. We fhall not, perhaps, be deemed to depreciate his merits, if we place the feries for the fum of the powers of the roots of any equation among the moft ingenious of his difcoveries; yet we cannot add, that it has very ufefully enlarged the bounds of fcience, or that the algebraift will ever find occafion to introduce it into practice. We may fay the fame on many ingenious transformations of equations, on the difcovery of impoffible roots, and fimilar exertions of undoubtedly great talents. They have carried the affumption to its utmoft limits; and the difficulty attending the fpeculation has rendered perfons more anxious to afcertain its real utility; yet they who reject it may occafionally receive ufeful hints from the Mifcellanea Analytica.

The firft time of Waring's appearing in public as an author was, we believe, in the latter end of the year 1759, when he publifhed the firft chapter of the Mifcellanea Analytica, as a fpecimen of his qualifications for the profefforfhip; and this chapter he defended, in a reply to a pamphlet, intitled, "Obfervations on the Firft Chapter of a book called Mifcellanea Analytica." Here the Profeffor was ftrangely puzzled with the common paradox, that nothing divided by nothing may be equal to various finite quantities, and has recourfe to unqueftionable authorities in proof of this pofition. The names of Maclaurin, Sanderfon, De Moivre, Bernoulli, Monmort, are ranged in favour of his opinion: But Dr Powell was not fo eafily convinced, and returns to the charge in defence of the Obfervations; to which the Profeffor replied in a letter to the Rev. Dr Powell, Fellow of St John's college, Cambridge, in anfwer to his Obfervations, &c. In this controverfy, it is certain that the Profeffor gave evident proofs of his abilities; though it is equally certain that he followed too implicitly the decifions of his predeceffors. No apparent advantage, no authority whatever, fhould induce mathematicians to fwerve from the principles of right reafoning, on which their fcience is fuppofed 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, fay 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 fame 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 abfurd. But we need only trace back our fteps to fee the fallacy in this mode of reafoning. For P is equal to fome number multiplied into $\frac{a-x}{a-x}$; that is, when x is equal to a, P is equal to fome number multiplied into nothing, and divided by nothing; that is, P is, in that cafe, no number at all. For $a-a$ cannot be divided by $a-x$ when x is equal to a, fince, in that cafe, $a-x$ is no number at all.

If, in the beginning of his career, the Profeffor could admit fuch paralogifms into his fpeculations, and the writings of the mathematicians, for nearly a century before him, may plead in his excufe, we are not to be furprifed that his difcoveries fhould be built rather on the affumptions of others than on any new principles of his own. Acquiefcing in the ftrange notion, that nothing could be divided by nothing, and produce a variety of numbers, he as eafily adopted the pofition, that an equation has as many roots as it has dimenfions.—

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 $x^n \pm 1 = 0$; 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

Warton.

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.

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.

Biog. Dict.

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 Cephalâ 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 protraxerim. 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 of

Warton. 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

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 Pittsburgh); 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 party

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.

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

Washington.

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 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 affaffins, who had the incredible effrontery to call their tyranny by the profaned name of republic. But hiftorians who relate heroic facrifices of feeling to duty, when they tell us, that Brutus thought himfelf obliged to condemn his fon to death, will not forget to add, that Wafhington was compelled to call Roberfpierre "his friend!" In the contemplation of fuch fcenes good men for a moment forget their deliberate opinions, and are led to curfe civil government itfelf with all the fevere duties which it impofes, and all the cruel facrifices which it demands.

Another ftruggle of feeling and duty Wafhington had to encounter, when he was compelled to fuppress the infurrection in the weftern counties of Pennfylvania by force of arms. But here he had a confolation. The exercife of mercy confoled his mind for the neceffity of having recourfe to arms. Never was there a revolt quelled with fo little blood. Scarcely ever was the bafeft daftard fo 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 feverity, nor without pretexts for it. His character and his office had been reviled in a manner almoft unexampled among civilized nations.—His authority had been infulted.—His fafety had been threatened. Of his perfonal and political enemies fome might, perhaps, have been fufpected of having inftigated the infurrection; a greater number were thought to wifh well to it; and very few fhewed much zeal to fupprefs it. *Is habitus animorum fuit, ut peffimum facinus auderent pauci, plures vellent, omnes paterentur.* But neither refentment, nor fear, nor even policy itfelf, could extinguifh the humanity of Wafhington. This feems to have been the only facrifice which he was incapable of making to the intereft of his country.

Throughout the whole courfe of his fecond prefidency, the danger of America was great and imminent almoft beyond example. The fpirit of change indeed, at that period, fhook all nations. But in other countries, it had to encounter ancient and folidly eftablifhed power. It had to tear up by the roots long habits of attachment in fome nations for their government, of awe in others, of acquiefcence and fubmiffion in all. But in America the government was new and weak. The people had fcarce time to recover from the ideas and feelings of a recent civil war. In other countries the volcanic force muft be of power to blow up the mountains, and to convulfe the continents that held it down, before it could efcape from the deep caverns in which it was imprifoned:—in America it was covered only by the afhes of a late convulfion, or at moft by a little thin foil, the produce of a few years quiet.

To thefe difficulties were added others, which, if duly weighed, will perhaps difpofe us to confider the prefervation of America from confufion under the government of Wafhington, by means fo mild, and apparently fo inadequate, as either one of the greateft mafter pieces of civil prudence that ever diftinguifhed an adminiftration, or one of the moft fortunate accidents that ever befel a ftate. To thofe who may reprefent it as mere good fortune, we may anfwer with FONTENELLE, who, when fomebody congratulated him on the *good fortune* of his friend *Lamotte*, in the fuccefs of his tragedy of "Inez de Caftro," anfwered—"*Oui; mais c'eft une* FORTUNE *qui n'arrive jamais aux fots.*"—The names of liberty and republic were fo naturally and juftly dear to the Americans, that, far from its being difficult to range them under any banners on which thefe words were infcribed, it was very far indeed from being eafy to perfuade them, that fuch founds could reprefent any thing but juftice, benevolence, and happinefs. The government of America had none of thofe prejudices to employ, which in every other country were ufed with fuccefs to enflame the people againft the French revolution. They had, on the contrary, to contend with the prejudices of their people in the moft moderate precautions againft internal confufion, in the moft meafured and guarded refiftance to the unparalleled infults and enormous encroachments of France. Without zealous fupport from the people, the American government was impotent. It required a confiderable time, and it coft an arduous and dubious ftruggle, to direct the popular fpirit againft a fifter republic, eftablifhed among a people to whofe aid the Americans afcribed the eftablifhment of their independence. It is probable indeed, that no policy could have produced this effect, unlefs it had been powerfully aided by the crimes of the French government, which have proved the ftrongeft allies of all eftablifhed governments; which have produced fuch a general difpofition to fubmit to any *known* tyranny, rather than rufh into all the unknown and undefinable evils of civil confufion, with the horrible train of new and monftrous *tyrannies* of which it is ufually the forerunner. But with what juftice foever fome governments may be accufed of having engrafted fervility on the rational and generous horror of their fubjects againft the atrocities of the French revolution, moft certain it is, that the adminiftration of Wafhington cannot be charged with having fo perverted fuch a juft and noble fentiment. He employed it for the moft honeft and praifeworthy purpofes; to preferve the internal quiet of his country; to affert the dignity, and to maintain the rights of the commonwealth which he governed, againft foreign enemies. He avoided war without incurring the imputation of pufillanimity. He cherifhed the deteftation of Americans for anarchy, without weakening the fpirit of liberty; and he maintained, and even confolidated, the authority of government, without abridging the privileges of the people.

Among the many examples of change and viciffitude in political connexion, which are amufing from their fingularity, and which would be moft ufeful if they were received as leffons of moderation by contending parties; there is none, perhaps, more remarkable, than that which may be obferved in the life of General Wafhington. In 1776, he was confidered in England as a profcribed rebel. In 1796, he was regarded as the leader of the Englifh party in America. In 1776, his deftruction was thought the only means of preferving America to Great Britain. In 1796, his authority was thought the principal fecurity againft 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 againft England. In 1796, he muft have confidered the power of Great Britain as one main barrier of the fafety of America againft France. Never, perhaps, did twenty years in the life of any individual, produce fo ftriking and fo important a change. But there was no inconfiftency 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

Washington. 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.

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

Washington. 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

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

* Conrad 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.

Watch-work.

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?

Watch-work.

4. If one pendulum defcribe the arch reprefented by ACa, and another defcribe the arch KCk, they will defcribe 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 ofcillations.

The fame proportions are true with refpect to the motions outwards from C. That is, when the pendulum defcribes 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 defcribing CK, KB, BA, CA, are as HM, HF, HA. Another pendulum fetting out from C, with the initial velocity CO, reaches only to K, CK being = CO. Alfo the times are equal.—If we confider the whole ofcillation as performed in the direction Aa, the forces AD, BE, KL accelerate the pendulum, and the fimilar forces ad, be, kl, on the other fide, retard it. The contrary happens in the next ofcillation aCA.

5. The areas DABE, DAKL, &c. are proportional to the fquares of the velocities acquired by moving along AB, AK, &c. or to the diminution of the fquares of the velocities fuftained by moving outwards along BA or KA, &c.

The confideration of this figure will enable the reader (even though not a mathematician) to form fome notion of the effect of any propofed 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 fituation A of the pendulum. We alfo know what addition or fubtraction we produce on the pendulum in that fituation by the wheel-work. Suppofe it is an addition of preffure equal to a certain number of grains. We can make AD to $D\delta$ as the firft to the laft; and then $A\delta$ will be the whole force urging the pendulum toward C. Doing the fame for every point of AC, we obtain a line $\delta\epsilon\lambda c$, which is a new fcale of forces, and the fpace $DC\delta$, comprehended between the two fcales CD and $C\delta$, will exprefs the addition made to the fquare of the velocity in paffing along AC by the joint action of gravity and the maintaining power. Alfo, by drawing a line $\kappa\pi$ perpendicular to AC, making the fpace $C\pi\kappa$ equal to CAD, the point π will be the limit of the ofcillation outward from C, where the initial velocity HC is extinguifhed. If the line $\kappa\pi$ cut the fame circle in θ, one-half the arch θA will nearly exprefs the contraction made in the time of the outward ofcillation by the maintaining power. An accurate determination of this laft circumftance is operofe, and even difficult; but this folution is not far from the truth, and will greatly affift our judgment of the effect of any propofal, 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 eftimate by infpection. This is faid from experience.

Since the motion of a pendulum or balance is alternate, while the preffure of the wheels is conftantly in one direction, it is plain that fome art muft be ufed to accommodate the one to the other. When a tooth of the wheel has given the balance a motion in one direction, it muft quit it, that it may get an impulfion in the oppofite direction. The balance or pendulum thus efcaping from the tooth of the wheel, or the tooth efcaping from the balance, has given to the general contrivance the name of SCAPEMENT among our artifts, from the French word *echappement*. We proceed, therefore, to confider this fubject more particularly, firft confidering the fcapements which are peculiarly fuited to the fmall vibrations of pendulums, and then thofe which muft produce much wider vibrations in balances. This, with fome other circumftances, render the fcapements for pendulums and balances very different.

I. *Of the Action of a Wheel and Pallet.*

THE fcapement which has been in ufe for clocks and watches ever fince their firft appearance in Europe, is extremely fimple, and its mode of operation is too obvious to need much explanation. In fig. 2. XY reprefents a horizontal axis, to which the pendulum P is attached by a flender rod, or otherwife. This axis has two leaves C and D attached to it, one near each end, and not in the fame plane, but fo that when the pendulum hangs perpendicularly, and at reft, the piece C fpreads 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. Thefe two pieces are called PALLETS. AFB reprefents 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 faw, leaning forward, in the direction of the motion of the rim. As they fomewhat refemble the points of an old-fafhioned 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; fo that when one of them B is preffing on a pallet D, the oppofite pallet C is in the fpace between two teeth A and I. The figure reprefents the pendulum at the extremity of its excurfion to the right hand, the tooth A having juft efcaped from the pallet C, and the tooth B having juft 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 prefs on the pallet D, and thus accelerates the pendulum, both during its defcent along the arch PH, and its afcent along the arch HG. It is no lefs evident, that when the pallet D, by turning round the axis XY, raifes its point above the plane of the wheel, the tooth B efcapes from it, and I drops on the pallet C, which is now nearly perpendicular. I preffes 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 eafily perceive, alfo, that when the pendulum is hanging perpendicularly in the line XH, the tooth B, by preffing on the pallet D, will force the pendulum a little way to the left of the perpendicular, and will force it fo much the farther as the pendulum is lighter; and, if it be fufficiently light, it will be forced fo far from the perpendicular that the tooth B will efcape, and then I will catch on C, and force the pendulum back to P, where the whole operation will be repeated. The fame 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 firft applied to clocks all over Europe, before the application of the pendulum. They were

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

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 $MI : Mv = V : x$, and $x \times MI = V \times Mv$. In like manner $y \times AH = Z \times Az$. Therefore, becauſe $x = y$, and $Az = Mv$, we have $V : Z = MI : AH$. 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 $V : Z = SM : SA$.

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 oCn perpendicular to sC, 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 $\delta \epsilon \lambda C$ of fig. 1. The rapid increase of the ordinates beyond those of the triangle ADC, forms a considerable area $DA\pi o$, to compensate the area $\kappa o C$, 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 abc (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 ad, 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 aAc. 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 ad, 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 ad, 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 preffures on a furface covered with oil, there is no fenfible retardation analogous to that produced by friction, and that what retardation we obferve arifes entirely from the clamminefs of the oil. We are fo imperfectly acquainted with the manner in which friction and vifcidity obftruct the motions of bodies, that we cannot pronounce decifively what will be their effect in the prefent cafe. Friction does not increafe much, if at all, by an increafe of velocity, and appears like a fixed quantity when the preffure is given. This makes all motions which are obftructed by friction terminate abruptly. This will fhorten both the length and the time of the outward excurfion of the pendulum. The vifcidity of the oil refifts differently, and more nearly in the proportion of the velocities. The diminution of motion will not be in this proportion, becaufe in the greater velocities it acts for a fhorter time. Were this accurately the cafe, the refiftance of vifcidity would alfo be nearly conftant, and it would operate as friction does. But it does not ftop a motion abruptly, and the motions are extinguifhed gradually. Therefore, although vifcidity muft always diminifh the extent of the excurfion, it may fo vary as not to diminifh the time. We apprehend, however, that it generally does. But whatever happens in the excurfion, the return will certainly be flower, and employ more time than if it had not been obftructed, becaufe the velocity in every point is lefs than if perfectly free. The whole arch, confifting of a returning arch and an excurfion on the other fide, may be either flower or quicker, according as the compenfation is complete or not, or is even overdone.

All thefe reflections occurred to Mr Graham; and he was perfuaded that the time of the tooth's remaining on the arch *a d*, both afcending and defcending, would differ very little from that of the defcription of the fame arch by a free pendulum. The great caufes of irregularity feemed 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 fame little fpace, expofed to their action. The derangement produced by any force depends on the time of its action, and therefore muft be greateft when the motion is floweft. The pendulum gets its impulfe in the very middle of its vibration, where its velocity is the greateft; and therefore the inequalities of the maintaining power act on it only for a fhort time, and make a very trifling alteration in the time of its defcribing the arch of fcapement. Beyond this, it is nearly in the ftate of a free pendulum; nay, even though it be affected by an inequality of the maintaining power, and it be accelerated beyond its ufual rate in that arch, the chief effect of this will be to caufe it to defcribe a larger arch of excurfion. The fhortening of the time of this defcription by the friction will be the fame as before, happening at the very end of the excurfion; but the return will be more retarded by the friction on a longer arch. And, by this, a compenfation may be made for the trifling contraction of the time of defcribing the arch of fcapement.

This circumftance of giving the impulfe in the middle of the vibration, where its time of action is the fmalleft poffible, and whereby the pendulum is fo long left free from the action of the wheels, is of the very firft importance in all fcapements, and fhould ever be in the mind of the mechanician. When this is adhered to, the form of the face *abc* is fcarcely of any moment. Much has been written on this form, and many attempts have been made to make it fuch that the action of the wheels fhall be proportional to the action of gravity. To do this is abfolutely impoffible. Mr Graham made them planes, not only becaufe of eafieft execution, but becaufe a plane really confpires 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 diminifhing. So is the accelerating power of the pallet from *a* to *b*. When the pendulum rifes from P to R, a force in the oppofite direction RP continually increafes. This is analogous to the continual diminution of a force in the direction PR. Now we have fuch a diminution of fuch a force, in the action of the pallet from *b* to *c*, and fuch an augmentation in the action of the other pallet.

For all thefe reafons, this conftruction of a fcapement appeared very promifing. Mr Graham put it in practice, and it anfwered his moft fanguine expectation, and is now univerfally adopted in all nice clocks. Mr Graham, however, did not think it prudent to caufe a tooth to drop on the very angle *a* of the pallet. He made it drop on a point *f* of the arch of excurfion. This has alfo the advantage of diminifhing the angle of action, which we have proved to be of fervice. It requires, indeed, a greater maintaining power; but this can eafily be procured, and is lefs affected by the changes to which it is liable by the effect of heat and cold on the oil. Our obfervations on the effects of friction and vifcidity in the arch *a d* feem to be confirmed by the obfervations of feveral artifts, who agree in faying that a great increafe of maintaining power increafes the vibrations, but makes them perceptibly flower. When they wrote, much oil was applied to diminifh the friction on the arch of repofe; but, fince that time, the rubbing parts were made fuch as required no oil, and this retardation difappeared. In the clock of the tranfit room of the Royal Obfervatory, the angle of action feldom exceeds one-third of the fwing of the pendulum. The pallets are of oriental ruby, and the wheel is of fteel tempered to the utmoft degree of hardnefs. This clock never varies a whole fecond from equable motion in the courfe of five days.

This contrivance is known by the name of the DEAD BEAT, the DEAD SCAPEMENT; becaufe the feconds index ftands ftill after each drop, whereas the index of a clock with a recoiling fcapement is always in motion, hobbling backward and forward.

Thefe fcapements, both recoiling and dead beat, have been made in a thoufand forms; but any perfon tolerably acquainted with mechanics, will fee that they are all on the fame principles, and differ only in fhape or fome equally unimportant circumftance. Perhaps the moft convenient of any is that reprefented in fig. 5. where the fhaded part is the crutch, made of brafs or iron, and A and B are two pieces of agate, flint, or other hard ftone, cut into the proper fhape for a pallet of either kind, and firmly fixed in proper fockets. They project half an inch, or thereabouts, in front of the crutch, fo that the fwing wheel is alfo before the crutch, diftant about $\frac{1}{10}$th of an inch or fo. Pallets of ruby, driven by a hard fteel fwing wheel, need no oil, but merely to be once rubbed clean with an oily cloth.

Sometimes the wheel has pins inftead of teeth. They are

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 *da*, acts on the face *ac*, and drops from *c* on the other concave arch *ig*, which continues to move a little way to the right. It then returns, and the pin ſlides and acts on the pallet *ib*, and eſcapes at *b*; and the next pin is then on the arch of repoſe *da*.

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

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.

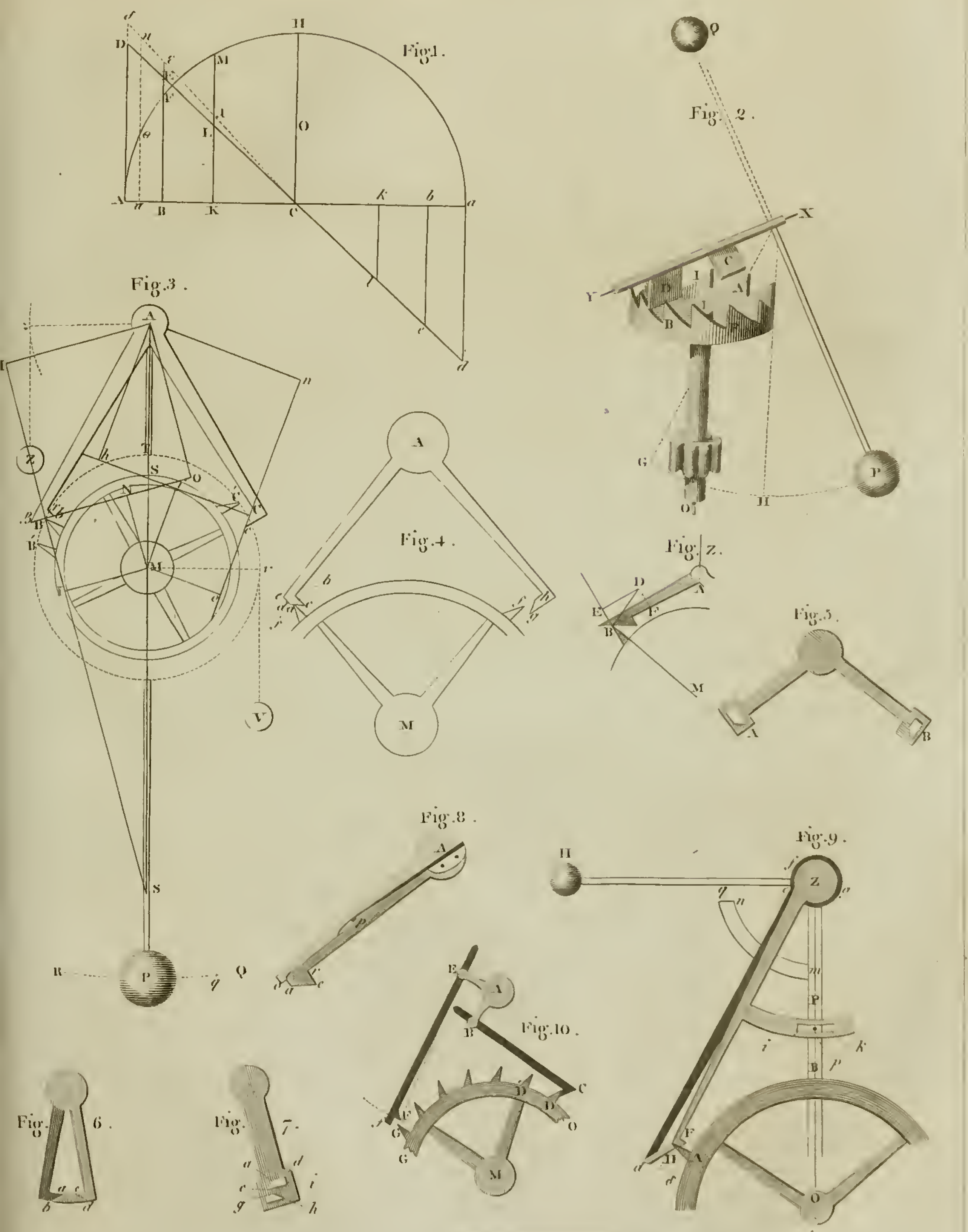
Mr Cumming executed another ſcapement, conſiſting, like thoſe, of a pallet and detent. But the manner of applying the maintaining power is extremely different in principle from any yet deſcribed. It is exceedingly ingenious, and ſeems to do all that is poſſible for removing every ſource of irregularity 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 other



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other fcapements, that it muft be confidered as a real improvement.

It is very uncandid to refufe the author a claim to the character of an ingenious artift on account of this contrivance, as has been done by a very ingenious univerfity Profeffor, who taxes Mr Cumming with ignorance of the *firft elements of mechanics*, and fays that the beft thing in his book is his advice to fufpend 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 Profeffor's clock would have performed ftill better if he had condefcended to follow it. It is ftill lefs candid to queftion 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 fimilar advantages, had done fo much.

* See Ludlam's Essay.

But while we thus pay the tribute of juftice to Mr Cumming, we do not adopt all his opinions. The clock has the fame defects of the former in refpect of the laws of the force which accelerates the pendulum. The fudden addition of the fmall weight, and this almoft at the extremity of the vibration, would derange it very much, if the addition were fufceptible of any fenfible variation. The irregularity of the action of the wheels *may* fenfibly affect the motion during the unlocking, when the clock is foul, and the pendulum *juft* able to unlock; for any difturbance at the extremity of the vibration greatly affects the time. We acknowledge that the parts which we here fuppofe to be foul may not be fo in the courfe of twenty years, thefe parts being only the pivots of the fcapement. The great defect of the fcapement is its liablenefs to unlock by any jolt. It is more fubject to this than the others already mentioned. This rifk is much increafed by the flender make of the parts, in Mr Cumming's drawings, and in the only clock of the kind we have feen; but this is not neceffary: and it fhould be avoided for another reafon; the interpofing fo many flender and crooked parts between the moving power and the pendulum weakens the communication of power, and requires a much more powerful wheelwork.

All thefe, however, are flight defects, and only the laft can be called a fault. The clocks made on this principle have gone remarkably well, as may be feen by the regifters of his majefty's private obfervatory. But the greateft objection is, that they do not perform better than a well-made dead fcapement; and they are vaftly more troublefome to make and to manage. This is ftrictly true, and is a ferious objection. The fact is, that the dominion of a heavy pendulum is fo great, that if *any one* of the fcapements now defcribed be well executed with pallets of agate, and a wheel of hard fteel, and if the pendulum be fufpended agreeably to Mr Cumming's advice, there is hardly any difference to be obferved in their performance. We fhall content ourfelves with a fingle proof of this from fact. The clock invented by the celebrated Harrifon is *at leaft equal* in its performance to any other. Friction is almoft annihilated, and no oil is required. It went fourteen years without being touched, and during that time did not vary one complete fecond from one day to another, nor ever deviated half a minute by accumulation from equable motion: Yet the fcapement, in fo far as it refpects the law of the accelerating force, deviates more from the proportion of the fpaces than the moft recoiling fcapement that ever was put to a good clock. It is fo different from all hitherto defcribed, both in form and principle, that we muft not omit fome account of it, and with it we fhall conclude our fcapements for clocks.

Let GDO reprefent the fwing-wheel, of which M is the centre. A is the verge or axis of the pendulum. It has two very fhort arms AB, AE. A flender rod BC turns on fine pivots in the joint B, and has at its extremity C a hook or claw, which takes hold of a tooth D of the fwing-wheel when the pendulum moves from the right fide to the left. This claw, when at liberty, ftands at right angles, or, at leaft, in a certain determinate angle, with regard to the arm AB; and when drawn a little from that pofition, it is brought back to it again by a very flender fpring. The arm AE is furnifhed with a detent EF, which alfo, when at liberty, maintains its pofition on the arm by means of a very flender fpring.

Let us now fuppofe that the tooth D is preffing on the claw C, while the pendulum is moving to the right. The joint B yields, by its motion round A, to the preffure of the tooth on the claw. By this yielding, the angle ABC opens a little. In the mean time, the fame motion round A caufes the point F of the detent on the other fide to approach the circumference of the wheel in the arch of a circle, and the tooth G at the fame 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 muft pufh the tooth G a little backward, by means of the detent EF. It cannot come any nearer to the wheel, becaufe the point of the tooth ftops the heel *f*. The inftant that F pufhes G back, the tooth D is withdrawn from the claw C, and C flies out, by the action of its fpring, and refumes its pofition at right angles to BA; and the wheel is now free from the claw, but is pufhing at the detent F (c). The pendulum, having finifhed its excurfion to the right (in which it caufes the wheel to recoil by means of the detent F), returns toward the left. The wheel now advances again, and by preffing on F, aids the pendulum through the whole angle of fcapement. By this motion the claw C defcribes 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 preffure of the tooth G, and it flies out a little from the wheel, refuming its natural pofition by means of

(c) The reader may here remark the manner in which the preffure of the tooth G on the detent is transferred to the joint E by the intervention of the fhank FE, and from the joint E to the pendulum rod, by the intervention of the arm EA. This communication of preffure is precifely the fame that we made ufe of in explaining the common fcapement. 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. Harrifon's pallet realifes the abftract theory.

of its fpring. Soon after, the motion of the pendulum to the left ceafes, 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 Harrifon and Hindley. Friction is almoft totally avoided, and oil entirely (D). The motion is given to the pendulum by a fair pull or pufh, and the teeth of the wheel only apply themfelves to the detents without rubbing. There is no drop, and the fcapement makes no noife, and is what the artifts call *a filent fcapement*. The mechanician will readily perceive, that by properly difpofing the arms AB, AE, and difpofing 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, fo as to harmonize, as far as the nature of fcapement, alternately pufhing and pulling, will admit, with the action of gravity.

But this is evidently a recoiling fcapement, and one of the worft kind; for the recoil is made at the very confines of the vibration, where every difturbance of the regular cycloidal vibration occafions the greateft difturbance to the motion. Yet this clock kept time with moft unexampled precifion, far excelling all that had been made before, and equal to any that have been made fince. This is entirely owing to the immenfe fuperiority of the momentum of the pendulum over the maintaining power.

II. *Of Scapements for a Watch.*

The execution of a proper fcapement for watches is a far more delicate and difficult problem than the foregoing, on account of the fmall fize, which requires much more accurate workmanfhip, becaufe the error of the hundredth part of an inch has as great a proportion to the dimenfions of the regulator as an inch in a common houfe clock. It is much more difficult on another account. We have no fuch means of accumulating fuch a dominion (to ufe Mr Harrifon's expreffive term) over the wheel-work in the regulator of a watch as in that of a clock. The heavieft balance that we can employ, without the certainty of fnapping its pivots by every flight jolt, is a mere trifle, in comparifon with the pendulum of the moft ordinary clock. A dozen or twenty grains is the utmoft 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 fuch a fmall 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 fhould pafs through at leaft ten inches in every fecond. Now, when we reflect on the fmall momentum of this regulator, the inevitable inequalities of the maintaining power, and the great arch of vibration on which thefe inequalities will operate, and the comparative magnitude even of an almoft infenfible friction or clamminefs, it appears almoft 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 fuch have been made. They muft be confidered as the moft mafterly exertions of human art. The performance of a reflecting telefcope is a great wonder: the worft that can find a market muft have its mirrors executed without an error of the ten-thoufandth part of an inch; but we now know that this accuracy is attained almoft in fpite of us, and that we fcarcely *can* make them of a worfe figure. But the cafe is far otherwife in watch-work. Here all thofe wonderful approaches to perfection are the refults of rational difcuffion, by means of found principles of fcience; and, unlefs the artift who puts thefe principles into practice be more than a mere copyift, unlefs the principles themfelves are perceived by him, and actually direct his hand, the watch may ftill be good for nothing. Surely, then, this is a liberal art, and far above a manual knack. The ftudy of the means by which fuch wonders are fteadily effected, is therefore the ftudy of a gentleman.

In the account given above of the fcapements for pendulums, we affumed as one leading principle that *the natural vibrations of a pendulum are performed in equal times, whether wide or narrow.* This is fo nearly true, when the arches on each fide of the perpendicular do not exceed four degrees, that the retardation of the wider arches within that limit will not become fenfible, though accumulated for a long time. The common fcapement with a plane face of the pallet, helps to correct even this fmall inequality much better than the niceft form of the cycloidal checks propofed by Huyghens.

In watch-work we affume a fimilar principle, namely, that *the ofcillations of a balance, urged by its fpring, and undifturbed by all foreign forces, are performed in equal times, whether they be wide or narrow.* This principle was affumed by the celebrated mechanician Dr Robert Hooke, on the authority of many experiments which he had made on the bending and unbending of fprings. He found that the force neceffary for retaining a fpring in any conftrained pofition was proportional to its tenfion, or deflection from its natural form. He expreffed this in an anagram, which he publifhed about the year 1660, in order to eftablifh his claim to the difcovery, and yet conceal it, till he had made fome important application of it. When the anagram was explained fome years afterwards, it was, "*Ut tenfio, fic vis.*" Dr Hooke thought of applying this difcovery to the regulation of watch movements. For, if a flender fpring be *properly* applied to the axis of a watch balance, it will put that balance in a certain determinate pofition. If the balance

(D) Mr Harrifon was at firft by profeffion 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 houfe. Its expofure made it wafte oil very faft, 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 himfelf how to make a clock go without oil. He changed all his pinion leaves into rollers; which anfwered very well. But the pallets required it more than any other part. After various other projects, he contrived thofe now reprefented, where there was no friction, and no oil is wanted. The turret clock continued to go without being touched till Mr Harrifon 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 quadruple,

ruple, and the force of the fpring 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 fpring. This great proportion is neceffary, as already obferved, that the watch may go as foon as unftopped.

We have but little to fay on this fcapement; its principle and manner of action, and its good and bad qualities, being the fame with thofe of the fimilar fcapement for pendulums. It is evident that the maintaining power being applied in the moft direct manner, and during the whole of the vibration, it will have the greateft poffible influence to move the balance. A given mainfpring and train will keep in motion a heavier balance by means of this fcapement than by any other. But, on the other hand, and for the fame reafon, the balance has lefs dominion over the wheel work, and its vibrations are more affected by any irregularities of the wheelwork. 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 moft hurtful to the ifochronifm of the vibrations.

Although this fcapement is extremely fimple, it is fufceptible of more degrees of goodnefs or imperfection than almoft any other, by the variation of the few particulars of its conftruction. We fhall therefore briefly defcribe that conftruction which long experience has fanctioned as approaching near to the beft performance that can be obtained from the common fcapement. Fig. 11. reprefents it in what are thought its beft proportions, as it appears when looking ftraight 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 reprefented as juft efcaped from the point of CA, and the lower tooth E as juft come in contact with the lower pallet. The fcapement fhould not, however, be quite fo clofe, becaufe an inequality on the teeth might prevent D from efcaping at all. For if E touch the pallet CB before D has quitted CA, all will ftand ftill. This fault will be corrected by withdrawing the wheel a little from the verge, or by fhortening the pallets.

The proportions are as follow. The diftance 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 diftance between the points of the teeth. The length CA, CB of the pallets is three-fifths of the fame diftance. 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 floping fide of the tooth muft be of an epicycloidal form, fuited to the relative motion of the tooth and pallet.

From thefe 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 ftrike againft 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 fide. From 240, the fum of thefe angles, take the angle of the pallets 95°, and there remains 145° for the greateft vibration which the balance can make without ftriking the front of the teeth. This extent of vibration fuppofes the teeth to terminate in points, and the acting furfaces of the pallets to be planes directed to the very axis of the verge. But the points of the teeth muft be rounded off a little for ftrength, and to diminifh friction on the face of the pallets. This diminifhes the angle of fcapement very confiderably, by fhortening the teeth. Moreover, we muft by no means allow the point of the pallet to bank or ftrike on the forefide of a tooth. This would greatly derange the vibration by the violence and abruptnefs of the check which the wheel would give to the pallet. This circumftance makes it improper to continue the vibrations much beyond the angle of fcapement. One-third of a circle, or 120°, is therefore reckoned a very proper vibration for a fcapement made in thefe proportions. The impulfe of the wheels, or the angle of fcapement, may be increafed by making the face of the pallets a little concave (preferving the fame angle at the centre). The vibration may alfo be widened by pufhing the wheel nearer to the verge. This would alfo diminifh 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 fo that its acting face may be where its back is juft now. In this cafe, the tooth D would droop on it at the centre, and lie there at reft, while the balance completes its vibration. But this would make the banking (as the ftroke is called) on the teeth almoft unavoidable. In fhort, after varying every circumftance in every poffible manner, the beft makers have fettled on a fcapement very nearly fuch as we have defcribed. Precife rules can fcarcely be given; becaufe the law by which the force acting on the pallets varies in its intenfity, deviates fo widely from the action of the balance fpring, efpecially near the limits of the excurfions.

The difcoveries of Huyghens and Newton in rational mechanics engaged all the mathematical philofophers of Europe in the folution of mechanical problems, about the end of the laft century. The vibrations of elaftic plates or wires, and their influence on watch balances, became familiar to every body. The great requifites for producing ifochronous vibrations were well underftood, and the artifts were prompted by the fpeculatifts to attempt conftructions of fcapements proper for this purpofe. It appeared clearly, that the moft effectual means for this purpofe was to leave the balance unconnected with the wheels, efpecially near the extremities of the vibration, where the motion is languid, and where every inequality of maintaining power muft act for a longer time, and therefore have a great effect on the whole duration of the vibrations. The maxim of conftruction that naturally arifes from thefe reflections is to *confine*, if poffible, *the action of the wheels to the middle of the vibration*, where the motion is rapid, and where the chief effect of an increafe or diminution of the maintaining power will be to enlarge or contract the angular motions, but will make little change on their duration; becaufe the greateft part of the motion will be effected by the balance fpring alone. This maxim was inculcated in exprefs terms by John Bernoulli, in his *Recherches Mechaniques et Phyfiques*; but it had been fuggefted by common fenfe to feveral unletterred artifts before that time. About the beginning of the 18th century watches

watches were made in London, where the verge had a portion edb (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 bde, 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 bdc, 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 edb; 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 bcd, 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 dcb, is finiſhed, the balance reſumes its firſt motion bcd, 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 that

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 $\frac{1}{15}$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 $4\frac{1}{2}$ 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, n° 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

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 *hdi*.

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, that

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*e* 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

Watch-work.

ready to receive it, &c. The vibrations may be increafed by giving a fufficient impulfe through the angle of fcapement. But they cannot be more than a certain quantity, otherwife the top N of the crank will ftrike the rim of the wheel. By placing the pins at the very edge of the wheel, the vibrations may eafily be increafed to a femicircle. By placing them at the points of long teeth, the crank may get in between them, and the vibrations extended ftill farther, perhaps to 240°.

This fcapement is unqueftionably a very good one; and when equally well executed, fhould excel Graham's, both by having but two acting faces to form (and thefe of hard fteel or of ftone), and by allowing us to make the circle of reft exceedingly fmall without diminifhing the acting face of the pallet. This will greatly diminifh 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 fhall be fufceptible of adjuftment and removal for repair, and yet fufficiently accurate and fteady, feems to us a very delicate j b.

Mr Cumming, in his Elements of Clock and Watchwork defcribes (flightly) pallets of the very fame conftruction, making what he conceives to be confiderable improvements in the form of the acting faces and the curves of reft. He has alfo made fome watches with this fcapement; but they were fo difficult, that few workmen can be found fit for the tafk; 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 fuch a contorted figure, that it is eafily bent and twifted by any jolt or unfkilful handling.

There remains another fcapement of this kind, having the tooth of the balance-wheel refting on a cylindrical furface on the axis of the verge during the excurfions of the balance beyond the angle of fcapement, and which differs fomewhat in the application of the maintaining power from all thofe already defcribed.

This is known by the name of *Dupleix's fcapement*, and is as follows: Fig. 16. reprefents the effential parts greatly magnified. AD is a portion of the balance-wheel, having teeth *f*, *b*, *g*, at the circumference. Thefe teeth are entirely for producing the *reft* of the wheel, while the balance is making excurfions beyond the fcapement. 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 eafily paffes the tooth B which is refting on the cylindric furface; but when it returns in the direction *q p o*, the tooth B gets into the notch, and follows it, preffing on one fide of it till the notch comes into the pofition *o*. The tooth being then in the pofition *b*, efcapes from the notch, and another tooth drops on the convex furface of the cylinder at B.

The balance wheel is alfo furnifhed with a fet of ftout flat-fided pins, ftanding upright on its rim, as reprefented by *a*, D. There is alfo fixed on the verge a larger cylinder GFC above the fmaller one *o p q*, with its under furface clear of the wheel, and having a pallet C, of ruby or fapphire, firmly indented into it, and projecting fo far as juft to keep clear of the pins on the wheel. The pofition of this cylinder, with refpect to the fmaller one below it, is fuch that, when the tooth *b* is efcaped from the notch, the pallet C has juft paffed the pin *a*, which was at A while B refted on the fmall cylinder: but it moved from A to *a*, while B moved to *b*. The wheel being now at liberty, the pin *a* exerts its preffure on the pallet C in the moft direct and advantageous manner, and gives it a ftrong impulfion, following and accelerating it till another tooth ftops on the little cylinder. The angle of fcapement depends partly on the projection of the pallet, and partly on the diameter of the fmall cylinder and the advance of the tooth B into the notch. Independent of the action on the fmall cylinder, the angle of fcapement would be the whole arch of the large cylinder between C and *x*. But *a* ftops before it is clear of the pallet, and the arch of impulfion is fhortened by all the fpace that is defcribed by the pin while a tooth moves from B to *b*. It ftops at *a'*.

We are informed by the beft artifts, that this fcapement gives great fatisfaction, and equals, if it do not excel, Graham's cylindrical fcapement. It is eafier made, and requires very little oil on the fmall cylinder, and none at all on the pallet. They fay that it is the beft for pocket watches, and is coming every day more into repute. Theory feems to accord with this character. The refting cylinder may be made very fmall, and the direct impulfe on the pallet gives it a great fuperiority over all thofe already defcribed, where the action on the pallet is oblique, and therefore much force is loft by the influence of oil. But we fear that much force is loft by the tooth B fhifting its place, and thus fhortening the arch of impulfion; for we cannot reckon much on the action of B on the fide of the notch, becaufe the lever is fo extremely fhort. Accordingly, all the watches which we have feen of this kind have a very ftrong main fpring in proportion to the fize and vibration of the balance. If we leffen this diminution of the angle of impulfion, by leffening the cylinder *o p q*, and by not allowing B to penetrate far into the notch, the fmalleft inequality of the teeth, or fhake in the pivots of the balance or wheel, will caufe irregularity, and even uncertainties in the locking and unlocking the wheel by this cylinder.

A fcapement exceedingly like this was applied long ago by Dutertre, a French artift, to a pendulum. The only difference is, that in the pendulum fcapement the fmall cylinder is cut through to the centre, half of it only being left; but the pendulum fcapement gives a more effective employment of the maintaining power, becaufe the wheel acts on the pallet during the *whole* of the affifted vibration. In a balance fcapement, if we attempt to diminifh the inefficient motion of the pin from A to *a*, by leffening the diameter of the fmall cylinder, the hold given to the tooth in the notch will be fo trifling, that the tooth will be thrown out by the fmalleft play in the pivot holes, or inequality in the length of the teeth.

With this we conclude our account of fcapements, where the action of the maintaining power on the balance is fufpended during the excurfion beyond the angle of impulfion, by making a tooth reft on the furface of a fmall concentric cylinder. In fuch fcapements, the balance, during its excurfions, is almoft free from any connection with the wheels, and its ifochronifm is difturbed by nothing but the friction on this furface.—We come now to fcapements of more artful conftruction, in which the balance is really and completely free during

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

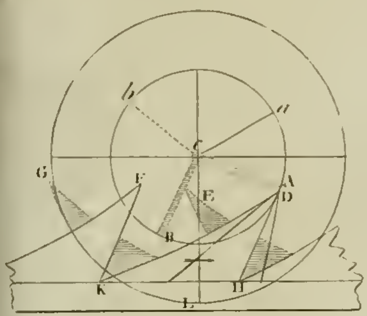


Fig 12

Fig 13

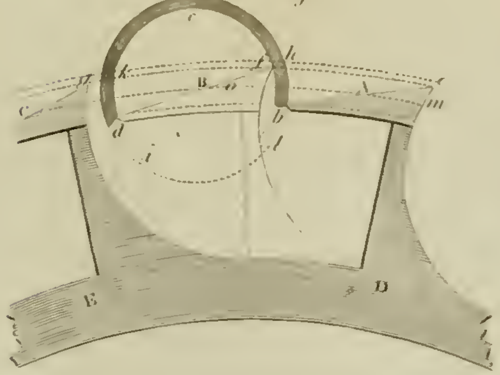
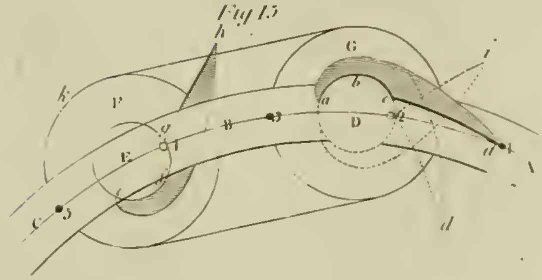


Fig 14.

Fig 15



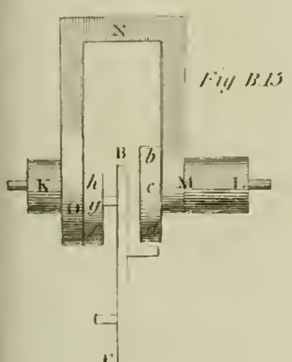


Fig B.15

Fig B.13.

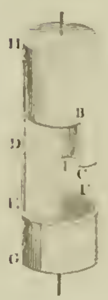


Fig C

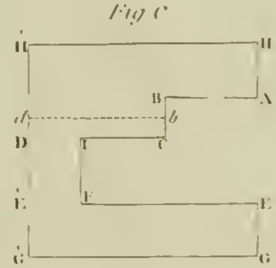


Fig 17.

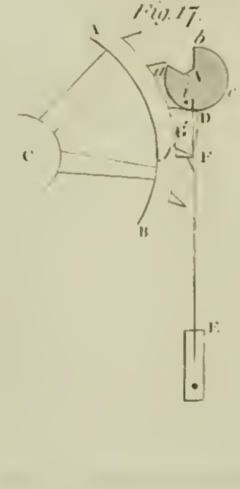


Fig 19

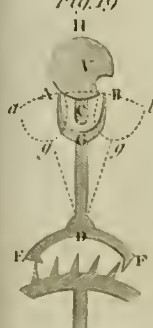


Fig 16.

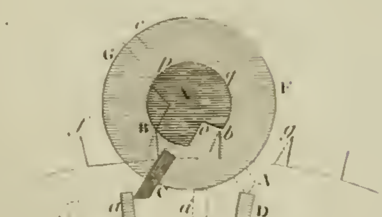
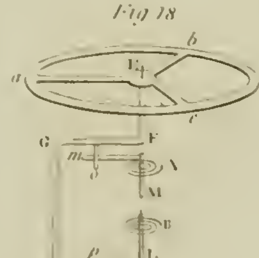


Fig 18



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

pocket watch he had ever feen. We are not difpofed to queftion its excellency. We faw an experiment watch of this conftruction, made by a country artift, having a balance fo heavy as to vibrate only twice in a fecond. Every vibration was fenfibly beyond a turn and a half, or 540°. The artift affured us, that when its proper balance was in, vibrating fomewhat more than five times in a fecond, the vibrations even exceeded this. He had procured it this great mobility by fubftituting a roller with fine pivots in place of the fimple pallet of Mudge. This great extent of detached vibration is an unqueftionable excellence, and is peculiar to thofe two fcapements of this ingenious artift.

Very ingenious fcapements have been made by Ernfhaw, Howel, Hayley, and other Britifh artifts; and many by the artifts of Paris and Geneva. But we muft conclude the article, having defcribed all that have any difference in principle.

The fcapement having been brought to this degree of perfection, we have an opportunity of making experiments on the law of action of fprings, which has been too readily affumed. We think it eafy to demonftrate, that the figure of a fpring, which muft have a great extent of rapid motion, will have a confiderable influence on the force which it impreffes on a balance in *actual motion*. The accurate determination of this influence is not very difficult in fome fimple cafes. It is the greateft of all in the plane fpiral, and the leaft in the cylindrical; and in this laft form, it is fo much lefs as the diameter is lefs, the length of the fpring being the fame. By employing many turns, in order to have the fame ultimate force at the extremity of the excurfion, this influence is increafed. A particular length of fpring, therefore, will make it equal to a given quantity; and it may thus compenfate for a particular magnitude of friction, and other obftructions. This accounts for the obfervation of Le Roy, who found that every fpring, *when applied to a movement*, had a certain length, which made the wide and narrow vibrations ifochronous. His method of trial was fo judicious, that there can be no doubt of the juftnefs of his conclufion. His time-keeper had no fuzee; and when the laft revolution of the main wheel was going on, the vibrations were but of half the extent of thofe made during the firft revolution. Without minding the real rate of going, he only compared the duration of the firft and laft revolution of the minute hand. An artift of our acquaintance repeated thefe experiments, and with the fame refult: But, unfortunately, could derive little benefit from them; becaufe in one ftate of the oil, or with one balance, he found the lengths of the fame fpring, which produced ifochronous vibrations, were different from thofe which had this effect in another ftate of the oil, or with another balance. He alfo obferved another difference in the rate, arifing from a difference of pofition, according as XII, VI, III, or IX, was uppermoft; which difference plainly arifes from the fwagging of the fpring by its weight, and, in that ftate, acting as a pendulum. This unluckily put a ftop to his attempts to leffen this hurtful influence by employing a cylindrical fpiral of fmall diameter and great length.

WATEHOO, an ifland in the South Pacific Ocean; a beautiful fpot, 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, fupplies air to a blaft furnace. It confifts of an upright pipe, through which a fhower of water is made to fall; and this fhower carries down with it a mafs of air, which is received beneath in a kind of tub, and conducted to the furnace by means of a pipe. The firft idea of fuch a machine was doubtlefs fuggefted by thofe local winds, which are always produced by natural falls of water over precipices, and in the mountains (fee page 577 of volume II.); but perhaps we are indebted for the firft accurate theory of it to Profeffor Venturi.

That philofopher in his experimental refearches 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 efcape the penetration of Leonardo Da Vinci. Suppofe a number of equal balls to move in contact with each other along the horizontal line AB (Plate XLVI. fig. 1.). Imagine them to pafs with an uniform motion, at the rate of four balls in a fecond. Let us take BF, equal to 16 feet Englifh. During each fecond four balls will fall from B to F, and their refpective diftances in falling will be nearly BC = 1, CD, = 3, DE = 5, EF = 7. We have here a very evident reprefentation of the feparation, and fucceffive 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 feparates into portions in the vertical direction, and ftrikes the pavement with diftinct blows. The water likewife divides, and is fcattered in the horizontal direction. The ftream which iffues out of the gutter may be one inch in diameter, and ftrike the pavement over the fpace of one foot. The air which exifts between the vertical and horizontal feparations of the water which falls, is impelled and carried downwards. Other air fucceeds laterally; and in this manner a current of air or wind is produced round the place ftruck by the water. Hence the following idea of a water-blowing machine:

Let BCDE (fig. 2.) reprefent a pipe, through which the water of a canal AB falls into the lower receiver MN. The fides of the tube have openings all round, through which the air freely enters to fupply what the water carries down in its fall. This mixture of water and air proceeds to ftrike a mafs of ftone Q; whence rebounding through the whole width of the receiver MN, the water feparates from the air, and falls to the bottom at XZ, whence it is difcharged into the lower channel or drain, by one or more openings TV. The air being lefs 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 fuppofed by fome eminent chemifts, that the air which paffes through the pipe O is furnifhed by the decompofition of water. To afcertain whether this be the cafe or not, our author formed a water-blowing engine of a fmall fize. The pipe BD was two inches in diameter, and four feet in height. When the water accurately filled the fection BC, and all the lateral

ral 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 $7,76 \sqrt{(a + b - 1,4)}$; 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 $= 6,1\, a^2 \sqrt{(a + b - 1.4)}$. 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 $= 0,4\, a^2 \sqrt{(a + 0,1)}$. Conſequently, the quantity of air which paſſes in one ſecond through KL, will be $= 6,1\, a^2 \sqrt{(a + b - 1,4)} - 0,4\, a^2 \sqrt{(a + 0,1)}$, 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 Mouſam 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 ſouthweſt 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

stomed 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 *Twichtwees,* 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 *t*, and draws it forward one tooth, each revolution of the sheeve. This ratchet wheel is in an iron frame *g g*, which also properly

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 2*, 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, n° 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 $1\frac{103}{141}$ pint ale measure.

The GRAMME, or cubic *centi-metre* of water, at the freezing point, = $\frac{1}{453}$ 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.

* H. Goodwin Esq; in *Nicholson's Journal*, vol. iv. p. 103, &c.

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 $\frac{1}{225}$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

† *Journal de Phys.* vol. v. p. 460.

‡ *Phil. Transf.* 1768, p. 326. and *Connoissance des Temps*, 1795.

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 0000092902 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

{ Long, Square, or Cube, } decades are reduced to { Long Square, or Cube, } English inches by multiplying by { 1.2, 1.44, 1.728 }

and decade ounces are reduced to grains.

containing { 7000, or 5760, } to the lb. { Avoird. Troy, } 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.* $3 \times 3 \times 3 = 27$.

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

Fig.1.

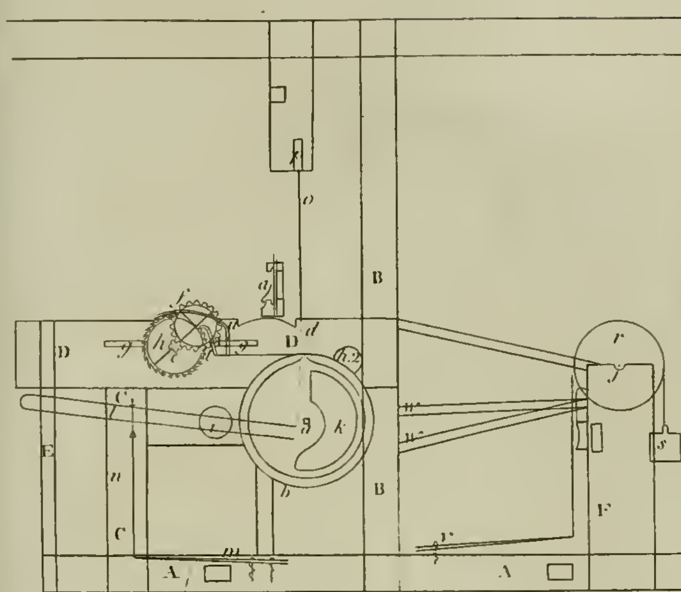
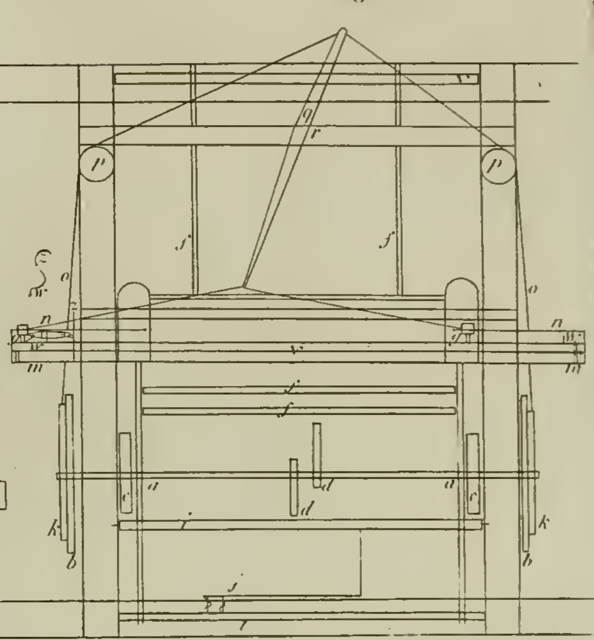
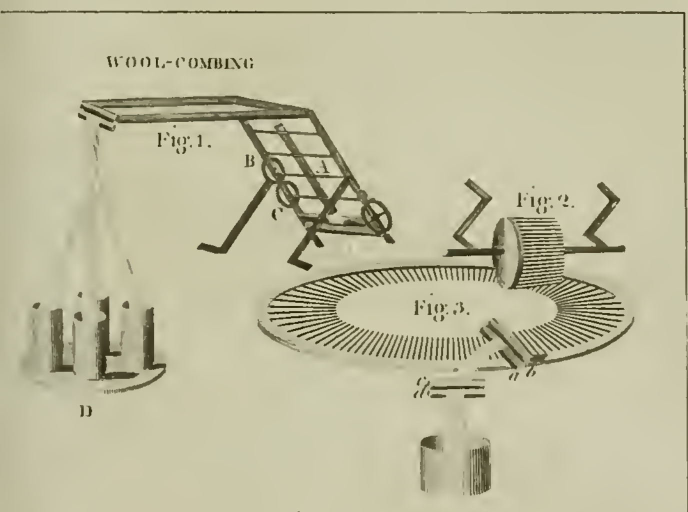
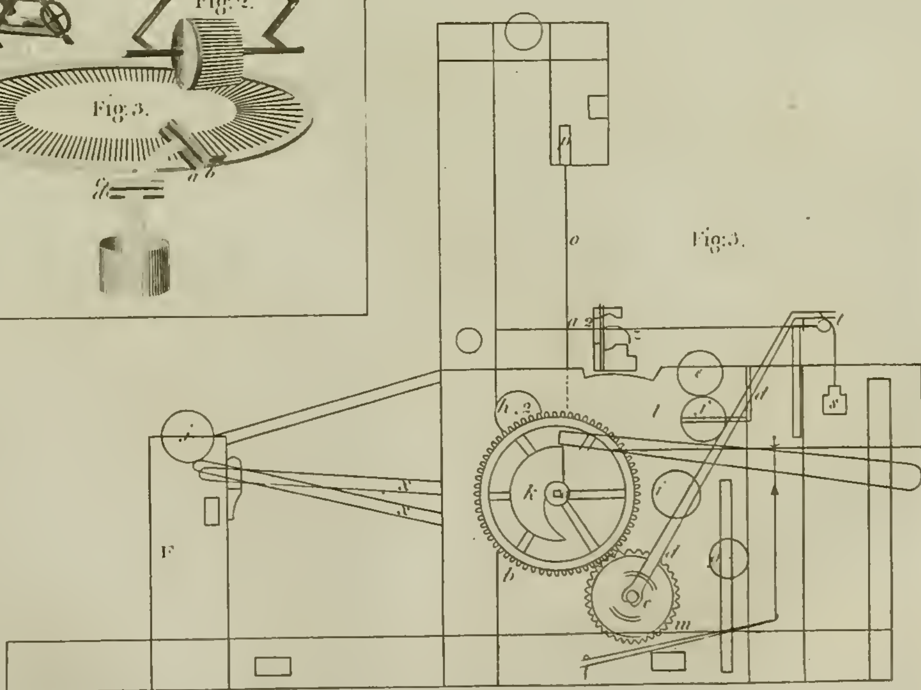


Fig.2.







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

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. fide of Connecticut river.—*ib.*

WEST *Harbour*, on the S. coaft of the ifland of Jamaica, is to the N. of Portland Point. There is good anchorage, but expofed to S. and S. E. winds.—*ib.*

WEST-HAVEN, a parifh of the townfhip of New-Haven, in Connecticut, pleafantly fituated on the Harbour and Sound, 3 miles W. S. W. of the city.—*ib.*

WESTMINSTER, a townfhip of Maffachufetts, fituated in Worcefter county, was granted to thofe who did fervice in the Narraganfet war, or their heirs, in 1728, and was then ftyled *Narraganfet, No.* 2. It was incorporated by its prefent name in 1759; and contains 20,000 acres of land, well watered. It is fituated on the height of land between the rivers Merrimack and Connecticut, having ftreams arifing in the town, and running into both. It is about 55 miles from Bofton to the north of weft, and about 22 miles north from Worcefter, and contains 177 dwelling-houfes, and 1176 inhabitants.—*ib.*

Westminster, a confiderable townfhip of Vermont, in Windham county, on Connecticut river, oppofite Walpole in New Hampfhire. It contains 1601 inhabitants. Sexton's river enters the Connecticut in the S. E. corner of the townfhip. Here is a poft-office 18 miles north of Brattleborough, 18 north-weft of Keen, in New Hampfhire, 59 north of Northampton in Maffachufetts, and 329 north-eaft of Philadelphia.—*ib.*

Westminster, the eafternmoft town of Frederick county, Maryland, about 18 miles E. N. E. of Woodfborough, 26 north-weft of Baltimore, and 47 N. by E. of the city of Wafhington.—*ib.*

WESTMORE, the wefternmoft townfhip of Effex county, Vermont. Willoughby Lake lies in this townfhip.—*ib.*

WESTMORELAND, a county of Virginia, bounded north and eaft by Patowmack river, which divides it from Maryland, fouth-eaft by Northumberland, fouth-weft by Richmond, and weft by King George. It contains 7722 inhabitants, of whom 4425 are flaves. This county has the honour of having given birth to George Wafhington, firft Prefident of the United States. The court-houfe in this county is on the fouth bank of Patowmack river, 10 miles N. by E. of Richmond, 16 north-weft of Kinfale, and 289 fouth-weft by fouth of Philadelphia. Here is a poft-office.—*ib.*

Westmoreland, a county of Pennfylvania, bounded north by Lycoming, and fouth by Fayette county, and abounds with iron ore and coal. It contains 11 townfhips and 16,018 inhabitants, including 128 flaves. Chief town, Greenfburg.—*ib.*

Westmoreland, a confiderable townfhip of New Hampfhire, Chefhire county, on the eaftern bank of Connecticut river, between Chefterfield and Walpole, 110 miles from Portfmouth. It was incorporated in 1752, and contains 2,018 inhabitants.—*ib.*

Westmoreland, a townfhip of New-York, in Herkemer county, taken from Whiteftown, and incorporated in 1792. In 1796, it contained 840 inhabitants, of whom 137 were electors. The centre of the town is 6 miles fouth of Fort Schuyler, and 36 north weft of Cooperftown.—*ib.*

Westmoreland, a tract of land in Pennfylvania, bounded eaft by Delaware river, weft by a line drawn due north and fouth 15 miles weft of Wyoming on Sufquehannah 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 purchafed of the Six Nations of Indians by the Sufquehannah and Delaware companies, and afterwards fettled by a confiderable colony, under the jurifdiction of Connecticut. This tract was called *Weftmoreland*, and annexed to the county of Litchfield in Connecticut. The Pennfylvanians difputed the claim of Connecticut to thefe lands, and in the progrefs of this bufinefs there was much warm contention and fome bloodfhed. This unhappy difpute has fince been adjufted.—*ib.*

WESTON, a townfhip of Maffachufetts, in Middlefex county, 15 miles weft of Bofton. It was incorporated in 1712, and contains 1,010 inhabitants.—*ib.*

Weston, a townfhip of Connecticut, Fairfield county, north of Fairfield, adjoining.—*ib.*

WEST-POINT, a ftrong fortrefs erected during the revolution, on the W. bank of Hudfon's river, in the ftate of New York, 6 miles above Anthony's Nofe, 7 below Fifh Kill, 22 S. of Poughkeepfie, and about 60 N. of New York city. It is fituated in the midft of the high lands, and is ftrongly fortified by nature as well as art. The principal fort is fituated on a point of land, formed by a fudden bend in the river, and commands it, for a confiderable diftance, above and below. Fort Putnam is fituated 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 houfes and barracks on the point near the forts. On the oppofite fide of the river, are the ruins of Old Fort Conftitution, with fome barracks going to decay. A number of continental troops are ftationed here to guard the arfenal and ftores of the United States, which are kept at this place. This fortrefs is called the Gibraltar of America, as by reafon of the rocky ridges, rifing one behind another, it is incapable of being invefted by lefs than 20,000 men. The fate of America feemed to hover over this place. It was taken by the Britifh, and afterwards retaken by ftorm, in a very gallant manner, by Gen. Wayne. Benedict Arnold, to whom the important charge of this fort was committed, defigned to have furrendered it up to the Britifh; but Providenee difappointed the treafonable defign, by the moft fimple means. Major Andre, a moft accomplifhed and gallant officer, was taken, tried, and executed as a fpy, and Arnold efcaped. Thus the Britifh exchanged one of their beft officers, for one of the worft men in the American army.—*ib.*

WESTPORT, a flourifhing townfhip of Maffachufetts, Briftol county, 70 miles foutherly of Bofton. It was incorporated in 1787, and contains 2,466 inhabitants.—*ib.*

WESTRINGIA, a new genus of plants defcribed by J. E. Smith, M. D. prefident of the Linnæan Society of London. It was firft difcovered in New Holland by Dr Solander, who called it *Cunila Fruticofa*, though it is totally different from the Cunila (fee that article, *Encycl.*), and more refembles rofemary, from which, however, it is likewife different. Its peculiar character is: *Calyx femiquinquefidus, pentagonus; corolla refupinata, limbo quadrifido, lobo longiore erecto, bipartito: Stamina diftantia, duo breviora (inferiora) abortiva.* Dr

Smith affigns it rather to the *didynamia-angiofpermia*, placing it immediately after the *Teucrium*, than to the *diandria* clafs of plants.

WEST-SPRINGFIELD, a townfhip of Maffachufetts, Hampfhire county, on the W. fide of Connecticut river, oppofite Springfield, about 28 miles N. of Hartford, and 100 W. S. W. of Bofton. In the compact part are about 40 dwelling-houfes, and a Congregational church. The townfhip contains 3 parifhes, and 2,367 inhabitants.—*Morse.*

WEST-STOCKBRIDGE, a townfhip of Maffachufetts, in Berkfhire county, adjoining Stockbridge on the weft, and has the New York line on the north-weft, and lies 150 miles from Bofton. William's river, and its ftreams water the townfhip, and accommodate 3 iron-works, a fulling-mill, a grift-mill, and 2 faw-mills.—*ib.*

WEST-TOWN, a townfhip in Chefter county, Pennfylvania.—*ib.*

WEYBRIDGE, a townfhip of Vermont, in Addifon county, feparated from New-Haven on the N. and E. by Otter Creek. It contains 175 inhabitants. Snake Mountain lies nearly on the line between this townfhip and that of Addifon on the weft.—*ib.*

WEYMOUTH, the *Wessagufcus*, or *Waffaguffet*, of the Indians, a townfhip of Maffachufetts, Norfolk county, incorporated in 1635. It lies 14 miles S. E. of Bofton, and employs fome fmall veffels in the mackarel fifhery. Fore river on the N. W. and Back river on the S. E. include near one half of the townfhip. The cheefe made here is reckoned among the beft brought to Bofton market. It is faid to be one of the oldeft towns in the ftate; Mr Wefton, an Englifh merchant, having made a temporary fettlement here in the fummer 1622. It contains 232 houfes, and 1469 inhabitants.—*ib.*

WHALE COVE *Ifland*, in the northern part of N. America, is the moft northerly of two iflands lying to the S. of Brook Cobham, or Marble Ifland, which is in lat. 63 N. Lovegrove, the other ifland, has a fair opening to the weft of it.—*ib.*

WHALE FISH *Ifland*, in the river Effequibo, on the coaft of S. America, is above the Seven Brothers, or Seven Iflands, and below the Three Brothers.—*ib.*

WHALE *Ifland*, at the mouth of M'Kenzie's river, in the North Sea or Frozen Ocean, on the north coaft of the north-weftern part of North America. N. lat. 69 14.—*ib.*

WHAPPING'S *Creek*, a fmall creek which empties through the eaft bank of Hudfon's river, in the townfhip of Fifh Kill, 8 miles fouth of Poughkeepfie, and 72 north of New York city. Here are two mills, at which confiderable bufinefs is performed.—*ib.*

WHARTON, a townfhip of Fayette county, Pennfylvania.—*ib.*

WHATELY, a townfhip of Maffachufetts, in Hampfhire county, 10 miles north of Northampton, and 105 miles from Bofton. It was incorporated in 1771, and contains 736 inhabitants.—*ib.*

WHEAT (fee Triticum, *Encycl.*) has for fome years paft been at fo very high a price, that every hint for increafing its quantity or improving its quality is intitled to notice. In the Leicefter Journal for the 6th of December 1799, there is an ingenious paper on the fubject of tranfplanting wheat, as a means of providing againft the expected fcarcity of that neceffary of life. It is recommended "to fow, in dry land, at the ufual feafon, as much corn as may be deemed neceffary to plant in the fpring any number of acres which may be occupied with that article in the following year. When the foil is prepared, a furrow is to be made with a very fmall plough and one horfe, in the centre of the ridge or land, returning back in the fame track (this time only of every ridge); then turn towards the left hand, and plough another furrow, about eight or nine inches from the firft furrow, turning always to the left hand, till the whole ridge is finifhed; it will then be formed into trenches, in parallel lines of about eight or nine inches afunder, and imitate what gardeners term drawing of drills. In thefe furrows the plants are to be laid." Mr John Ainfworth of Glen, the experienced author of this communication, fays he has practifed this method with the moft complete fuccefs.

It has been likewife practifed, on a fmall fcale, with equal fuccefs, but we know not in what county. About the end of Auguft 1783, that gentleman threw a fmall quantity of wheat, which near two years before had been fteeped and limed (fee Wheat, *Encycl.*) into an unmanured corner of his garden. In the beginning of February following he had a piece of ground (alfo unmanured) dug in an open part of his orchard, and he tranfplanted it on beds of fix rows wide, at nine inches afunder every way. It tillered, and fpread over the ground fo 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, fuppofing the feed to be very good, and the plants fet at the diftance above menttioned, would require only *half a peck* of feed.

Befides the faving of the feed, there are two other material advantages which attend fuch a method; one is, that fome fuitable crop may be on the ground all the winter for ufe; and the other is, that ploughing the ground fo late as February, will effectually bury and deftroy thofe weeds which were beginning to vegetate; and before others can fpring up, the corn plants have taken to the ground, and fo fpread over it that the weeds cannot rife, by which means there is a very clean crop, and all the cuftomary expenfe for weeding is faved.

This author feems to think that wheat will thrive as well, and produce as full a crop, when fown in the fpring, as if it had been committed to the ground in the preceding autumn. In the fouthern counties of England we doubt not but it may; but the cafe is otherwife in Scotland, where the fpring is not fo early, and where from the narrownefs of the ifland, the froft is feldom fo fevere. We agree, however, with Dr Pike, in thinking it a pity that the way of fetting wheat (as done in Norfolk and Suffolk) is not every where more general. The procefs is indeed tedious and troublefome; and we have often wondered that, among the numberlefs machines lately contrived to leffen manual labour, none has been invented for dibbling wheat expeditioufly and accurately. We are therefore pleafed to learn, that Dr Pike himfelf has turned his attention to the fubject, and hopes in the courfe of this year (1800) to prefent the public with a *method of fetting wheat at* PERFECTLY EXACT *diftances through a whole field, and as* EXPEDITIOUSLY *as the common broadcaft fowing, which can therefore be applied to farms of any magnitude;*

nitude; and when a peck of feed is found to be sufficient for an acre (and in fome land much lefs), the faving on a large farm muft be immenfe. We truft to the liberality of his profeffion, that he will not take out a patent for his invention.

Though we have elfewhere given the ufual recipes for preventing fmut in wheat, it would be improper to conclude this article without mentioning the very fimple one which Mr Wagftaffe of Norwich has uniformly found attended with complete fuccefs. This confifts in nothing more than immerfing the feed in pure water, and repeatedly fcouring it therein, juft before it is fown or dibbled in the foil. Whether well, fpring, or river water be ufed, is indifferent; but repeated ftirring and change of water is effential to remove the particles of infection that may have imperceptibly adhered to the feeds thus purified. The fubfequent crop will be perfect in itfelf, and its feeds, he fays, fucceffively fo likewife, if there are no adjacent fields from whence this contamination may be wafted. He recommends the fame wafhing, and for the fame reafon, of barley and oats before they be fown.

WHEELING, or *Wheelin*, a poft-town of Virginia, fituated at the mouth of a creek on the eaft bank of Ohio river, 10 miles above Grave Creek, 18 fouth-weft of Weft Liberty, and 61 fouth-weft of Pittfburg. Not far from this place, a wall has been difcovered fome feet under the earth, very regularly built, apparently the work of art. It is 363 miles from Philadelphia.—*Morse.*

WHEELOCK, a townfhip of Vermont, in Caledonia county, about 20 miles north-weft of Littleton, and contains 33 inhabitants.—*ib.*

WHETSTONE *Fort* is on the north fide of Patapfco river, and weft fide of the mouth of Baltimore Harbour, in Maryland. It is oppofite Goffuch Point, 2½ miles eafterly from the Baltimore Company's iron-works, at the mouth of Gwinns Falls.—*ib.*

WHIPPANY, a village of New Jerfey, Morris county, on a branch of Paffaick river, nearly 5 miles N. E. of Morriftown.—*ib.*

WHIRL, or *Suck*, in Tenneffee river, lies in about lat. 35 N.—*ib.*

WHITE, a river or torrent iffuing from the mountain of fulphur in the ifland of Guadaloupe, in the Weft-Indies. It is thus named as often affuming a white colour from the afhes and fulphur covering it. It empties into the river St Louis.—*ib.*

WHITE, a river of Louifiana, which joins Arkanfas river, a water of the Miffiffippi, about 10 miles above the fort, which Mr Hutchins reckons 550 computed miles from New-Orleans, and 660 from the fea. It has been navigated above 200 miles in flat-bottomed boats.—*ib.*

WHITE, a fmall river of the N. W. Territory, which purfues a north-weft, and, near its mouth, a wefterly courfe, and enters Wabafh river, 12 miles below the mouth of Chickafaw 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, fome diftance from its mouth. Its fource is in a fpring, which by means of Onion river, communicates with Lake Champlain. It derives its name from the whitenefs of its water.—*ib.*

WHITE *Cape*, or *Blanco*, on the weft coaft of New Mexico, is 20 leagues to the north-weft of Herradura. This cape, in lat. 10 N. bears with the ifland Canoe, at north-weft by weft and S. E. by E. and with St Luke Ifland at N. E. by N. and fouth-weft by fouth, being about 9 leagues from each.—*ib.*

WHITE *Deer*, a townfhip of Pennfylvania, fituated on Sufquehannah river.—*ib.*

WHITEFIELD, a townfhip of Pennfylvania, in Weftmoreland county.—*ib.*

WHITE *Ground*, a place in the Creek country, 10 miles from Little Tallaffee.—*ib.*

WHITEHALL, a townfhip of Pennfylvania, in Northampton county.—*ib.*

WHITEHALL, a townfhip of New York, Wafhington county, bounded foutherly by the S. bounds of the tract formerly called Skeenfborough, 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 townfhip of Pennfylvania, Montgomery county.—*ib.*

WHITEPAINE, a townfhip of Pennfylvania, Montgomery county.—*ib.*

WHITE PLAINS, a townfhip of New York, Weft-Chefter county, bounded eafterly by Mamaroneck river, and wefterly by Bronx river. It contains 505 inhabitants, of whom 76 are electors, and 49 flaves. It is remarkable for a battle fought here between the American and Britifh forces, on the 28th of October, 1776. It is 15 miles E. by N. of Kingfbridge, 30 N. E. by N. of New York, and 125 from Philadelphia.—*ib.*

WHITE *Point*, in the ifland of Jamaica, lies eaftward of White Horfe Cliffs, about 7 leagues E. of Port Royal.—*ib.*

WHITE'S *Bay*, on the coaft of Newfoundland. N. lat. 50 17, W. long. 56 15.—*ib.*

WHITESTOWN, in Herkemer county, New York, on the fouth fide of Mohawk river, 4 miles weft of Old Fort Schuyler, and 100 weft of Albany. The compact part of this new and flourifhing town lies on one beautiful ftreet, about a mile in length, ornamented with trees. The houfes are generally furnifhed with water, conducted by pipes laid under ground, from the neighbouring hills. At prefent the court-houfe, meeting-houfe, and fchool-houfe, are combined in one building; but it is contemplated fhortly to erect feparate and handfome edifices for thefe feveral purpofes. The foil of this town is remarkably good. Nine acres of wheat in one field, yielded, on an average, 41 bufhels of wheat, of 60 lb. each, an acre. This is no uncommon crop. This town and its neighbourhood has been fettled with remarkable rapidity. All that diftrict comprehended between the Oneida Refervation, and the German Flats, and which is now divided into the townfhips of Whitef-town, Paris, and Weftmoreland, was known, a few years fince, by the name of *Whiteftown*, and no longer ago than 1785, contained two families only, thofe of Hugh White, and Mofes Foot, efquires. In 1796, there were within the fame limits, 6 parifhes, with as many fettled minifters, 3 full regiments of militia, 1 corps of light-horfe, all in uniform. In the whole, 7359 inhabitants, of whom 1190 were qualified electors.—*ib.*

WHITING, a townfhip of Vermont, in Addifon county,

county, feparated from Leicefter on the E. by Otter Creek, and has part of Orwell on the W. It contains 250 inhabitants.—*ib.*

WHITTINGHAM, a townfhip of Vermont, in the fouth-weft corner of Windham county, containing 442 inhabitants.—*ib.*

WHITSUN *Ifland*, in the South Pacific Ocean, is about 4 miles long, and 3 broad; and fo furrounded 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 Jofeph, 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 weft fide. It has many branches, which are all navigable.—*ib.*

WICKFORD, a fmall trading village in the townfhip of North Kingftown, Rhode-Ifland, and on the W. fide of Narraganfet-Bay; 24 miles S. of Providence, and 9 or 10 N. W. of Newport.—*ib.*

WIESPINCAN, a river of Louifiana, which empties into the Miffiffippi, 22 miles above the Soutoux village.—*ib.*

WICOMICO, a fmall river of Maryland, which rifes in Suffex county, Delaware, and empties into Fifhing-Bay, on the eaft fhore of Chefapeak Bay.—*ib.*

WIGHCOMICO, a fhort navigable river of Maryland, which is formed by Piles and Allen's Frefh, and, running fouthward, empties into the Patowmac, about 35 miles from its mouth. Cob Neck forms the north limit of its mouth.—*ib.*

WILBRAHAM, a townfhip of Maffachufetts, in Hampfhire county, 10 miles E. of Springfield, 30 N. E. of Hartford in Connecticut, and 89 S. W. of Bofton. It was incorporated in 1763; contains 2 parifhes, and 1555 inhabitants.—*ib.*

WILKES, a county of the upper diftrict of Georgia, feparated from S. Carolina, on the eaftward, by Savannah river, and contains 31,500 inhabitants, including 7,268 flaves. 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 fpring, near its chief town, Wafhington.—*ib.*

Wilkes, a county of Morgan diftrict, in the N. W. corner of N. Carolina. It contains 8,143 inhabitants, including 549 flaves.—*ib.*

Wilkes, a poft-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 parifh of Dalmeny, in the county of Weft-Lothian, on the 5th of October 1721. He was defcended of an ancient family in that county, though his father rented only a fmall farm, and was poor and unfortunate through life. He was able, however, to give his fon a liberal education; and that fon, it is faid, difcovered fo early a propenfity to the ftudy of poetry, that he began to write verfes in his tenth year.

As this wonderful prematurity of genius was never heard of during Wilkie's life, it will probably be confidered as a ftory fabricated to raife the Scottifh poet to the fame eminence with Pope, whofe verfification he is allowed to have imitated with fuccefs. We have no doubt but that Wilkie wrote in early life the defcription of a ftorm, which is publifhed in the 9th volume of the Statiftical Account of Scotland; but that he wrote it in his tenth year is not proved, and is highly improbable. The poem difplays a notion—a confufed notion indeed—of the laws of electricity, which a boy in his tenth year, and at a period when electricity was little underftood, could not have acquired.

Having learned the rudiments of the Latin tongue at the parifh-fchool of Dalmeny, young Wilkie was, at the age of thirteen, fent to the univerfity of Edinburgh, where he was foon diftinguifhed by his originality of thought, and by his rapid progrefs in erudition and fcience. Among his fellow ftudents he was moft clofely affociated with Dr Robertfon the hiftorian, Mr John Home the poet, Dr M'Ghie (A), who afterwards obtained the friendfhip of Johnfon, and became a member of the Ivy-lane Club; and a Mr Cleghorn, who promifed to be an ornament to the univerfity, in which he was afterwards a profeffor, but died before he had time to realize the fond hopes of his friends. During the courfe of his education, Wilkie became acquainted with the celebrated David Hume and Dr Fergufon, and at a later period with Dr Adam Smith, the far-famed author of "The Wealth of Nations." Of all thofe men he regarded Dr Fergufon with the greateft affection, and Dr Smith with the greateft admiration. This laft writer he confidered as equal to Robertfon and Hume in erudition, and vaftly their fuperior in originality and invention; and this opinion he cherifhed to the day of his death.

Before he had completed his education, his father died, leaving him no other inheritance than the ftock and unexpired leafe of his farm, and the care of his three fifters. Wilkie, therefore, turned much of his attention to agriculture, in which he became eminent, not merely as a theorift, but as a practical farmer. He had too much fcience to be the flave of ancient prejudice, and too much judgment to be hurried into hazardous experiments by the charms of untried fpeculation. One of his fifters being married to a fkilful, though unlettered farmer, he availed himfelf of his brother's experience; and upon the facts and maxims derived from him built a fyftem of practical farming, which fully anfwered his own expectation, and obtained the applaufe of all his neighbours.

He ftill profecuted his ftudies in the univerfity, and without ceafing to be a farmer became a preacher in the church of Scotland. For fome years this made no alteration in the mode of his living. He preached occafionally for the minifters of his neighbourhood; culti-

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(A) According to Sir John Hawkins, this man bore arms on the fide of government at the battle of Falkirk 1745. After which, taking a degree in phyfic, he went to London in hopes of employment through the intereft of his countrymen, and perhaps in return for his loyalty. He was a learned, ingenious, and modeft man; but fo little fuccefsful in his profeffion, 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 penuriousness, 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,

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 Canaſerago 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 Braſſerton, 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 Borlington 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

rated 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 southwest 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 northwesterly 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 northwesterly 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. Winnipiscogee 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 coaft of South-Carolina, communicates with the ocean 12 miles below George-town.—*ib.*

WISCASSET, a port of entry and poft-town of the Diftrict of Maine, Lincoln county, on the weft fide of Sheepfcut river, 10 miles S. E. of New-Milford on the E. fide of Kennebeck river, 13 north-weft of Bath, 56 north-weft of Portland, 178 N. E. by N. of Bofton, 525 from Philadelphia, and 1513 from Sunbury in Georgia. It is a part of the townfhip of Pownalborough, and is very flourifhing. It contains a congregational church, and about 120 houfes. Its navigation is greater in proportion to its fize and number of inhabitants than any part of Maffachufetts. A gazette is publifhed here, and the county courts are held in it. Wifcaffet Point is 3 leagues from Crofs river. The exports for one year, ending the 30th of Sept. 1794, amounted to 23,329 dollars.—*ib.*

WITCHARN *Bay*, is within the great found in the Bermudas Iflands, in the Weft-Indies; fituated at the E. part of the bottom or S. part of the Sound, having two fmall iflands at the mouth of it.—*ib.*

WOAHOO, one of the Sandwich Ifles, in the North Pacific Ocean, 7 leagues north-weft of Morotoi Ifland. 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 Iflands, lefs in fize than Chriftiana. The body of it lies in lat. 9 27 S. It bears north-weft by weft, about 20 leagues from Refolution Bay. It was called *Adams*, by Capt. Ingraham; and a fmall ifland to the fouthward of it he called *Lincoln*. Capt. Roberts afterwards difcovered them and named them from his fhip and fchooner; the larger *Jefferfon*, and the leffer *Refolution*.—*ib.*

WOBURN, a townfhip of Maffachufetts, in Middlefex county, 10 miles north of Bofton. It was incorporated in 1642 by the name of *Wooborne*, and was till then known by the name of *Charleftown Village*. It contains 1727 inhabitants.—*ib.*

WOLCOTT, a townfhip of Vermont, in Orleans county, fouth of Craftfbury, containing 32 inhabitants. La Moille river runs N. weftward through it.—*ib.*

WOLF, a fmall boatable river of Tenneffee, which runs wefterly into Miffiffippi river, about 19 miles fouth of Hatchy river, and 55 from Reelfoot. It is 50 yards wide feveral miles from its mouth, which is very near the fouth-weft corner of the State, in lat. 35.—*ib.*

WOLFBOROUGH, a townfhip of New-Hampfhire, Strafford county, on the E. fide of Winnipifiogee Lake, and contains 447 inhabitants. It contains fome fine farms, and particularly that which formerly belonged to Gov. Wentworth.—*ib.*

WOLVES *Iflands* lie near Campo Bello Ifland, on the eafternmoft coaft of the Diftrict of Maine. Between thefe the foundings are from 50 to 100 fathoms. N. lat. 44 48, W. long. 66 40. From Grand Mannan Ifland to Wolves Iflands the courfe is N. E. by N. 3 leagues.—*ib.*

WOMELDORF, a poft-town of Pennfylvania, in Berks county, fituated on the weft fide of a fmall ftream which falls into Tulpehocken Creek. It contains about 40 houfes, and a German Lutheran and Calvinift church. It is 68 miles north-weft of Philadelphia.—*ib.*

WOODBRIDGE, a poft-town of New-Jerfey, Middlefex county, on the great road from New-York to Philadelphia, on a ftream which falls into Arthur Kull, above Amboy. It is about 3 miles N. by W. of Amboy, 10 fouth-wefterly of Elizabeth-Town, and 70 N. E. of Philadelphia. The townfhip contains 3550 inhabitants, including 256 flaves.—*ib.*

Woodbridge, a townfhip of Connecticut, New-Haven county, about 7 miles north-weft of New-Haven city.—*ib.*

WOODBURY, a townfhip of Vermont, in Caledonia county, 15 or 20 miles weft-north-weft of Barnet.—*ib.*

Woodbury, a poft-town of New-Jerfey, and capital of Gloucefter county, fituated near a fmall ftream, which empties into the Delaware below Red Bank. It contains about 80 houfes, a handfome brick court-houfe, a Quaker meeting-houfe, and an academy. Several of the houfes are neat and handfome. It is 9 miles fouth of Philadelphia, and 11 north-eaft of Swedefburg. Alfo, the name of a townfhip of Pennfylvania, in Huntingdon county.—*ib.*

Woodbury, a townfhip of Connecticut, in Litchfield county, 8 miles fouth of Litchfield. It was fettled in 1672.—*ib.*

WOOD *Creek*, a fluggifh ftream which rifes in the high lands, a little eaft of Fort Edward, on Hudfon's river; and after running 25 miles, falls into the head of Lake Champlaine at Skenefborough. It has a fall at its mouth, otherwife it is navigable for batteaux for 20 miles up to Fort Anne.—*ib.*

Wood *Creek* runs weftward, and empties into Lake Oneida.—*ib.*

WOOD-cuts are engravings on wood, commonly on box, which, in many cafes, are ufed with advantage inftead of copper-plates. The art of cutting or engraving on wood is undoubtedly of high antiquity; for Chinefe printing is a fpecimen of it. (See China, n° 127. *Encycl.*) Even in Europe, if credit be due to Papillon, this art was practifed at a period confiderably remote; for he mentions eight engravings on wood, entitled, "A reprefentation of the warlike actions of the great and magnanimous Macedonian king, the bold and valiant Alexander; dedicated, prefented, and humbly offered, to the moft holy father, Pope Honorius IV. by us Alexander Alberic Cunio Chevalier, and Ifabella 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 thefe two years. Even this is not the remoteft period to which fome have carried the art in Europe; for the ufe of feals or fignets being of very high antiquity, they imagine that the invention of wood-cuts muft be coeval with them. The fuppofition is certainly plaufible, but it is not fupported by proof. The earlieft impreffion of a wooden-cut, of which we have any certain account, is that of St Chriftopher carrying an infant Jefus through the fea, in which a hermit is feen holding up a lantern to fhew him the way; and a peafant, with a fack on his back, climbing a hill, is exhibited in the back ground. The date of this impreffion is 1423.

In the year 1430 was printed at Haarlem, "The hiftory

Wood-cuts. history of St John the evangelist and his revelation, represented in 48 figures in wood, by Lowrent Janson Cotter;" and, in 1448, Jorg Schappf 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, Wood-cuts. 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 Anderson,

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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.

od-cuts. fon, whofe beautiful cuts adorn the poem entitled *Grove Hill*, were the next, and hitherto have been the laft of Thomas Bewick's pupils, who have appeared before the public as artifts. By thefe gentlemen we are authorized to fay, that the method practifed by the ancient engravers on wood, whofe works are ftill admired, muft have been different from that of Bewick and his pupils. What that method was feems to be altogether unknown. Papillon, who writes the beft hiftory extant of the art, gueffes indeed in what manner the old engravers proceeded fo as to give to their works the fpirit and freedom for which they are famed; but that his gueffes are erroneous feems evident from the ftiffnefs of his own works. The principal characteriftic in the mechanical department of the productions of the ancient mafters is the croffing of the black lines, which Papillon has attempted with the greateft awkwardnefs, though it feems to have been accomplifhed by them with fo much eafe, 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 crofs hatching is fo difficult and unnatural, that it may be confidered as impracticable (B).

The engravers of Bewick's fchool work on the end of the wood which is cut acrofs the trunk of the tree, in pieces of the proper thicknefs. As wood-cuts are generally employed in the printer's prefs amidft a form of types, this thicknefs muft be regulated by the height of the types with which they are to be ufed. The tools employed are nearly the fame with thofe ufed in copperplate engraving, being only a little more deep, or lozenge, as engravers call it. They muft have points of various degrees of finenefs for the different purpofes to which they are applied, fome of them being fo much rounded off at the bottom as to approach to the nature of a goodge, whilft others are in fact little chiffels of various fizes. Thefe chiffels and goodges, to which every artift gives the fhape which he deems moft convenient, are held in the hand in a manner fomewhat different from the tool of the engraver on copper, it being neceffary to have the power of lifting the chips upwards with eafe. To attempt a defcription of this in writing would be in vain; but it is eafily acquired, we are told, by practice.

The pupils of the fchool of Bewick confider it as quite improper to fpeak of his invention as a revival of the ancient art. Some old prints, it is true, have the appearance of being executed in the fame way with his; but others have certainly been done by a method very different. It is therefore not fair to appreciate the prefent art by what has been done, but by what may be done; and that remains yet to be fhewn. The art is in its infancy; and thofe who are difpofed 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 fhould have been perfons fo very blind as to miftake the copies for the originals. If copper has its advantages over wood in point of delicacy and minutenefs, wood has, in its turn, advantages not inferior in regard to ftrength and richnefs. Thofe prints which were executed under the aufpices of Titian and Rubens, will always remain a monument of the fpirit and vigour natural to wood-engraving; and if there be not found in them all the attention to *chiaro fcuro*, which the prefent age demands, it muft not be attributed either to defect in the art, or to want of abilities in the artifts, but to the tafte of the times when *chiaro fcuro* was little underftood. It remains for fome enterprifing artift to fhew that the vigour of the ancient art may be attained by the prefent one, and at the fame time to add to that vigour thofe gradations of fhade which are fo much admired in good copperplates. As there feems to be a more perfect, or at leaft a more pleafant black produced by wood than by copperplate printing, and certainly a more perfect white (c), who will fay that any intermediate fhade whatever may not be produced by wood-cuts? To attempt this on a fmall fcale would indeed be vain, becaufe the flighteft variation, produced by a little more or lefs ink, or a harder preffure in printing, bears fuch a proportion to a very fhort line, as muft neceffarily render the attempt abortive.

Wood-cuts, || Woods.

Wood-engraving, therefore, muft always appear to difadvantage while it is confined to fmall fubjects, and will never reach its ftation *as a fine art*, till thofe who are engaged in its cultivation improve upon the difcoveries of one another, and apply to fubjects to which it is properly adapted. As an *economical art* for illuftrating mechanics and other fubjects of fcience, it is too little employed even in its prefent ftate.

The works of Bewick and his pupils which have hitherto been publifhed, are not numerous. Befides his quadrupeds and birds, the Hudibras by Nefbit, and the Grove Hill by Anderfon, which have been already noticed, we are acquainted with none but the following:—Goldfmith's *Traveller* and *Deferted Village* with elegant plates, all by Thomas Bewick, except one or two which were executed by John; Somerville's *Chace* by the fame artifts, executed in a ftyle of elegance which perhaps has never been furpaffed; a View of St Nicholas's Church, Newcaftle, 15 inches long, by Mr Nefbit, who received for it a filver 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, Verfailles.—*Morse*.

WOODFORD, a townfhip of Vermont, eaft of Bennington, adjoining. It contains 60 inhabitants.—*ib.*

WOOD *Ifland*, on the fea-coaft of the Diftrict of Maine, 5 leagues north-eaft of Cape Porpoife, and fouth-weft by fouth 4 leagues of Richman's Ifland.—*ib.*

WOODS, *Lake of the*, the moft northern in the

United

(B) Mr Nefbit has indeed introduced fomething of it into two or three of his pieces, merely to fhew that he *could* do it; but fo great was the labour, and fo little the advantage of this improvement, if fuch 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, Snowhill.—*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, Worcester. 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.

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, ‖ Xeres.

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.

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, ‖ Yago.

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 St 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 Miſſiſſippi, 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

 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, 270feet 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 (Kherâje), 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 Monâſib), 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

(A) This event took place towards the cloſe of the 12th century. N. B. *Kherâje* ſignifies ſpecifically the tribute paid by a conquered country.

Zemindars.

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.

Zemindars, ‖ Zoneſhio.

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.

APPENDIX.

THE importance of every invention which tends to facilitate Navigation is fuch 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 prefented to our readers from the Specifications of the Patents obtained by Chefter Gould, the Inventor of the *Artificial Horizon*. He fays, " My invention confifts in applying a fluid or fluids coloured, or otherwife, to the quadrant or fextant, fo as to obtain a level for the purpofe of taking the altitudes of celeftial and other fubjects, on land or water, without the affiftance of the natural horizon. This I perform in the manner following: that is to fay, I make a circular tube or ring of brafs, or of other proper fubftance, from two to three inches in diameter, or more or lefs, as convenience may direct, in which I fit four tranfparent glaffes, directly oppofite to, and parallel with, each other, fo that the furfaces of the fluid contained in the tube may be diftinctly feen by the obferver. The infide 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 ufe fhould be about half filled with fome tranfparent fluid, and it fhould be fixed to a fmall apparatus made of brafs or other proper fubftance, with fuch joints and adjuftments as are neceffary to bring it to its true pofition on the quadrant or fextant.

" The artificial horizon, reprefented in the annexed drawing, I confider to be moft proper for general ufe.

" Fig. A, in the drawing (fee Appendix, Plate III.), reprefents the whole inftrument with the artificial horizon put together; *m*, reprefents the fcrew which binds the cramp *n* to the frame of the quadrant or fextant, fo that the ring or tube of the artificial horizon will ftand directly behind the fore horizon glafs. The pofition of the tube or ring ought to be fuch, that its plane will be parallel to the plane of the quadrant or fextant, and fo alfo that the centre of its glaffes and the hole of the forefight vane of the quadrant or fextant, which is intended to be ufed, fhould form a line parallel to the chord of the arch, and to the plane of the quadrant or fextant at the fame time. Its true pofition on the quadrant or fextant being obtained, and the ring or tube being filled as is above defcribed up to the centre of its glaffes, and the quadrant or fextant being held in a vertical pofition, the furface of the fluid may be brought to form a perfect level with the eye of the obferver. This being done, the object whofe altitude is to be taken is then reflected down to this fluid level, in the fame manner as when altitudes are taken by a fea horizon.

" The whole inftrument may be varied in its form, fcale and proportion, the tube may be filled with mercury, but I prefer a tranfparent fluid; and, in order to retard the too fudden motion of the fluid, I make an adjuftment in the bottom of the tube (either fixed or moveable) by which the motion of the fluid is obftructed and regulated at pleafure. I have in fome inftances ufed coloured glaffes, but for general ufe I prefer the plain; in either cafe the furfaces fhould be well ground and finely polifhed. I have alfo ufed two tubes or rings, fo placed, that, when the inftrument is in ufe, the level is formed by an apparent contact of one of the furfaces of the fluid in each tube, but I think a fingle tube or ring to be much preferable.

" I prefer the artificial horizon made and ufed as above defcribed, but it may be fo conftructed as to be connected with a telefcope, fuch as is frequently applied to quadrants or fextants, by which means the furfaces of the fluid, and their contact with the image of the fun or any other body, may be more exactly determined, and this may be effected whether the inftrument is intended to be fitted up with two rings or with one only. As the form of the telefcope and of the artificial horizon as well as the mode of connecting them together admit of great variety, I inftance the following examples; that is to fay,

"The firft example fhall be where only one ring or tube is ufed. In this cafe I make the tube of fuch a figure, that one pair of the glaffes occupy the field of the telefcope, between which glaffes one of the furfaces of the fluid appears, and the other furface of the fluid is put fo much out of the axis of the telefcope, as not to obftruct the light from the object glafs, and by placing a horizontal wire, or by drawing a horizontal line acrofs one of the glaffes, the inftrument being previoufly adjufted, and fo held or placed, that the furface of the fluid in the tube between the glaffes and the wire or line is made to correfpond. The image of the fun or other object may be brought to touch the wire or line at the fame time by moving the index of the quadrant or fextant, and the altitude may be read off upon the arch as in common cafes.

" The fecond example fhall alfo be with one tube or ring only, and where both the furfaces of the fluid fhall appear as in the field of the telefcope. In this cafe, I cut off one half of the object glafs of the telefcope commonly ufed, fuppofing it to be divided by a line parallel to the plane of the inftrument, and inftead of the part taken away I place half of another object glafs, whofe focus is equal to one half of the focus of the original object glafs, and I encreafe the diftance between the furfaces of the fluid to twice the focal diftances of the original glafs, and by placing one furface of the fluid in the field of the telefcope, as in the firft example, and the other furface in the axis of the telefcope produced, the inftrument being adjufted, that furface of the fluid neceffarily placed behind the object glafs will appear to meet the furface of the fluid placed in the field of the telefcope, and to which the image of the fun can be made to coincide as in the firft example.

" The laft example fhall be where two tubes or rings are ufed. In this cafe I place one of the rings or tubes as in the firft example, that is to fay: one of the furfaces of the fluid in the field of the telefcope, and the other out of the axis of the telefcope and towards the object glafs, and I place the fecond ring or tube with one furface.

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

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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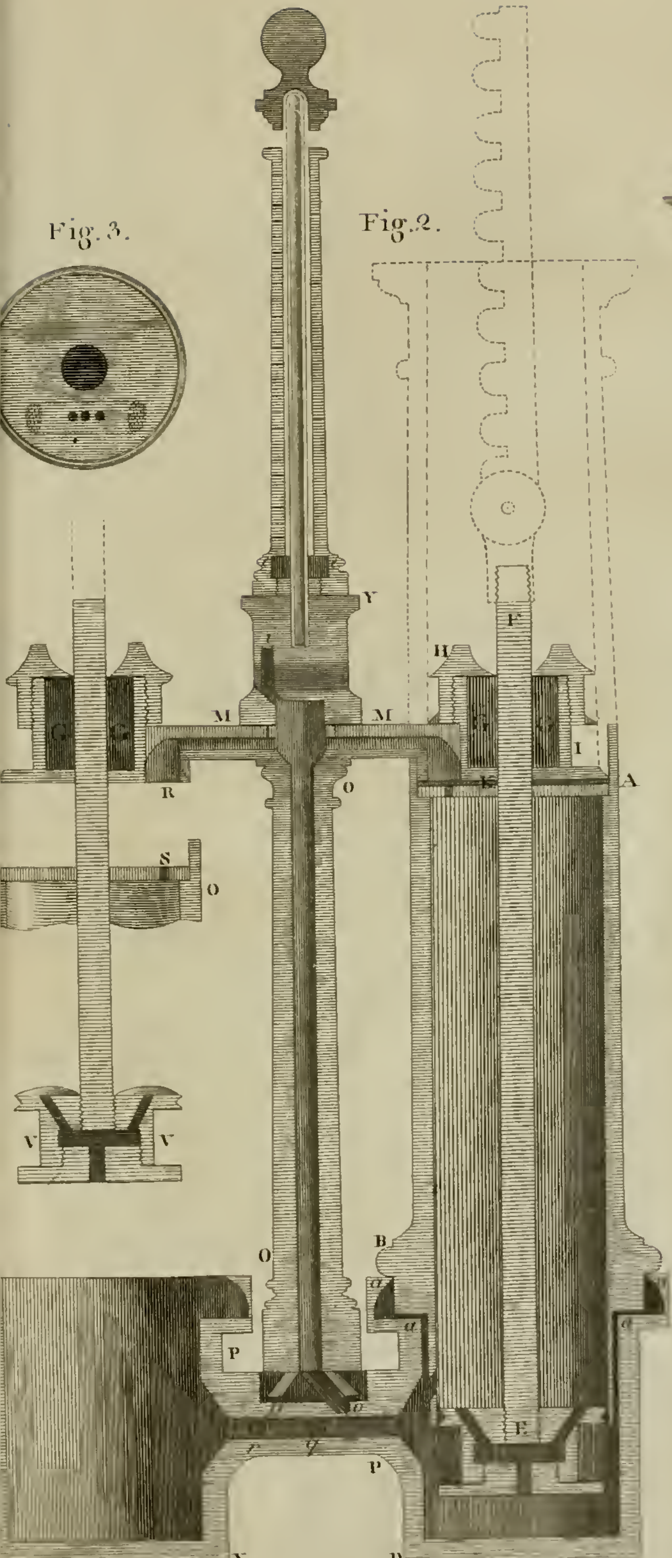
Fig. 3. Fig. 2.



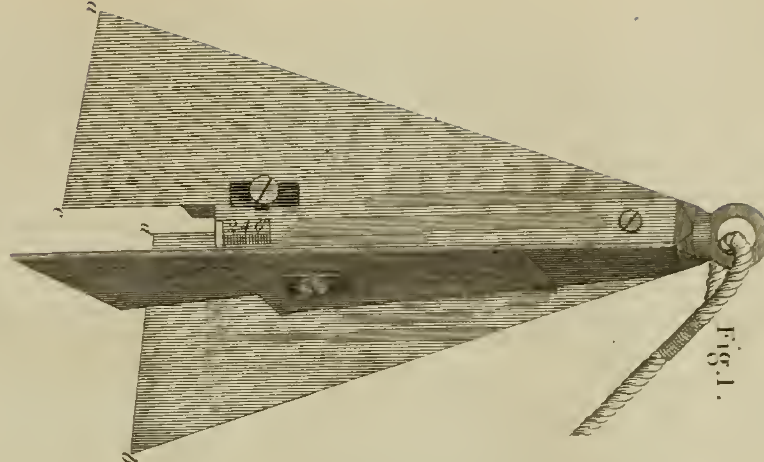


Fig. 1.

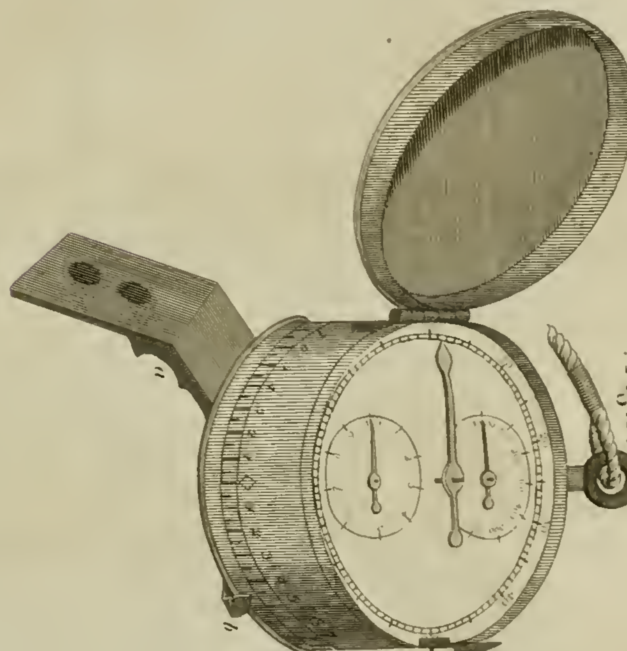


Fig. 4.

Fig. 3.

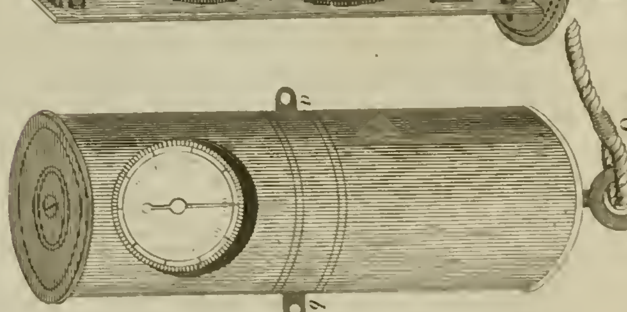


Fig. 2.

App.x Plate II.

Air Pump

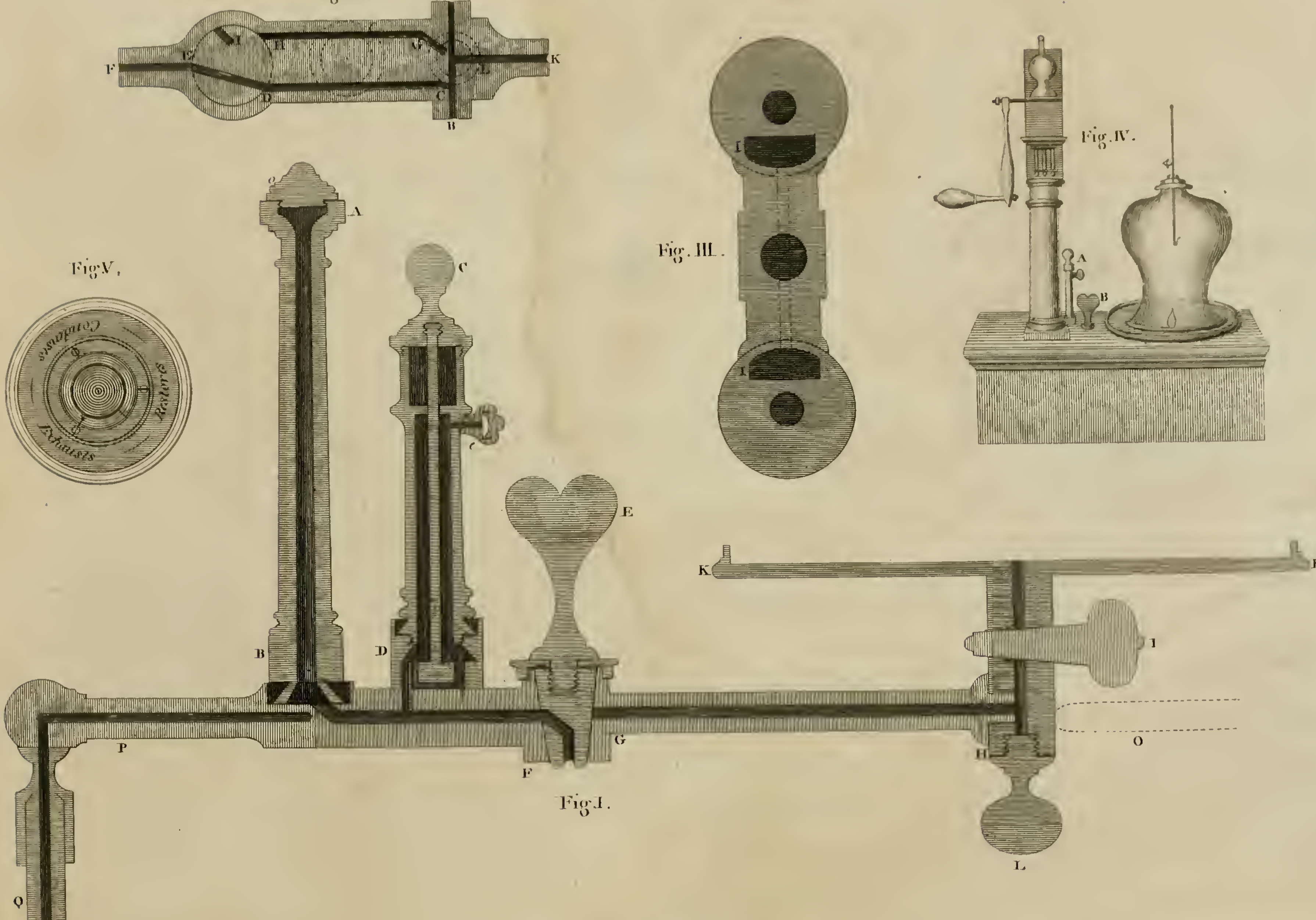


Fig. I.

Etch'd by Lowry

App^x Plate III.