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POLITE LITERATURE.

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—— 152, —— 10, for *Helas* read *Hellas.*
—— 155, —— 5, *for* Greeks *read* Greek historians.
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SCIENCE.

DESCRIPTION OF AN APPARATUS

FOR

TRANSFERRING GASSES OVER WATER OR MERCURY, &c.

BY THE REV. GILBERT AUSTIN, M.R.I.A.

READ, JULY 4th, 1803.

THE difficulty of transferring gasses from one jar or receiver to another, without loss, or mixture of atmospheric air, by the common mode in the pneumatic apparatus, must have been experienced often by philosophical chemists. And this difficulty is encreased when very large jars are used, and when the production of gas in them is inconsiderable; as when oxygen gas is obtained from vegetables exposed to light, or from the decomposition of water. Of the small quantity, obtained in this manner, a portion is often lost in transferring it into a smaller jar for the purpose of subjecting it to examination; and the result of the experiment is rendered uncertain, if the object be to measure the quantity. In order to obviate this inconvenience, I beg leave to submit to the Royal Irish Academy the description of a small apparatus, which I have found

found to answer well, and conceive may be admitted as a useful instrument into a philosophical laboratory.

The principal part of this apparatus consists of two pieces of plate glass, with a hole of about half an inch diameter drilled through each. They should be something broader, and about twice as long, as the diameter of the jars used in collecting and transferring the gasses. The holes should be disposed as in the figure. That in the plate (Fig. 1.), marked (*a*), should be nearly in the middle of the piece. The hole in the upper plate (*b*), near the extreme edge. The upper plate is shorter than the under plate, and its edge is ground fair and straight, so as to fit the edge of the *third* plate, which is not drilled, and should be a square piece cut off the second plate, as it is very necessary that these two plates should be of the same thickness. The length of these plates together should exceed that of the under plate about an inch. It is rather better to grind the polish off the plates with a little fine emery, as they slide more equably over each other when so prepared. All the jars to be used with them should have their mouths ground on a flat plate with fine emery. Things being thus prepared, the transferring plates may be used in the following manner, particularly when the jars for collecting the gasses are large.

When the jars, inverted in the usual manner in the pneumatic trough, are filled with the gas in any proportion, the two plates (*a* and *b*) are laid over each other in such a situation, that their holes shall not coincide; they

are

are then plunged into the water, and the plate (*b*) applied to the mouth of the jar, and that and the plate (*a*) being moderately pressed against the mouth, so that they shall not slip, or suffer any gas to escape, the jar, together with the plates, is lifted out of the water, and set with the mouth turned up. In this position the jar is ready for yielding the gas to the jar into which it is to be transferred. This last jar is now to be filled with water, taking care not to leave any air in it, and its mouth is to be closed by the third plate. It is then to be turned with its mouth downwards, and, together with the third plate on which it stands, is to be placed on that part of the under plate which is not covered by the upper plate. The edges of the third and upper plate are placed as nearly as possible in contact; and across them the small jar, filled with water, is to be slided till it rests entirely on the upper plate. The hole in the upper plate is to be filled with a few drops of water, and the jar is to be slided so as to stand over it. The upper plate, and the jar standing upon it, are then to be so moved over the under plate, that the holes in each shall coincide. The water in the upper jar, as soon as the communication is thus opened, will descend into the lower or magazine jar, and be supplied with an equal bulk of gas from below at pleasure. When a sufficient quantity is transferred thus into the upper jar, it is pushed, together with its plate, in such a manner that the holes shall no longer coincide, and, consequently, the communication shall be cut off. The upper jar is slided back upon the third plate,

plate, and, together with the plate, is removed in the same manner as it was applied. The mouth of the jar is turned upwards, the plate removed, and the gas submitted to examination: or, with mouth downwards, the small jar is placed on the shelf of the pneumatic trough, as the experiment may require. This detail appears tedious, but the practice is very easy. In this process there is, however, some danger of disturbing the lower plate, by lifting it from the mouth of the magazine jar, and so vitiating the gas by the introduction of common air. To prevent this inconvenience, it is necessary to secure the two perforated plates to the mouth of the jar, and to each other, allowing the upper plate, at the same time, to slide freely over the other. For this purpose, it is necessary to fix the plates, and the magazine jar, in a frame; which renders the use of them very convenient, and not liable to accidental disturbance.

The two plates (*a* and *b*), as in Fig. 1., are fixed in the upper part of the frame: (*a*) is fastened, (*b*) slides easily over it. The jar (*d*) is pressed up against the plate (*a*), by a moveable bottom (*k*), tightened by wedges or screws. The jar may be filled with water before it is fixed in the frame, and inverted in the trough; or the air may be generated in the jar, without the frame, and then, the frame being inverted, and the plates sunk in the water, the jar may be slipped into its place, and fixed there, which is the better way. The frame and jar are then set upright, and the gas may be transferred as before, without danger of loss or mixture.

By

By means of this apparatus, jars of any size may be used as magazines, without the inconvenience of being obliged to invert them in large troughs.

This apparatus, also, on a smaller scale, may be used in operating with those gasses which can only be confined over mercury. The joints of the transferring plates retain very securely any quantity of mercury, provided the height of the jar is inconsiderable, not more than three or four inches, for reasons well known to experimental philosophers. And small jars, with ground mouths, hold mercury very well, when standing, without agitation, with their mouths downwards, on ground plates of glass. The careful operator will, however, gently press them to prevent accidents. This apparatus may be so far reduced in size, that, on a small scale, all operations on gasses only to be confined over mercury, may be performed with about four or five pounds of mercury: which may, in many cases, be an object of attention to the philosophical chemist.

FIG. 1.

(*a*) The under plate; the dotted line marks the circumference of the mouth of the magazine jar.

(*b*) The upper plate.

(*c*) The third plate; the dots mark the circumference of the mouth of the small jar. The small dark circle shews the place of the holes.

FIG.

FIG. 2.

(*a b c*) The section of the plates, (as in Fig. 1.)
(*d*) The magazine jar.
(*e*) The small jar.
(*f*) The dotted jar shews how the small jar is placed, together with the third plate (*c*), before it is slided across the edges (*g*) of that and the upper plate.

FIG. 3.

(*a b c*) The plates as before, but fixed in
(*h*) The frame.
(*d*) The lower or magazine jar, (as in Fig. 2.) wedged up against the under plate, by
(*k*) The moveable bottom.
(*e*) The small jar to be filled with gas from the lower jar.

FIG. 4.

A SMALL APPARATUS FOR OPERATING WITH MERCURY.

(*a b c*) The plates as before.
(*d*) The small jar, four inches high, with a broad rim, by which the lower plate may be confined to its mouth, together with a frame in which the upper and third plates may slide. This frame may be made of hard wood, of ivory, or of iron.

(*g*) A

Fig. 1.

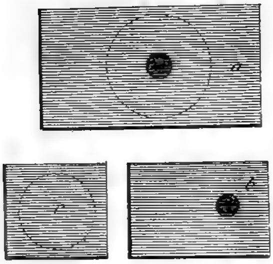


Fig. 2.

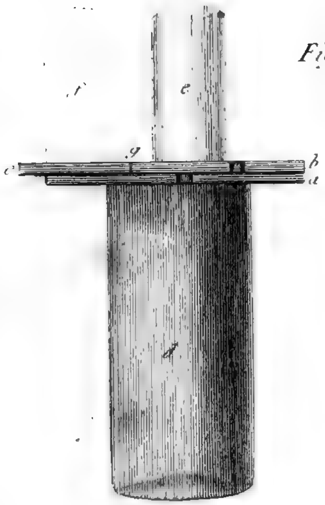


Fig. 3.

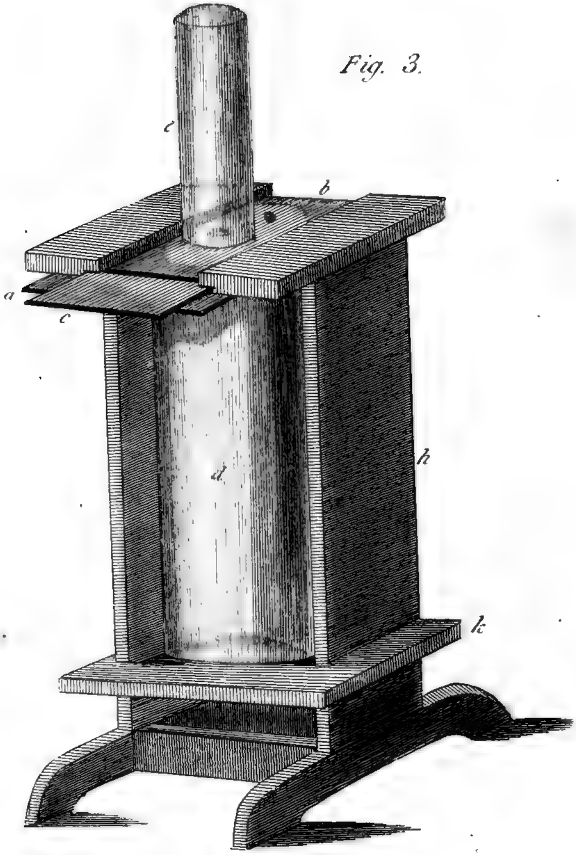
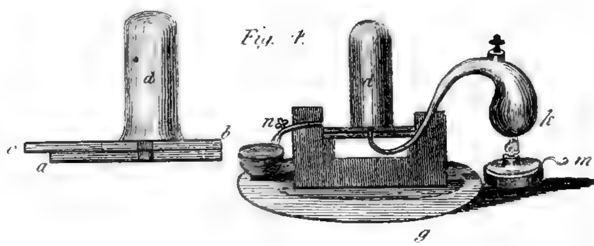


Fig. 4.



(*g*) A section of a wooden box, to hold as much mercury as will cover the plates and frame, and admit the bent tube of

(*k*) A small retort or vial, with a bent tube, for generating the gas which passes through the hole of the plates.

(*m*) A small spirit lamp.

(*n*) A tube, fixed so in the box, that the mercury, descending from (*d*) as the gas is generated, shall overflow, and be received in a cup; with which small jars may be filled for transferring.

AN ACCOUNT

OF A NEW SEMI-METALLIC SUBSTANCE,

CALLED

MENACANE, AND ITS ORES,

BY THE LATE G. MITCHEL, M.B.

READ, JULY 4th, 1803.

SINCE the discovery of Menacane by Mr. Gregor, the distinguishing properties of the peculiar metallic substance it contains have been so fully developed, and satisfactorily ascertained, by the united exertions of Kirwan, Klaproth, Vauquelin and Lampadius, that little is left to wish for, so far as the chemical characters are concerned. As an object of natural history, it has, as yet, been little attended to. It is therefore hoped, the following attempt, to supply in some measure that deficiency, so far as the present data allow it, will prove acceptable to the naturalist. It is scarcely necessary to observe, that I follow Werner's method most exactly; as it is to him that we are indebted for the successful vindication of Mineralogy, as an independent province in the fœderal state of natural history; and which acknowledges, in Chemistry, the powerful and indispensable ally, not the imperious and arbitrary lawgiver.

Of the genus Menac we are already acquainted with five species or ores. It is, however, sufficiently probable, that

several

several new species will, at no distant period, be added to the list; and that this metal is more widely distributed, and more generally diffused, and plays, perhaps, a more important part, than is at present suspected.

MENAC, GENUS.

Tribe of Rutile	1. Rutile. 2. Rutilite.
Tribe of Menacane	3. Nigrine. 4. Menacane. 5. Iserine.

FIRST SPECIES.

RUTILE.*

Titanite of Kirwan.
Rutil of Werner.
Sagenite of Saussure.

EXTERNAL CHARACTERS.

The colour varies from light hyacinth to dark brownish red. Is found crystallized.

1°. In

* Probably the anatase of Hauy is a variety of Rutile.—R. J.

1°. In right angled four-sided prisms, acuminated by four planes, which are set on the lateral planes.

2°. In six-sided prisms, which are said sometimes to exhibit a tendency to a six-sided acumination.

3°. In acicular and capilliform crystals, whose regular shape is no longer determinable, and which are, moreover, strongly compressed.

The crystals are longitudinally sulcated, often very deeply; are commonly small, and very small, rarely middle sized. The acicular are often fascicularly aggregated: the capilliform crystals are often in a singular manner reticulated, the interstices forming equilateral triangles: exteriorly, shining and moderately glistening; interiorly, glistening; the lustre adamantine.

The principal fracture is foliated with a two-fold cleavage, cutting each other at right angles: the transverse fracture is imperfect and minute conchoidal.

The fragments are cubical.

It sometimes exhibits slender, columnar, distinct concretions.

Is usually translucent, sometimes only translucent at the edges.

Hard.

Brittle.

Gives a pale orange yellow streak.

Is easily frangible.

Heavy, in an inferior degree, about 4, 200.

OBSERVATIONS.

The larger crystals, particularly those from Hungary, are often curved, have frequent transverse rifts, are sometimes broken intirely across, the ends removed to some distance from one another, and the interstices filled up with the substance of which the matrix consists; sometimes two crystals meet under an angle more or less obtuse, and are joined like the corner of a frame. The crystals are, moreover, subject to great irregularities, are seldom fully crystallized, and, therefore, rarely acuminated; the four-sided prisms are often slightly rhomboidal; the six-sided prisms, from Hungary, are usually dilated, and seem composed of accumulated acicular crystals, from whence arise the columnar distinct concretions; the six-sided prisms, from France, are said to originate from the truncation of two opposite lateral edges of the four-sided prism; the capilliform crystals are sometimes coloured green, from chlorite earth. By some authors, this fossil has been said to resemble red silver ore; but the slightest acquaintance with the oryctognostical characters is sufficient to shew the difference; a geognostical character also furnishes us here with an easy means of distinguishing this fossil from other ores of a red colour. Rutile is generally of cotemporaneous formation with its associated fossils; whereas red silver ore, red orpiment, &c. being formed in veins, are always of later formation than the rock on which they are seated.

seated. Some systematic writers have confounded it with rubellite, with which it has scarcely two characters in common.

CHEMICAL CHARACTERS.

Without addition, or even with phosphoric salts, it is infusible by the heat of the common blow-pipe; with borax or alkali, it affords a hyacinth red transparent glass; with the heat excited by pure air, it gives a milk white bead, and suffers a considerable loss of weight. It is insoluble in the mineral acids, before it has been melted with alkali, but yields readily to acid of sugar; is precipitable by acid of galls with a bright red, and by prussian alkali with an handsome dark green colour. The method of analysis I shall omit, as belonging properly to mineralogical chemistry; the result has shewn that this fossil consists wholly of the calx of Menac.

GEOGRAPHIC DISTRIBUTION.

This fossil has hitherto been discovered in but few places, and in moderate quantity, principally near Rosenau in Upper Hungary; in Mount St. Gothard in Switzerland; in Fischthal in the high mountains of Saltzburg; near St. Yrieux in France; in the province of Burgos in Spain; in the forest of Speysart, near Aschaffenberg, in Franconia; at Beresooskoi in Siberia, and Olapian in Transilvania.

GEOGNOSTIC OCCURRENCE.

The Hungarian rutile is found imbedded in a kind of quartz, passing into rock crystal, and forming nests in mica slate; it is therefore of cotemporaneous formation with the rock in which it lies. That from St. Gothard in Switzerland occurs partly in those drusy cavities, which are not unfrequent in granific mountains of high antiquity, lying in or upon the rock crystal, adularia, and foliated chlorite, with which those cavities are lined, and partly dispersed through, or seated in, the scarcely perceptible clefts of one of those nameless chloritic rocks, which abound so much throughout the Alps in general. That from Aschaffenberg is said to occur in granite; that from Saltzburg is found imbedded in massive common tremolite. The rutile from Spain and Siberia is imbedded in rock crystal. It would therefore appear that this fossil lays claim to great antiquity, the time of its production falling within the period of the earlier primitive rocks, and that the metal it contains probably surpasses, in that respect, tin, molybdæna and tungsten, vieing even with iron and manganese.*

The

* Von Buch has discovered rutile in layers of quartz, in clay slate (Thonschiefer), near Mühlbach in Saltzburg, in the vicinity of metallic layers, consisting of copper glance, copper pyrites, iron pyrites, nickel, and rarely native copper: also on the mountain Brennkogl, in the valley of Fusch; where it occurs in mica slate, either reticularly aggregated in rifts, or in acicular crystals, accompanied by those singular cylindrically aggregated crystals of foliated chlorite, in venules of almost coeval formation with the rock itself.—*Buch's Geognostische Beobachtungen.*——R. J.

Rutile

The above description has been chiefly taken from an attentive examination of the specimens of rutile existing in the best collections of Vienna and Saxony.

SECOND SPECIES.

RUTILITE.

Calcareo-siliceous titan ore of Kirwan.
Titanit of Klaproth.

EXTERNAL CHARACTERS.

The colour varies from brownish red to dark reddish brown.

Has been hitherto found only crystallized in very rhomboidal four-sided prisms, acutely bevelled at the extremities, the bevelling planes set on the obtuse lateral edges. The crystals are small, and very small, seldom middle sized.

Exteriorly, they are shining. Interiorly, glistening, with a resinous lustre.

The fracture is imperfect and minute conchoidal, passing into the uneven.

The fragments are indeterminately angular, tolerably sharp edged.

Rutile has also been discovered by Von Humboldt, on the summit of a mountain near Caraccia, in New Granada, at the height of 1316 toises.—R. J.

The transparency varies, from translucent, through translucent at the edges, to opaque.

Is semihard, bordering upon hard.

Brittle.

Gives a greyish white streak.

Is easily frangible.

Not particularly heavy, approaching the heavy (3,500).

OBSERVATIONS.

The lateral planes meet alternately under angles of 135° and 45. From the foregoing fossil it is sufficiently distinguished by crystallization, fracture, inferior hardness, and specific gravity. From grenatite it may readily be discriminated, by the difference in crystallization, fracture, and sort of lustre.

CHEMICAL CHARACTERS.

Before the blow-pipe it suffers no change, nor in the heat of a porcelain furnace, when exposed in an earthen crucible; but in a crucible of charcoal it melts to an imperfect black glass, owing to the partial reduction of the metallic contents. With considerable difficulty, and only by repeated digestion, marine acid dissolves a third part of the weight of this fossil, consisting partly of the menac contents. Klaproth, from whom these characters are taken, found it to consist of nearly equal parts menac-calx, silex, and lime, to which Vauquelin joins a large portion of iron calx.

GEOGNOSTIC OCCURRENCE.

In the mountains of Passau, this fossil is found imbedded in a coarse granular aggregate of felspar and hornblende, and felspar and actynolite; therefore belonging to the genus green-stone, and order of primitive trap. In Norway it occurs in rocks belonging to the same formation, in which the celebrated layers of magnetic iron ore lie, and is associated with hornblende, and several individuals of a tribe not as yet sufficiently examined and described, but which evidently constitute middle links between actynolite and hornblende, and to which the names arendalite and acanticone have been applied. Near Dresden and Brünn it is found dispersed through sienite; and at Galway in Ireland, in an uncommonly beautiful porphyritic sienite. Hence it appears, that this fossil has only occurred in rocks belonging to primitive trap, or in sienite, the last crystallization which took place within the primitive period, and must therefore be considered as a later production than rutile. Here a consideration of the laws of crystallization countenances the observations on the order in which the primitive rocks follow one another. The rutile, consisting of few and simple elements of cotemporary origin, with a granite, in which rock crystal occupies the place of quartz, and adularia that of common felspar, sufficiently bespeaks a period, when the solution being purer and more tranquil, furnished an earlier and purer crop of crystals; while the confused and irregular crystallization of primitive trap and sienite, together with the greater impurity of the felspar, and very compounded nature of the hornblende and rutilite, indicate an inferior purity of the solution, and, consequently, later precipitation of the crystallized mass.

THIRD SPECIES.

NIGRINE.

Nigrin of Werner.

EXTERNAL CHARACTERS.

The colour is dark brownish black, passing into velvet black.

Is found in larger and smaller angular grains, and pebbles.

Externally, moderately glistening. Internally, principal fracture is glistening; the transverse fracture moderately glistening.

Lustre, adamantine.

The principal fracture is imperfectly foliated, with a single cleavage; the transverse fracture is flat, and imperfectly conchoidal.

The fragments are indeterminately angular, and sharp-edged.

Perfectly

Perfectly opaque.
Semihard.
Brittle.
Gives a yellowish brown streak.
Heavy, in a moderate degree (4,500).

OBSERVATIONS.

This fossil is readily distinguished from menacane, by its stronger lustre and superior hardness, the colour of the streak, and by its not being in the least magnetic; which also sufficiently distinguishes it from iserine and iron sand.* Being found in company with fragments of rutile of a dark colour, the latter has by most been confounded under the same denomination; but the red colour of the rutile, joined to its perfectly foliated fracture, with a two-fold cleavage, intersecting each other at right angles, and the thence resulting cubical fragments, distinguish it sufficiently from nigrine.

The present description is taken from a specimen I had the pleasure of receiving from Professor Jacquine the younger, of Vienna.

CHEMICAL CHARACTERS.

The nigrine is infusible per se by the blow-pipe; but, with the assistance of borax, it melts to a transparent, hyacinth

* Genuine iron sand must not be confounded with magnetic iron ore in a *sandy form*, which usually passes under that name.

cinth red bead: to acid of sugar, it readily yields its menac contents, which furnishes the characteristic precipitate of this genus. Klaproth and Lampadius have given us the constituent ingredients, 8 or 9 per cent. menac calx, and 2 or 1 calx of iron. It is probable, however, that the proportion of menac calx is over-rated; it appearing evident, from the description accompanying the analysis, that there had been no care taken to select the nigrine from the grains of rutile which accompany it.

GEOGNOSTIC OCCURRENCE.

The nigrine has been hitherto found only at Ohlapian, in Transylvania, in alluvial hills, consisting of yellow sand, intermixed with fragments and bowlders of granite, gneiss, and mica slate, and from which gold is obtained by washing. This gold is the purest found in Transylvania; a circumstance sufficiently indicating, that it belongs to a different, and, consequently, earlier formation, than the usual Transylvanian native gold, which occurs there in clay porphyry, grey wacce, and grey wacce slate, and belongs to the brass yellow variety, from the considerable alloy of silver which it contains. In these stream works, the nigrine is obtained at the same time with the gold, and comes to us intermixed with grains of rutile, oriental garnet, native iron, cyanite, and common sand; which renders it extremely probable, that this fossil, also, is a native of the primitive mountains.

FOURTH

FOURTH SPECIES.

MENACANE.

Menachanite of Kirwan.
Menacan of Werner.

EXTERNAL CHARACTERS.

Is of a greyish black colour, inclining somewhat to iron black.

Only met with in very small, flattish, angular grains, which have a rough, glimmering surface.

Internally, moderately glistening, with adamantine lustre, passing into the semi-metallic.

The fracture is imperfectly foliated, approaching to the slaty.

The fragments are indeterminately angular, and sharp-edged.

Perfectly opaque.

Is soft.

Brittle.

Retains its colour in the streak.

Easily frangible.

Heavy, in a moderate degree (4,427).

OBSERVATIONS.

This fossil has been said, but erroneously, to have much resemblance to iron sand, from which it may be easily distinguished by the fracture, lustre, and inferior specific gravity.

PHYSICAL AND CHEMICAL CHARACTERS.

Menacane is attractable by the magnet, but much more weakly than iron sand, or magnetical iron ore; it is infusible by the common blow-pipe, or heat of a porcelain furnace, exposed in a coal crucible, but melts, when in contact with a clay one; it also melts quickly to a black bead, before a blow-pipe animated by pure air. The menac contents may be easily extracted by digestion with acid of sugar. Klaproth and Lampadius, about the same time, have shewn, that it consists of nearly equal parts menac and iron calces.

GEOGNOSTIC OCCURRENCE.

This fossil has hitherto been only found, accompanied by fine quartz sand, in the bed of a rivulet, which washes the valley of Manachan, in Cornwall. The neighbouring mountains belong to the primitive order, in which, most probably, the menacane formerly constituted a superficial layer; but, by their decomposition, and consequent degra-

dation,

dation, by means of rains and floods, the earthy parts have been carried off, and the heavier metallic fragments collected in the valley.

FIFTH SPECIES.

ISERINE.

Iserin of Werner.

EXTERNAL CHARACTERS.

The colour is iron black, inclining a little to brownish black.

Is found in small, obtuse, angular grains, and in pebbles, with a somewhat rough, strongly glimmering surface.

Internally, it is shining, with semi-metallic lustre.

Fracture is more or less perfectly conchoidal.

Fragments are indefinitely angular, and sharp-edged.

Perfectly opaque.

Hard.

Brittle.

Retains its colour in the streak.

Is heavy, in a moderate degree (4,500).

OBSERVATIONS.

Of all fossils, this has the strongest resemblance to iron sand; into which, as Mr. Werner first observed, it actually graduates, but may be distinguished from it by the shade of brown in its colour; by its superior external, and inferior internal lustre; by its less specific gravity; but, chiefly, by being only slightly, and that by a powerful magnet, attractible. From nigrine and menacane, it differs sufficiently in fracture and lustre. This, as well as nigrine, was first considered as a particular species by Werner; both which determinations were afterwards confirmed by the analysis.

CHEMICAL CHARACTERS.

As in the foregoing species, the menac calx may here be readily extracted by acid of sugar, the residuum being dissolved in aqua regia: on the addition of tartarised tartarin, a lemon yellow powder falls to the bottom, which is tartarised menac; what remains in the solution is iron. Lampadius, to whom we owe the analysis, found that menac and iron are here in a decreasing proportion; the latter amounting to about 20 per cent. A late experiment has shewn him, that iron sand contains the same principles, but, probably, in an inverted proportion.

GEOGNOSTIC OCCURRENCE.

Hitherto this fossil has been only found in the high Riesen mountains, which separate Silesia from Bohemia, near the origin of the Iser, dispersed through the granitic sand which forms the bed of that river. To what order of rocks it owes its origin is uncertain; but its near affinity to iron sand, which is exclusively an inmate of the flötz trap formation, and the certainty, that this formation was formerly superstratified, at a great elevation, on the Riesen mountains, (as the remains, which form the Buchberg,* and occupy the Schneegruben, sufficiently testify,) render it highly probable, that this fossil, also, may belong to that formation; and, consequently, dates its origin from a much more recent period, than the foregoing species of this genus.†

* The Buchberg (which I enjoyed the invaluable opportunity of examining with my excellent and ever to be regretted friend) is the highest basalt hill in Germany, being 2921 feet above the level of the sea, and the highest basalt, except that small quantity lodged in the cavity of the Schneegruben, which is some hundred feet higher. The hill itself is elevated about 500 feet above the Iser, that washes its granitic basis, and the Iserine is found at some distance below. We could, indeed, discover no trace of it in the basalt of the present hill.—R. J.

† Mr. Gregor (as stated in Nicolson's Journal) has found, that menac is one of the constituent ingredients of basalt; a fact, which adds much to the plausibility of Dr. Mitchell's very ingenious supposition.—R. J.

GENERAL REMARKS.

These are the only fossils of this genus, with whose characters we are as yet sufficiently acquainted to say, with certainty, that they form distinct species. Between the three latter and iron sand, the intermediate transitions, as between all adjacent fossils, are, probably, innumerable. Were we to take analysis alone for our guide, it would multiply the species without necessity, and lose sight of the intentions of nature, who does not confine herself to 5 or 10 per cent. of an ingredient; beside, a Klaproth has confessed, that it is not so much the identity and proportion of the ingredients, as the particular state of their combination, (which to us is perfectly unknown,) that determines the nature of the resulting fossil. In addition to those fully determined species, we have been favoured, by Klaproth, with the analysis of a menacaniferous ore, from Aschaffenberg; by Vauquelin, with that of another, from Bavaria; and, by Abildgaard, with that of a third, from Barboe, in Norway; all which differ from the foregoing species, and from one another, in composition, or in the proportion of ingredients; so that it is impossible to determine, with any probability, to what species they belong, from the want of an adequate external description, and account of their geognostic occurrence.

The masterly hand of Klaproth has further detected this metal, in the iron sand, which accompanies the hyacinths, &c. in Ceylon, and in some of the iron ores of Norway; and

and Lampadius has lately discovered it, in the iron sand of Hohenstein, near Stolpen, in Saxony, and in that found with the pyrope of Bohemia. Besides these, I have seen, in the imperial cabinet, at Vienna, and some few private collections, ores, said to come from Stiria or Carinthia, and from Bohemia, in which the menac calx probably abounded; as may be conjectured, from the strong shade of brown in the colour, together with the considerable adamantine lustre, both which are strongly characteristic of this genus.

The use of this metal is, as will readily be supposed, from its scarcity, and the newness of its discovery, very confined. The rutile, indeed, was, for a length of time, employed to give a brown colour, in the porcelain manufacture of Sevres, near Paris; but, from the difficulty of communicating an equal tint by it, has been since abandoned. The rock crystal, inclosing capilliform crystals of rutile, has been employed as a setting for rings. The precipitates, especially those from acid of sugar, may be employed as water colours; that, by acid of galls, affording a good tile red, and that, with Prussian alkali, an agreeable dark green. The latter, also, communicates a durable colour to silk, as my friend, Lampadius, assures me; perhaps, with proper management, it might be employed to furnish the so much wished for durable green for the printing of cotton. And, lastly, its close connection with some iron ores, and those exactly of the most superior quality, such as the ores of Norway and Stiria, leads naturally to the suspicion, that it may possess some favourable influence upon the manufacture of iron,

and,

and, therefore, well deserves the attention of future enquirers. Such are the principal circumstances, at present known, respecting this genus of fossils: time will, doubtless, here, as usual, find much to amend, to correct, and to supply.

SYNOPTICAL

SYNOPTICAL VIEW OF

BY RICHARD

1802.	BAROMETER.			
	HIGHEST.	DAY IT HAPPENED.	LOWEST.	DAY IT HAPPENED.
January ..	30,56	22d and 23d, W.	29,34	31st, S. W. ....
February ..	30,50	13th, var. N. E. to W. ..	29,36	4th, var. W. to S. ..
March....	30,80	14th, N. and E.	29,16	21st, W. and W. by S.
April.....	30,56	20th, E.	29,55	26th, S. W. ....
May	30,64	5th, E.	29,74	29th, E. ....
June.....	30,68	21st, E.	29,53	9th, S. W.........
July	30,52	14th, E.	29,42	1st, W...........
August ...	30,50	14th and 28th, E. and W.	29,66	24th, var. E. to W.
September .	30,66	26th, W.	29,45	10th, W..........
October ..	30,60	15th, var. E. S. W.	29,34	25th, S. W. to S. E.
November .	30,42	8th and 9th, N. E.—N. W.	29,10	22d, S. ....
December .	30,60	18th, W.	29,00	29th, S. S. E. ......
MEAN OF THE YEAR	30,586		29,387	

SYNOPTICAL VIEW OF THE STATE OF THE WEATHER AT DUBLIN,

IN THE YEAR 1802.

BY RICHARD KIRWAN, ESQ. L. L. D. F. R. S. P. R. I. A. &c.

READ, JAN. 2d, 1804.

1802.	BAROMETER.					THERMOMETER.			RAIN.		STORMS.
	HIGHEST.	DAY IT HAPPENED.	LOWEST	DAY IT HAPPENED.	MEAN OF THE MONTH.	HIGHEST IN THE DAY.	LOWEST AT NIGHT.	MEAN OF THE MONTH.	NUMBER OF DAYS.	INCHES.	NO. WINDS THAT PREVAILED.
January . .	30,[illegible]	22d and 23d, W.	29,34	31st, S. W.	30,035	52,	22,	37,325	14. On 4 of which some snow, . . .	1,024653	3. W.—S. W.
February . .	30,50	13th, var. N. E. to W. . .	29,36	4th, var. W. to S. . .	29,95	55,50	28,	41,10	17. On 5 of which some snow, . . .	1,418751	2. Var. S. W.—W.—N. W.—W.
March . .	[illegible]	14th, N. and E.	29,16	21st, W. and W. by S.	30,57	60,	30,	44,44	11. On 1 some snow, and 6 some hail,	1,103473	2. W. by S.—W.
April.	30,56	20th, E.	29,55	26th, S. W.	29,225	66,	34,	49,308	23. On 2 some snow, and 4 some hail,	0,867014	
May	30,64	5th, E.	29,74	29th, E.	30,28	72,	31,	49,87	14. On 5 some snow, ...	0,656816	
June	30,63	21st, E.	29,53	9th, S. W.	30,056	72,	43,	57,64	20.	1,58952	
July	30,52	14th, E.	29,12	1st, W.	30,021	69,5	43,	57,258	27.	4,256255	1. W.
August . . .	30,50	14th and 28th, E. and W.	29,66	24th, var. E. to W.	30,18	76,	49,	63,70	21.	2,285765	
September .	30,46	26th, W.	29,45	10th, W.	30,207	71,	40,	57,16	14. On 1 some hail fell, ...	1,497570	
October . .	30,60	15th, var. E. S. W.	29,34	25th, S. W. to S. E.	29,885	70,	36,	50,837	20. On 1 some hail fell, ...	3,229599	1. W.
November .	30,42	8th and [illegible]th, N. E.—N. W.	29,10	22d, S.	29,88	53,	31,5	45,365	23.	3,822745	1. S. E.
December	30,[illegible]	18th, W.	29,00	29th, S. S. E.	29,89	51,	26,5	39,64	18. On 2 of which some sleet, ...	6,226619	3. S. E.—E.—N.—S. S. E.
[illegible]			29,357		30,021			48,637	222. Number of rainy days.	27,97878	13. Total in the year.

SYNOPTICAL VIEW O

BY RICHARI

1803.	BAROMETER.			
	HIGHEST.	DAY IT HAPPENED.	LOWEST.	DAY IT HAPPENED.
January ..	30,60	31st, N.	29,07	9th, E. by N. .....
February ..	30,60	11th, S.	29,37	17th, var. S. S. W. E.
March....	30,52	13th, W.	29,76	2d, N. at night, ...
April.....	30,70	12th, E.	29,30	21st, W. by N. ....
May	30,68	18th, N. to E.	29,36	2d, S. W. ....
June.....	30,77	26th, E.	29,85	3d, S. E. ....
July	30,70	15th, E.	29,90	28th, S. ....
August ...	30,60	26th, E.	29,50	3d, S. W. ....
September .	30,77	4th, E.	29,67	20th, E. to W. ....
October ..	30,66	23d, E.	29,80	16th, W. ....
November .	30,57	5th, S. E.	28,55	11th, W. ....
December .	30,60	1st, W.	28,93	27th, S. ....
MEAN OF THE YEAR	30,64		29,42	

SYNOPTICAL VIEW OF THE STATE OF THE WEATHER AT DUBLIN,

IN THE YEAR 1803.

BY RICHARD KIRWAN, ESQ. L. L. D. F. R. S. P. R. I. A. &c.

READ, JAN. 2d, 1804.

1803.	BAROMETER.					THERMOMETER.			RAIN.		STORMS.
	HIGHEST.	DAY IT HAPPENED.	LOWEST.	DAY IT HAPPENED.	MEAN OF THE MONTH.	HIGHEST IN THE DAY.	LOWEST AT NIGHT.	MEAN OF THE MONTH.	NUMBER OF DAYS.	INCHES.	NO. WINDS THAT PREVAILED.
January . .	30,60	31st, N.	29,07	9th, E. by N.	29,85	51,	29,	37,89	18. And on 5 fell some snow, ...	1,9042968	3. E. by N. E.
February . .	30,60	11th, S.	29,37	17th, var. S. S. W. E.	30,05	55,	29,	41,35	18. And on 2 fell some snow, ...	1,261112	3. N. W.—W.—S. W.
March. . . .	30,52	13th, W.	29,76	2d, N. at night, . . .	30,26	[illegible]	27,50	45,52	16. And on 4 fell slight snow, ...	1,115731	Thunder and Lightning.
April.	30,70	12th, E.	29,30	21st, W. by N.	30,02	59,50	36,	47,50	14. On 9 fell hail, and on 1 snow,	1,197570	2. W. S. W.
May	30,68	15th, N. to E.	29,36	2d, S. W.	30,19	68,	36,50	51,24	15. On 1 sleet, and on 2 hail, ...	1,9599858	
June	30,77	26th, E.	29,85	3d, S. E.	30,26	71,	40,	57,49	18.	0,945834	
July	30,70	15th, E.	29,90	28th, S.	30,36	79,50	49,	63,60	11.	0,341538	
August . . .	30,60	26th, E.	29,50	3d, S. W.	30,25	76,50	43,	59,91	17. And on 1 some hail, ...	1,339931	Thunder and Lightning.
September .	30,77	4th, E.	29,67	20th, E. to W.	30,39	70,	38,	54,05	8.	0,551736	
October . .	30,66	23d, E.	29,80	16th, W.	30,30	63,	35,	49,78	17.	0,210178	1. S. W.
November .	30,57	5th, S. E.	28,55	11th, W.	29,70	53,	22,50	40,95	18. And on 2 fell some snow, ...	2,926320	1. W.
D[illegible]	[illegible]	[illegible] S. W.	[illegible]	27th, S.	29,[illegible]	[illegible]4,	22,	[illegible]	2[illegible]. And on 3 fell some snow, ...	[illegible]	7. E. S. E.—W. and S.
MEAN OF THE YEAR	[illegible]		29,12		30,11			49,16	193. On 17 of which fell snow,	19,67718	17. Total in the year.

ON THE

VOLCANIC THEORY.

BY THE REV. WILLIAM RICHARDSON, D.D.

LATE FELLOW OF TRINITY COLLEGE, DUBLIN.

COMMUNICATED BY THE RIGHT. REV. THE LORD BISHOP OF DROMORE.

READ, DEC. 10th, 1804.

PART I.

EXAMINATION OF MR. DESMAREST'S MEMOIR,

PUBLISHED IN THE TRANSACTIONS OF THE ACADEMY OF SCIENCES, IN THE YEAR 1771.

NAVEM SI POSCAT SIBI, PERONATUS ARATOR
LUCIFERI RUDIS, EXCLAMAT MELICERTA, PERISSE
FRONTEM DE REBUS.——

I BELIEVE I need not enter into any proof, that the theory, which makes Basalt a volcanic production, and once fluid lava, was invented by Mr. Desmarest; the friends, as well as the enemies, of this opinion, are unanimous in ascribing it to him alone. Dr. Hamilton (Lett. I. Part II.) calls him, the ingenious father of the Volcanic Theory; and Mr. Raspe says, "if it deserves any praise to have first "hit on a lucky hypothesis, it cannot possibly be denied to "Mr. Desmarest;" and Mr. Kirwan, while he combats the opinion, calls Mr. Desmarest, the father of the Volcanic Theory.

In

In discussing a philosophical question, it may not, at first view, seem very important, to determine with whom the opinion originated; but Mr. Locke tells us, that, in the case of propositions whereof we have no certainty, but only some inducements to receive them for true, the grounds of probability are to be considered; and, where the question turns on the testimony of others, we are to look to the number, the integrity, the skill, of the witnesses, and the design of the author, if it be a book, &c.

Now, I have shewn already, from the letter, of which Mr. Desmarest himself was bearer,* that his design, in making observations in natural history, was to enable him to combat the account, given by Moses, of the creation of the world, particularly in its date.—I do not mean to avail myself any farther, of this discovery of Mr. Desmarest's intentions, than as an excuse for examining his Memoir with more minuteness, than it is probable I would otherwise have done; and, also, for cautioning those who read it, to be on their guard against the statements of an *ex parte* writer.—If the merit of an author is to be estimated by the success of his work, I do not know any man, who, in this point of view,

* It is to the following tenor:—" This letter, my dear companion, will be " delivered to you by Desmarest, a man of merit and sound philosophy, who " wishes to pay his respects to you, on his journey to Italy, where he *purposes* " *to make such observations in natural history, as may very well give the lie to* " *Moses.* He will not say a word of this to the master of the Sacred Palace, but " if, perchance, he should discover, that the world is more ancient than even " the Septuagint pretend, he will not keep it a secret from you." (Lettr. 137. An. 1763, as quoted by Baruel, Memoires de Jacobinisme, Tom. I. p. 151.)

view, can compare with Mr. Desmarest. He made, as he says, a discovery in natural history, which had hitherto escaped the most penetrating philosophers. He published a new theory, and the world instantly adopted his opinions; and with such zeal, that we find many respectable writers, of the time, catch at opportunities (even out of their way) to express their approbation of them.

It is a bold undertaking to convince the world, that it has been in the wrong; nor can I expect a favourable reception,

Dum veteres avias tibi de pulmone revello:

and the rather, as I have a double task to perform; for I must not only shew, that Mr. Desmarest's opinions are perfectly unfounded, but I have also to account for their miraculous propagation.

In this latter part, I have the assistance of the same person, who discovered to us Mr. Desmarest's original intention, Abbé Barruel; who states, that, at the time the Memoir was published, upon which the whole theory rests, (1771), the public opinion, in philosophical matters, was very much governed by the authority of the Academy of Sciences; the leading members of which were all Mr. Desmarest's associates in his hostility to Moses, and in pursuit of the same end (the extirpation of Christianity); that they countenanced, or rather puffed, all opinions which they (being in the confidence of the authors) knew had a tendency to favour their grand object.

 This

This charge, against so respectable a body as the Academy of Sciences, is, I admit, too general; especially as it is made by an author of decided partiality. It, therefore, requires some more direct proof to establish it, and from a less suspected source. Such evidence, I apprehend, will be readily found, and in the Transactions of the Academy itself.

In general, when a memoir was approved, and published by that Society, a precis, or abridgment of it, was prefixed at the beginning of the volume. This was the business of an officer, called the Historian of the Academy: of course, while the memoir rested upon the authority of its author alone, the precis had the sanction of the Academy itself, which took this method of announcing to the world, the opinion that body entertained on the subject.

Two passages, in the precis of Mr. Demarest's Memoir, mark the zeal with which the Academy took up this question; and prove, that its members were as little scrupulous, as Mr. Demarest himself, about the means they made use of, to support a favourite opinion, which they were told, by its author, would be useful in furthering their grand scheme.

In this precis, the Historiographer of the Academy makes two assertions, obviously decisive on the question, if admitted to be true: he says,

" Almost every where, basalt is found mixed with scoria;" and " all known volcanos are accompanied by masses " of basalt."

After

After two such clear and positive assertions, so conclusive to the point, and from such authority, it is not surprizing, that the world should implicitly adopt an opinion so effectually supported.

But, as Mr. Desmarest's object in inventing this theory, the tendency of his opinions, and the use to which he meant to apply them, are now fortunately discovered, I hope to be excused, for requesting the public to rally a little, and to examine into the truth of these positions of the Academy, that have, no doubt, contributed much to accredit the theory, which ascribes to basalt a volcanic origin.

As to the first, that *basalt is almost every where found mixed with scoria,* the obvious mode of ascertaining its truth seems to be, an examination of the accounts, given by respectable writers, of different countries, where basalt has been found; and I begin with Egypt, where it seems to have been first noticed.

Egypt has never been supposed a volcanic country; nor does the place, where Strabo found basalt, bear any marks of the irregularity of surface, the necessary effect of volcanic eruptions; for Strabo describes it as a level plain, through which he drove in a chariot. Mr. Desmarest himself, who must have been well acquainted with volcanic countries, is so little pleased with this account of Strabo's, that, notwithstanding his known accuracy, he endeavours to invalidate his testimony, on the authority of Norden and Pococke. Still, however, the scoria of the Academy escapes them all.

 The

The next place I shall mention, is Haut Vivarois, described, by Mr. St. Fond, as an extensive basalt country, reaching all the way to the Loire, abounding wish basalt mountains of great elevation, *buttes isoleés,* and articulated prisms: but he expressly tells us, that the volcanic features and productions have all disappeared; lavas or scoriæ are never mentioned.

Mr. Dolomieu, another sanguine advocate for the volcanic origin of basalt, and also a friend of Mr. Desmarest, was much surprised, when he found Lisbon situated in a basaltic country, without a single volcanic feature, or production; no scoria, as he expressly tells us.

The late Dr. Gillan, who accompanied the Chinese embassy, seems to have paid great attention to volcanic matters, wherever he met with them; yet, when he found columnar basalt at Rio Janeiro, he neither mentions scoria, nor any other volcanic production.

Sir Joseph Banks gives us a most excellent account of the basaltic island of Staffa, with its magnificent colonnades, and neat prisms; yet he does not mention a single volcanic matter; and I can scarcely think, that scoria would have escaped so accurate an observer.

Mr. Ferber, Mr. Strange, and Mr. Saussure, tell us of columnar basalt in the Veronese and Vicentin, but take no notice of any scoria.

Mr. Ferber, also, gives a particular account of different varieties of basalt at Bolsena, but looks in vain for volcanic features. The crater is gone, or buried in the lake, as he conjectures, and no mention of scoria.

I add

I add, to the countries abounding with basalt in columns, among which scoria is not found, the county of Antrim, which I have carefully examined.

The Historian of the Academy is not more fortunate in his second position on this subject, though he puts it with more confidence, and more generally. He says, "*all* "*known volcanos are accompanied by masses of basalt.*"

The reader will scarcely expect, that it is to the friends of Mr. Desmarest, and to the advocates for the volcanic origin of basalt alone, I will have recourse, for the contradiction of this unfounded assertion.

Mr. Strange, our resident at Venice, at the time this theory came in fashion, publishes a geological letter in Viaggi di Tozzetti, in which he says, "basalt prisms are "admitted, *da piu bravi chimici et fisici moderni,* to be "volcanic crystallizations;" and that such pillars have been discovered in the Veronese, in the Euganean Hills, and also above Valdagno; whence he expresses some surprise, that these prisms should be, as it were, peculiar to the Venetian territory; in the rest of Italy found at Bolsena alone; and not at all in the kingdom of Naples, *though abounding with so many volcanic phænomena.*

The next authority I shall quote, in contradiction to this general assertion, is that of Sir William Hamilton; who lets no opportunity escape him, of proving his attachment to Mr. Desmarest's theory. Our Baronet had examined Vesuvius more frequently, and with more care, than any other person ever did; and, not finding any basalt

salt upon it, thinks it necessary to account for a fact so hostile to his favourite theory. He says, "*the basalts were* "*all carried off from Vesuvius, to make Roman roads.*"

I will not presume to comment on the conjecture of so zealous a naturalist; and, as he establishes for me the total want of basalt, on this theatre of his repeated observations, I will, in my turn, admit, that he accounts satisfactorily for its disappearance from this volcano.

But the same conjecture will not account for the want of basalt, at the volcanos of Madeira, Teneriff, or the Isle of Amsterdam, which Dr. Gillan examined carefully, without noticing a particle of basalt.

The late Mr. Forster accompanied Captain Cook in his second voyage, undertaken soon after the publication of Mr. Desmarest's Memoir, and avows his adoption of the volcanic theory; yet, though Mr. Forster paid the greatest attention, both to basalt, and volcanic productions, he appears never to have found them together in the same place. His testimony bears directly against the confident position of the Academy; for he found undeniable marks, that proved the existence of former volcanos, at St. Jago, at Huaheine, at Bolabola, at Ulietea, at Easter-island, at the Marquesas, at St. Helena, and at Ascension-island. He also found volcanos, actually burning, at Tanna, and at Ambrymm; but at not one of these places does he take notice of any basalt. Yet his observations at Otaheite and New Zealand, shew, that he was well acquainted with it; and, from his having, for a time, mistaken trees for basalt

basalt pillars, he shews the subject was much in his thoughts.

It would be tiresome to lead the reader about the world, naming the different volcanos, scattered over its surface, where a particle of basalt has never been noticed. I have already given him sufficient materials, to enable him to form a judgment of the fairness with which the Academy of Sciences ushers in Mr. Desmarest's Memoir. The world will no longer be at a loss to account for the rapid success this theory has had. It can judge now, with what a prepossession, in its favour, a reader will pass from the *Precis* to the *Memoir*, when he finds its object is to prove, that there is an actual connection between certain productions of nature, which he has, the moment before, been assured, from the highest authority, are invariably found together.

But it is not by the weight of authority, nor the precipitate assent of the public, that our judgment should be regulated on philosophical subjects; nor because Mr. Desmarest's intentions have been discovered to be hostile to what we have been used to respect, are we, therefore, at once, to condemn his opinions. Let us temperately examine his Memoir, and try, whether it be entitled to the credit it has obtained. Here I must request the reader to observe, that it is not the merits of the Volcanic Theory I am, at present, proceeding to discuss; but simply those of Mr. Desmarest's Memoir, admitted, on all sides, to be the basis upon which the Volcanic Theory rests. If this shall be found insufficient to sustain it, I will next examine, what support it

receives

receives from its other numerous and zealous advocates; and then I will proceed to try, whether this opinion be reconcileable, or not, to the facts in my own basaltic country.

MR. DESMAREST'S MEMOIR.

Mr. Desmarest states, that, as he travelled through the mountains of Auvergne, he examined the extinguished volcanos, of which that country is full; and found, that currents of lava had issued from them in such abundance, as to cover a district eight or nine leagues in diameter. He gives us a map of this district, and affects to trace the several currents upon it, with great accuracy.

He observed, that when these currents were broken by mountain torrents, or other causes, the perpendicular face, so laid bare, was often composed of prismatic pillars, generally articulated, and exactly like those of the Giant's Causeway, in Ireland.

He tells us, also, that he has traced these currents up to the crater itself.

From the situations and circumstances, under which Mr. Desmarest found these pillars, he infers, they were formed by the fluid lava assuming these shapes as it cooled.

Such are the observations and inference, upon which the whole theory of the volcanic origin of basalt is founded; and it is plain, that, if what Mr. Desmarest pronounces to be currents of lava, are proved to be actually such, his conclusion is irresistible.

The

The question at issue, is thus reduced to a mere point. Were *these* currents of lava? or were they not?

On a former occasion, I had the hardihood to differ from Mr. Dolomieu, on the subject of the basalts of Sicily, which I had never seen; and attempted to prove, from *his own* facts and admissions, that what he pronounced to be currents of lava, had never flowed from any volcano. (Bibliotheque Britannique, No. 144.)

A similar attempt, in the case of Mr. Desmarest, will, I hope, be deemed more excusable, for two reasons; the first, that he himself has set me the example, by discussing the features, and products, of my country, which he, also, has never visited.

The second, that, as Mr. Desmarest, on the spot, confesses *his* doubts, and hesitates about pronouncing on his currents of lava; I hope I too may be forgiven for having *my* doubts, and that I shall be excused for examining these facts, which, it will appear, staggered himself.

The first seems to have been, *the solitary masses of basalt*, which he found in great abundance; for he admits, had these been all, he never could have pronounced basalt to be lava.

He is again puzzled, and confesses, that often he cannot find the volcano itself, at the upper extremity of the current which issued from it.

But the fact, which seems to have embarrassed him most of all, was, the groupes of pillars he found standing vertical on the summits of hills. These, he confesses, cost him much reflection,

reflection, before he could account for them; which he does, at last, by considering the *suite of degradations*, and the *decomposition*, by which so many materials had been carried off.

I must confess, it is not surprising, that Mr. Desmarest should be much puzzled at finding a material, which, according to his theory, must have been in an high state of fluidity, settling itself on the summits of hills; yet this is a situation, for which columnar basalt seems to have a strong predilection, as well in Vivarois, and the North of Ireland, as in Auvergne.

These difficulties, Mr. Desmarest has been able to get over, at least, to his own satisfaction, without giving up his theory. With others, he is not equally fortunate: he tells us, page 720, that he found prismatic masses, *qui ne tiennent a rien*, which, by their disposition, exclude all correspondence with currents of lava, or with volcanos. These, he says, we are under the necessity of supposing, *were fused and cooled on the spot.*

Here Mr. Desmarest admits, that his theory does not account for the formation of *all* columnar basalts. Some, he confesses, are out of the reach of volcanos; and he is under the necessity of inventing a new operation of nature for the purpose. And, since it is plain, on inspection, that fluid lava could not have travelled to the place where he found these basalts, he is obliged to fuse something, on the spot, for his purpose; without condescending to give us the slightest account of these *new* and *occasional fires*, or of any circumstance attending them.

Mr.

Mr. Desmarest's induction in this case, and which is perpetually adopted by those of his school, is short and clear.

He first *assumes*, that basalt is the effect of igneous fusion; and then it must be granted to him, that he may model these fires, so as to answer the end.

His successors have, in stating this argument, a great advantage over Mr. Desmarest; for, while he is obliged to get over his whole difficulty, by one grand postulate, they have the benefit of his authority; and quote him, like another Aristotle, *ipse dixit.*

A new difficulty occurred to Mr. Desmarest, which he does not avow, until he publishes his second Memoir. No doubt, emboldened by the great success of his first, he now discovers, that his theory cannot be overturned by any facts, however hostile to it; and, that his credit is so well established, that the world will implicitly receive any reason, he shall think proper to assign, for the most anomalous facts.

He found, as he admits, horizontal strata (couches) of argil and limestone, incumbent on his basaltic lavas. These materials are not volcanic productions; yet Mr. Desmarest must account for their being found in this unexpected situation, which he does, lightly and easily. He says, "*these are* "*(pour ainsi dire) a superfœtation, posterior to the lavas:*" that is, he throws *alma mater tellus* into labour again, delivers her of two or three strata; which, happening to be placed over his lavas, fully account for every thing.

With this ingenious and philosophical solution of his last difficulty, Mr. Desmarest completes the sum of the argu-

ments,

ments, and evidence, which Auvergne affords, to enable him to establish his discovery, that columnar basalt is a volcanic production, formed in currents of lava as they cooled.

Fortunately, however, for *science*, and, I may say, for *truth*, Mr. Desmarest is not the only naturalist who has visited Auvergne, and published an account of its natural history. Mr. Guetard, a professed mineralogist, twice made a tour of Auvergne; and, with an interval of eight years, twice he published his observations, in the same Transactions with Mr. Desmarest. Should, therefore, any contradictions occur between these two gentlemen, the reader must decide between them as he best can: and, the better to enable him, I remind him, that, while Mr. Guetard seems to have no other views, but what are purely scientific; Mr. Desmarest has discovered his intention, of making natural history subservient to his purposes.

The Volcanic Theory, as laid down, and maintained, by Mr. Desmarest, I have shewn before, turns entirely on one question, to wit, whether what he pronounces to be currents of lava, actually flowed from any volcano? I, therefore, in comparing Mr. Guetard's account of the same country with his, shall limit myself merely to such facts and observations, as promise to throw light on this question.

Mr. Guetard visited Auvergne in 1752, and again in 1760. He piques himself on discovering this country to have been, at a remote period, ravaged by subterraneous fires and eruptions. His attention seems much fixed on

volcanic

volcanic objects: yet, in both tours, all these currents of lava escaped him; which, by Mr. Demarest's account, covered a district of country, eight or nine leagues in diameter.

This negative evidence, against Mr. Desmarest's currents of lava, is pretty strong: but Mr. Guetard is so good, as also to furnish us with positive evidence, direct to the point; for he assures us, Volvic alone, of all the extinguished volcanos in Auvergne, produced lavas in any considerable quantity; the others, to not more than the thickness of a few inches; their ejections consisting merely of scoria, cinders, pumices, and ashes.

Mr. Guetard, also, gives (quite incidentally) a most important *fact*, decisive as to these currents of lava, to wit, *the diameters of the craters*; the greatest of which measured but from five to six toises (from 30 to 36 feet); yet, if we believe what Mr. Desmarest calls currents of lava, to have been actually such, we must allow, that it was through these diminutive funnels such mighty torrents issued; and, in particular, the current, that formed the facade of Ladabraise, one hundred feet high. This I select, not as the greatest, but because Mr. Desmarest says, it issued at one jet.*

In

* Though Mr. Desmarest, who, on his mission, had visited the Italian and Sicilian volcanos, often mentions the *craters*, from which his currents of lava issued, he carefully suppresses their dimensions; the difference between which, and those of other volcanos, known to have produced currents of lava, must instantly have struck every reader acquainted with such subjects. Sir William Hamilton informs us, that the crater of Etna was two miles and a half in circumference; that

In one point, these gentlemen are entirely agreed; that is, in their account of the Volvic lava, which Mr. Desmarest allows to be quite different from his basaltic lava, in its neighbourhood, but perfectly resembling the Vesuvian lava, full of pores, and breaking in all directions, *(casse en tout sens;)* while his own prismatic lava was quite compact, and so refractory, in the hands of masons, that the natives, who had a name of their own for it, *pierre d'eragne*, and were well acquainted with its inutility, instantly forsook a quarry, when they found the stone of this species.

Thus, by Mr. Desmarest's account, the volcanos of Auvergne produced two sorts of lava, quite different from each other. The first, exactly like the lavas of all other volcanos; the second, totally different: in *texture*, as being quite compact; in *form*, as being shaped into pillars and prisms; and in *fracture*, as disobedient to the tool of the workman.

Mr. Guetard's account is more simple. He tells us, the volcanos of Auvergne produced but one species of lava, and that exactly like all other lavas.

Should the reader be embarrassed by the contradictions of these gentlemen; the testimony of an author, who lived, at the

that of Vesuvius, half a mile. Sir William thinks, that the craters of *extinguished* volcanos increase in size; and, accordingly, Bracini found, before the eruption of 1531, after an interval of rest of 492 years, that the circumference of the crater of Vesuvius was then five miles.

Sir William adds, that the craters of the extinguished volcanos, of Astruni and Monte Gauro, were six miles; while the smallest crater he mentions, is that of Monte Nuovo, which was but a quarter of a mile. This mountain, however, was thrown up in one night.

the time of the eruptions, in Auvergne, will, probably, throw light on the question, and enable him to decide between them.

Sidonius Apollinaris, Bishop of Clermont, in Auvergne, in the fifth century, describing the calamities of his country, to which he was witness, says:

"The mountains vomited out fire; their height was increased, by the quantity of burnt matters they threw up, and which, as they fell, heaped upon one another: the wild beasts fled into the towns for shelter."

We cannot have a more accurate description of Mr. Guetard's mountains, composed of scoria, cinders, pumices, and ashes; but not one word of Mr. Desmarest's currents of lava, which, by his account, covered a district, eight or nine leagues in diameter; and mighty torrents of liquid fire would have heightened Sidonius's picture, who appears disposed to be turgid.

Mr. Desmarest seems to have suspected, that the observations he made upon Auvergne, alone, were not sufficient to establish his discovery, that basalt prisms were a volcanic production. He must call in the aid of some other country, and shew, that in it, also, basalt was produced by subterranean fire.

He selected our county of Antrim for his purpose; a country he had not visited, and whose basaltic wonders, though even then much celebrated, had never been examined with care; nor was any tolerable account of them,

at

at that time, published. Besides, one point alone (the Giant's Causeway itself) had been dwelt upon; whereas, it ought to be, from the general construction of the country, and the circumstances attending its basalts, that arguments were to be sought, to establish a decided resemblance between Antrim and Auvergne, in order to lead to the conclusion he wishes to draw; to wit, that Antrim also was a volcanic country.

Two views of the Giant's Causeway, published by Mrs. Drury, supplied the defect of other materials.

The first argument he drew from these views was, that, as they exhibit our Causeway, standing at the foot of a conical mountain, this must have been the volcano, whence the current of lava issued, in which it was formed.

Dr. Hamilton takes pains to shew, that Mr. Desmarest was misled in this point; which I would willingly allow, if it was the only instance in which he misrepresents our facts: but, as, in every step he takes, he endeavours to *mislead*, I will not precipitately acquit him, of the same intention, in this instance.

His next argument, to prove Antrim to be a volcanic country, is, from a resemblance, he thinks he discovers, between the valleys of Mont d'Or, in Auvergne, and, what he considers as, the skirts of mountains, in Mrs. Drury's drawings.

I must confess, I cannot discover any resemblance, between the faces of our precipices, in these drawings, and mountain

mountain valleys;* nor do I conceive a resemblance, between the skirts of mountains, in distant countries, (even if better established,) to be a fact of such importance, as to warrant a general conclusion of their similarity, in all other respects.

It is amusing to observe, with what force Mr. Desmarest puts this argument; how well satisfied he is with the *vis consequentiæ*, and to what an extent he avails himself of it. He says, " je tirai de cette conformité reconnue, une con-" sequence, que la force de l'analogie m' autorisoit a' tirer. " Cette consequence me fit voir dans la Chaussee de Geans, " et dans toutes les masses prismatiques, qui se montrent " sur les bordes escarpeés de la mer, en Irlande, en un mot, " dans les sommets tronqueés, q'on y appercoit, l'ouvrage " des eruptions, d'un ou des plusieurs volcans, qui se sont " eteints, comme ceux d'Auvergne."

I must make two observations on this passage. The first, that Mr. Desmarest calls this fanciful resemblance (he thinks he has discovered) *une conformité reconnue*, as if known and admitted by all the world.

The second, that he takes this opportunity of sliding in a most important fact, *sommets tronqueés*, truncated summits or cones, being one of the most characteristic features of volcanic countries; of course, when found in Antrim,

 decisive

* Since I wrote the above, I have carefully examined Mrs. Drury's drawings, which represent our uniform façades with great accuracy. No *valleys* or ravines, either in nature or the drawing, nor any thing like the skirts of a mountain.

decisive on what Mr. Desmarest labours to prove, to wit, that it was once the seat of volcanic eruptions.

Thirty pages afterwards, he resumes the topic; and, complaining of the English writers, for giving no account of the form of the mountain, at the foot of which the Giant's Causeway is placed, Mr. Desmarest kindly supplies their deficiency, and tells us, it is *une cone tronquée*.

Now, as there is nothing in Mrs. Drury's views, which can be tortured, by the warmest imagination, into a truncated cone; nor, in the vicinity of the Giant's Causeway, any feature of the slightest resemblance to it; and, as Mr. Desmarest himself admits, that none of the English writers mention the shape of these mountains, it becomes necessary to ask, where did he meet with this truncated cone, this decided volcanic feature, that helps him to establish his resemblance, between Antrim and Auvergne?

Mr. Desmarest was not aware, that, even in his own time, his intention, "*to make such observations in natural history, as* "*would very well enable him to give the lie to Moses,*" would be in possession of the public; or he probably would have been more cautious, how he exposed himself to a retort from any of Moses's friends;

Στρεπτη γὰρ γλωσσ᾽ ἐστι βροτων πολεες δ᾽ ἐνι μυθοι,
Οπποιον κ᾽ ἐιπησθα επος τοιον κ᾽ ἐπακουσαις.

Glib runs the tongue, with words unnumber'd fraught,
And gives you back as good as you have brought.

But,

But, as I pérceive, from the late publications in the National Institute, that Mr. Desmarest still wields his pen, I trust he will explain.

All that remained, to enable Mr. Desmarest to complete his proof, of Antrim being a volcanic country, was, to find the scoria, which, he well knew, was admitted, by all naturalists, invariably to accompany every volcano. Not one English writer, on the subject of the Giant's Causeway, had mentioned the word scoria: but Mr. Desmarest assures us, that their not having mentioned the scoria, along our coast and precipices, was pure omission; and, as to the scoria, that ought to have been found on the Giant's Causeway itself, it was (as he tells us) all washed off by the breach of the sea.

As Mr. Desmarest has been pleased to give us so much information, about our county of Antrim, which he never saw; I think the least I can do is, to return the obligation, and give him some information, relative to his Auvergne, which I have never visited.

I, therefore, venture to assure him, that Auvergne was, originally, a basaltic country; with its materials, arranged by the hand of nature, precisely in the same manner, as they are in Antrim, and, I believe, in all basaltic countries: that is, in extensive strata, horizontal, or nearly so; exhibiting flat terraces, accumulated upon each other, in several tier; often abrupted into perpendicular façades, displaying the prismatic and columnar construction of the basalt, of

 which

which they are composed; and that some of these strata are (as with us) often red or ochreous.

That this was the original construction of Auvergne, I rest upon the authority of Mr. Desmarest's own Memoir; where the corresponding circumstances of the two countries are detailed, in a manner not to be mistaken. For instance, he tells us, page 706, that his prisms rest upon a stratum of *terres cuites*, as our own often do upon an ochreous stratum, strongly resembling *baked earth*, or brick.

Page 730, he says, the strata form *plusieurs etages, ou ranges horizontales:* and again, page 737, the same words recur. Page 730, *terraces assez etendues*, platforms and terraces, perpetually occur; and the perpendicular façades, common to all basaltic countries, are to be met with, as well as his *terres cuites*, in almost every page.

From this account of Mr. Desmarest, it is plain, that the original materials and stratification, of Antrim and Auvergne, were precisely similar: but we have had the good fortune to remain undisturbed, while Auvergne has been ravaged by destructive eruptions. One at Volvic, more tremendous than the rest, poured forth vast torrents of lava; while the others, more diminutive, emitted only lighter materials, scoria, cinders, pumices, and ashes.*

Mr. Strange (whose adoption of Mr. Desmarest's theory I have proved before, by a quotation from his geological letter

* These latter were, probably, some of the eruptions, to which Sidonius Apollinaris was witness; while, in all likelihood, the great eruption of Volvic happened at an earlier period.

letter to Tozzetti) was much astonished, when he came to visit Auvergne, that, in no one instance, he found prismatic basalt near to any of the volcanos: a fact, which seems to have much weakened his belief in the Volcanic Theory.

No doubt, it must have appeared very extraordinary to him, that no connection or continuity was to be found, between *cause* and *effect;* between the volcano, and the lava that had issued from it. Mr. Desmarest, aware of this objection to his theory, anticipates it; and undertakes to account for this extraordinary circumstance. He tells us, that it is only at a great distance from their craters, that the currents of lava are able to disentangle themselves from the scorified matters.

This important fact, of the constant remoteness of the basalt from the volcanos, thus fully established, by the testimony both of Mr. Desmarest and Mr. Strange, is not very difficult to account for; as the volcanic ejections must, in every instance, have covered the original basalts, in the vicinity of the craters, so that the remote ones only are left visible.

The reader is now able to form his judgment, upon the merits of this celebrated Memoir; and to determine whether, in his opinion, it ought to have had such weight with the world, as to procure so rapid and general an assent, to Mr. Desmarest's theory.

As this gentleman undertook to enlighten mankind, on basaltic subjects, it was, no doubt, supposed, he had made this fossil his peculiar study; for,

Publica lex hominum naturaque continet hoc fas,
Ut teneat vetitos inscitia debilis actus.

Yet, I am afraid, that, while, upon the credit of Mr. D'Alembert, we admit Mr. Desmarest to be *a man of merit and sound philosophy;* we must, upon his own evidence, convict him of being little acquainted with the fossil, upon the nature of which he undertook to instruct the world; and ignorant of the varieties of basalt, and the modes in which nature has been pleased to arrange it.

Men of genius, and warm imagination, have sometimes dashed rapidly into topics, with which they had not taken time to make themselves sufficiently acquainted. Thus, Mr. Desmarest, from his zeal to co-operate in the views of his friends, D'Alembert and Voltaire, may have hurried into his basaltic Memoir, before he had taken sufficient time to examine this fossil. But he has since had leisure enough. He saw the world, for thirty years, busied upon the basaltic topics he had thrown out to them: he alone gave himself no trouble on the subject; for, at the end of thirty years, he shews, that he is perfectly unacquainted with most of the circumstances attending basalt.

After this long interval, Mr. Desmarest resumes his pen, and publishes another Memoir, in the fourth volume of the National Institute, and now talks of basalt with authority. He there tells us (page 320), that basalt pillars are formed by *une retraite et le reserrement, equally applicable to desiccation.*

Again

Again (page 230), he repeats the same common cause, *retraite et reserrement;* in one case, the effect of *desiccation;* in the other, of *refroidissement.*

I will not detain the reader, by shewing the folly of lumping two causes for the same effect, so totally different from each other, as desiccation and contraction: the one arising from evaporation; the other from that property, which all solid bodies seem to have, of expanding, and contracting, with heat and cold. Nor will I dwell on the utter insufficiency of either cause, to produce our exquisitely neat and regular pillars, and especially their highly finished articulations.

It is to Mr. Desmarest's total ignorance of the *facts,* attending this fossil, I call the attention of the reader: for each cause, to which he ascribes the formation of basalt pillars, necessarily supposes intervals between them. Every one knows, that, on desiccation, cracks and intervals are produced: and Mr. Desmarest himself (page 222), explaining the formation of basalt prisms, by the other process, contraction in cooling, says, " *leur faces sont le* " *resultat des fentes verticales.*"

But, unfortunately for Mr. Desmarest's credit, in basalt, there are no intervals, no *fentes,* between the prisms, or pillars: all are united together, into one solid mass, separable from each other; but it is by external causes alone, that they are actually separated. It is true, the pillars, in our façades, sometimes exhibit very small intervals, between which, as Sir Torbern Bergman says, the point of a knife

can

can scarcely pass: but, even these are limited to the surface; and, probably, the effect of contraction, and dilatation, from the variation of temperature, in our atmosphere. For, as we quarry farther in, the mass soon becomes solid: even the surface itself is frequently without the slightest intervals between the prisms or pillars. I refer the naturalist to two points, where he can easily get access to the foot of the precipice; the S. E. point of Portmoon, and Grace Staple's Cave, at Carrickarade: in both places, the façade is neatly columnar and prismatic, and also completely solid.

As this want of intervals establishes, both the inadequacy of the causes, which Mr. Desmarest assigns, with so much confidence; and, also, proves his own total ignorance of basalt, in its natural state: I will mention two facts more, which must put this point past a doubt.

The first; that a fall of 200 feet has not been able to separate the prisms, composing the prismatic masses, which have fallen down the vast perpendicular precipice at Fair-head.

The second; that the hollows, on the surface of the Giant's Causeway, are as staunch as a bason, and hold the water, that collects on them, from rain, or the spray, until it evaporates; whereas, it would soon find a passage, through Mr. Desmarest's intervals, if such existed.

Though this gentleman has given us opportunities enough, of discovering his ignorance of a subject, upon which he has brought so much attention; I will trouble the reader but with one instance more.

He

He had told us (page 222), that the prisms are always vertical: and again, (page 231), he generalizes, and makes this not an accidental position, but a matter of necessity; assuring us, that, " *in lava, the result must be a vertical* " *prism.*"

Had Mr. Desmarest paid any attention to basalt, he would have known, there are different varieties of it, which directly contradict his rule, so dogmatically laid down: some varieties, in which the axes of the prisms are indifferent to all positions; while the stratum, in which they are placed, remains perfectly steady; the axes assuming different degrees of obliquity, at short distances, and sometimes undulating.

The prisms, too, of the basalt walls, commonly called *whynn dykes*, are always horizontal.

PART II.

EXAMINATION OF THE FACTS AND OPINIONS,

GIVEN BY DIFFERENT ADVOCATES

FOR THE VOLCANIC ORIGIN OF BASALT,

WHO FOLLOWED MR. DESMAREST;

TO WIT,

MR. FAUJAS DE ST. FOND, MR. DOLOMIEU, MR. WHITEHURST, BISHOP TROLL, ABBE SPALANZANI, AND DR. HAMILTON.

UTINAM TAM FACILE VERA INVENIRE POSSEM, QUAM FALSA CONVINCERE. CICERO.

I HAVE, in the preceding account of Mr. Desmarest's Memoir, enabled the reader to form some judgment of its merit; and to determine, how far its author has succeeded in establishing his position, that basalt is a volcanic production.

The advocates for this opinion, no doubt, may say, that its truth does not rest *solely* on Mr. Desmarest's proofs; that the Volcanic Theory has many other advocates, who, perhaps, may support it more ably than its original inventor; and who may adduce new arguments and facts, which had escaped him: that, therefore, to judge fairly, it becomes necessary to examine, what other writers say in its favour; and to try what new lights they throw upon the subject.

 It

It is very true, this theory has been taken up by many others, who shew an eagerness to express their approbation of it; but not one of them seems to think any further proof of it necessary, than what Mr. Desmarest has already given. Arguments, therefore, in support of this theory, are not to be found in their works, nor, indeed, many *facts* that apply to the question; but, in their stead, we shall find *postulates* in abundance; for, circumstances most frequently occur, hostile to the volcanic origin of basalt. These must be explained, and accounted for: the friends, therefore, of this opinion, are reduced to the necessity of making postulates, which will, probably, surprise the reader, and, I hope, will also afford him some entertainment.

Mr. Faujas de St. Fond is the most celebrated, as well as the most voluminous writer on the subject. That he considered the volcanic origin of basalt, as a question no longer at issue, but finally decided in the affirmative, appears from the words, with which he commences one of his treatises, "*Mineralogie des Volcans.*" He begins thus: "*Le basalte est une veritable lave, qui a incontestablement* "*coulé.*" After this debut, the reader will not expect, that Mr. St. Fond will be at the trouble of demonstrating, what he has already taken for granted. An examination, however, of his *facts* is necessary. One of them has been considered, by different writers, as quite conclusive on the question; and, no doubt, at first view, appears to give strong testimony in favour of this theory.

Mr.

Mr. St. Fond describes the mountain De la Coupe, in Vivarois, as bearing undeniable marks, of having been once a great volcano; a vast crater, scoriæ, and burnt matters, in abundance. But, the important fact is, that a current of lava has (as Mr. St. Fond says) run down from this crater, and descended into the plain, where it has formed an extensive *pavè de geans;* and that prisms appear in the current, before it has quite reached the plain.

Now, *audi alteram partem.* A naturalist, quoted by Mr. Kirwan, assures us, that the mountain De la Coupe never was a volcano; and, that what Mr. St. Fond calls a current of lava, is merely a stripe of trapose matter, which happens to have been laid bare.

Here we have the contradiction direct; and one instance, of the many, from which it appears, that disputed points, in natural history, are now reduced to mere wars of assertion, upon which no reliance whatsoever can be placed. How, then, is an impartial inquirer to obtain truth, when he knows that, in the relations given by partial theorists, no respect is paid to it?

The only method I know, is to neglect the strong assertions, which betray the object of the writer; and to attend to the more minute, and apparently unimportant circumstances, which escape him. Let us try that mode, in the present instance; and, I suspect, we shall come at the truth.

When Mr. St. Fond (who wishes to make this mountain a volcano) talks of scoria, and vitrified matters, I consider

him,

him, as using the common-place language of all those, who are anxious to establish similar points; and such as we meet with, in most accounts of my own country, written by friends to the Volcanic Theory; though, in reality, no such substances are found in it.

But, when he incidentally mentions *laves torses*, lavas twisted like a rope, a decided volcanic accompaniment, though rarely noticed as such, I begin to believe him, and admit his mountain, De la Coupe, to be an extinguished volcano.

Again, when I find Mr. St. Fond, labouring to establish a current of lava, as descending from the crater of this mountain, and continuing its course down its side, until it reaches the plain; where, as he says, it forms a most superb Giant's Causeway, of vast height; this fact is so decidedly conclusive in his favour, that I begin to suspect him, and think it necessary to examine and compare the minute circumstances of his account, which soon turn out irreconcileable to its main object. For instance, he tells us, the whole country, from Rigaudelt Enstragues, is one mass of Giant's Causeway. The river Volant has excavated for itself, a deep and large bed, edged on both sides by superb basalt prisms. The escarpment, on the right side, is *d'une hauteur prodigieuse*. It is there plain, the lava has run down *a diverses reprises*, to form this *pavé a plusieurs etages*.

We have next to examine Mr. St. Fond's account of the current of lava, which has produced such mighty effects. He

He admits, it is only thirty feet wide; but, he says, it must enter *fort avant dans le profondeur de terre*, to judge by the profile of the causeways it has produced; in other words, it should have been much greater. In another place, he admits its apparent diameter, to be but five or six feet; *at least, we can only see so much:* scoriæ conceal the rest, *which ought to be ten times as great.*

Is it not now plain, that a current, of such trifling dimensions, was totally insufficient, to produce the effects Mr. St. Fond ascribes to it? Must we not, therefore, when we admit his volcano, give up his current of lava, as untenable? And this exactly corresponds with the observations, made on the spot, by my ingenious and learned friend, Dr. Perceval, Professor of Chemistry, in Dublin College; who assured me, that the mountain, De la Coupe, was an extinguished volcano; but that what Mr. St. Fond called a current of lava, was merely a ravine, the effect of some torrent.

Lest, however, I should be blamed, for contradicting a gentleman, who visited the place, which I never did, I give up the point, and admit Mr. St. Fond's current of lava; which, descending the hill, enveloped some of the prisms of the pavé, of which the whole country, by his own account, is formed; and which obviously existed there, before the volcano erupted; as did Mr. Desmarest's prisms and pillars, in Auvergne.

I have dwelt upon this fact; both because it has been often quoted with much triumph, and, also, because it is the

the only one I ever met with, that gives a plausible support to the Volcanic Theory.

I will now proceed to examine the remaining facts, (thinly scattered through Mr. St. Fond's voluminous works,) that seem, in the least, to apply to the present question.

He found, at Montbrul, basalt prisms, at, what he calls, the bottom of an old crater; but, he adds, they develope themselves much more behind the crater, where they have formed a *pavé de Geans, des plus elevees.* (Vol. etein. page 287.)

Here it appears, by Mr. St. Fond's own account, that the lava has risen far above the crater: of course, if this be really a crater, (which I much doubt,) the pillars must have been formed antecedent to the eruption, as in all other cases.

At Chenavari, he found a colonnade of prisms, which he calls the remains of a vast crater, of which the greater part has been *ensevelie and abimee.* I believe this, without further proof, (than his supposed revolutions,) will scarcely be admitted to be a crater.

At Pont de Baume, Mr. St. Fond observed a range of articulated prisms, supporting a stratum of a different variety of basalt. This he calls a superb *coulee de lave;* but, unfortunately, he cannot determine from which of two craters it comes. (Page 300.) I fancy the reader will require some little proof, before he admits it to have issued from either.

On

On another occasion he is more decided; for, finding *buttes isolees* unconnected with currents of lava, he says, they were forced *hors de terre*, by the efforts of the two superior craters. (Page 269.) A combination of forces, and a conjunction of operations, which, I confess, I do not well comprehend.

Mr. St. Fond's account of Pont de Baume is very important; as it describes, accurately, a circumstance, common to many basaltic countries, to wit, strata of columnar basalt, alternating with strata of another variety of this fossil; as at Staffa, Bolsena, the Giant's Causeway, and the whole neighbouring country. We see, too, that Mr. St. Fond himself cannot reconcile this arrangement with the common mode of volcanic formation.

I will now proceed to state some of the postulates, which Mr. St. Fond finds himself under the necessity of making, in order to reconcile, to his theory, the extraordinary facts, which are perpetually occurring to him. He seems to forget, that the sole proof, adduced to support the Volcanic Theory, is, that basalt prisms were found in actual currents of lava. He now proceeds to invent, for his purpose, new and extraordinary operations, without assigning any reason, or proof, to shew, that nature ever performed any such.

Mr. St. Fond describes, and gives us a drawing of Mont Maillas, which appears to be an enormous basaltic hummock, of great elevation, formed by an horizontal stratum of columnar basalt, exhibiting a colonnade round its periphery. He admits, no crater is to be found near Mont

 Maillas;

Maillas; and, from its height, it could not have been formed in the common way: he, therefore, assures us, that the inconceivable force of subterranean fire, *l'a fait sortir, toute formeé, de l'interieur de terre;* that is, it was forced up, *ready made.* (Page 280.)

Though Mr. St. Fond chuses to call these, explosions of his *volcaniques,* yet, he takes care to inform us, that they have nothing volcanic but the name. For Roche Rouge, a pyramidal basaltic rock, 100 feet high by 60, was forced up, (I may say, like a peg,) *par l'effort d'une explosion volcanique, de l'interieur de terre,* without being preceded, or followed, by any other volcanic phænomenon; as there are neither *scoria* nor *porous lava, nulle coulée de lave,* no crater, nor apparent volcano, in the neighbourhood. (Vol. Eteints, page 364.)

Nor does Mr. St. Fond limit his volcanic explosions to the land only: for he assures us, that Rocher St. Michel, and Rocher Corneille, though in the province of Velay, in the heart of France, were formed by submarine eruptions. (Page 341 and 344.)

What opinion the reader will form, of these mighty agents, which Mr. St. Fond introduces, to help him through his difficulties, he must determine for himself: but Mr. Dolomieu considers the discovery of them, as a superior effort of human sagacity. He can now get over his own difficulties, and account for the formation of the basaltic mount Paterno, which, he admits, could not have been formed by the common volcanic process; and of La Mothe, whose

whose pillars are 30 feet high; and of the Cyclopian Islands, whose vertical pillars are covered with marine exuviæ. All these, he says, were formed by a sort of *vertical jet;* which, in the case of the Cyclopian Islands, carried up the bottom of the sea with it, leaving it on the tops of the pillars, where it was placed before.

I shall make no other comment, on this machinery of these gentlemen, than to observe, that it must have been managed with great dexterity; since, from their own account, it appears, that the explosion, however violent, has not deranged the perpendicularity of the pillars; at least, at Maillas, La Mothe, and the Cyclopian Islands.

Mr. St. Fond, though, in general, so well able to account for every thing, yet, on some occasions, like his friend, Mr. Desmarest, cannot suppress his doubts. He says, page 271, *on rest stupefait, et on est à chercher, d'ou a pu venir une masse, aussi etonnante, et aussi isoleé.*

And again, page 279, he was so much embarrassed, by finding a beautiful suite of prisms, imbedded in the solid rock, that, he confesses, he cannot pronounce on so delicate a subject.

Mr. Dolomieu was a friend, and a correspondent, of Mr. St. Fond; and a zealous, though, sometimes, not quite so bold, an advocate for the volcanic origin of basalt. He, too, has his doubts, as he candidly confesses to his friend; and also his postulates, though he admits he is somewhat *effrayée* at proposing them.

 His

His doubts he expresses thus, in his second letter to Mr. St. Fond, from Lisbon. He says, "can a mountain be "called volcanic, which is not conic, has no crater, is "grouped with other mountains of a different species, "which form, together, but one mass? Can we say, that a "volcano has burned in a country, where we find neither "*scoria*, *pumices*, *cinders*, or *puzzolana?*"

I must confess, Mr. Dolomieu assigns good reasons to justify his doubts; which, however, he surmounts gradually; for he tells us, he thinks, the difficulty may be got over, if we concede to him, *that the agitation of the waves destroyed all other stones, except the basalts.*

At length, in his fourth letter, he pronounces himself satisfied these mountains are volcanic, *provided* his postulates be granted to him; which are, "that there have been "*four* revolutions, in this part of the globe; that the vol-"canos were anterior to the last *alluvion*, and posterior to "another *sejour* of the sea, which deposited the calcareous "strata, upon which these lavas are placed."

Mr. St. Fond is just as ready as his friend, to make use of *revolutions*, *submersions*, and *deluges*, to help him to get over the difficulties, which his favourite theory has to encounter. He found, at Chamarelle, in Vivarais, what he calls a current of lava, attended by many circumstances, incompatible with the state of fluidity he ascribes to it. For instance:

This lava has not only been able to penetrate the hardest calcareous rocks, *mais encore d'y circuler*, *tantot dans une sens, tantot dans une autre;* to cut, transversely, strata of considerable

able thickness; and thus to travel (*voyager*) more than six thousand yards, without being impeded by such barriers: and, what seems still more extraordinary, this current has not only descended the declivity, but has also ascended (*escaladée*) the skirt of the mountain, *et s'est élevé jusques sur sa crete.*

The postulates Mr. St. Fond makes, to enable him to explain this singular fact, are, that the volcano was submarine; that the current of lava, as it flowed along the bottom of the sea, impinged against the mountain of Chamarelle, at that time, as well as all the other mountains in its vicinity, submerged, *par l'effet de quelque grand revolution.* And we must presume, (as we now find them highly elevated,) that they were raised again, by some other as powerful revolution. (Min. des Volcans, chap. 13.)

I hope to be excused, for having dwelt so long upon Mr. St. Fond and Mr. Dolomieu. They are admitted to be the most eminent writers on this question; and they are both spoken of, in the highest terms, by Mr. Kirwan and Dr. Hamilton. Yet, notwithstanding this honourable testimony, from men decidedly attached to the religion they profess, I cannot help suspecting, that both Mr. St. Fond, and Mr. Dolomieu, were in the confidence of Mr. Desmarest; acquainted with his object, which we have accidentally discovered; and that they were his associates, in carrying it into effect. That they both leaned to the same conclusion he wished to draw, appears, from many passages in their

writings,

writings, especially where they find basalts covered by calcareous strata.

Of Mr. St. Fond I know little, but that he was the friend and correspondent of the Duke de Rochefoucault and Mr. Desmarest, as well as of Mr. Dolomieu. Of the latter we have better information. We know that he was an *illuminatus* of the first order; a member of the Lodge of the Nine Sisters, with Rochefoucault, Brissot, Condorcet, Garat, Pethion, Danton, Bailly, and other leaders of the anti-christian and anti-monarchical conspiracy. We find him active in revolutionizing Malta, and imprisoned for similar attempts at Naples.

But, whatever may have been the ultimate object of these gentlemen and their associates; they pursued it with such activity, that they inspired their followers with the same zeal for making proselytes, which they possessed themselves; and the same contempt for truth, of which their leader, Mr. Desmarest, had set them so striking an example.

Though I do not suspect the naturalists of the British Isles, to be, in the least, privy to this conspiracy; yet, some of them seem to have adopted the French mode of supporting favourite theories; and to have modelled the *facts* they met with, so as to make them serve their purpose.

One of these gentlemen, indeed, Mr. Whitehurst, a mineralogist of some eminence, seems to have improved upon the

the French stile; for he *misquotes*. He tells us, "Mr. St. "Fond's treatise contains many instances, of basalts being "absolutely a part of the matter, which flowed from a "volcano, in a state of liquid fire; which evidently ap- "pears, from the same mass of lava, situated near its "crater, being wholly, or in part, columnar."

I wish Mr. Whitehurst had been so good, as to name the pages, where these instances are to be found. I certainly never met with any thing, in Mr. St. Fond's works, to warrant the strength of this passage. It seems, also, to have escaped Mr. Whitehurst, that Mr. Strange (as I have stated before) positively denies, that columnar basalt is to be found in the vicinity of a volcano: and Mr. Desmarest himself, aware of the awkwardness of this unexpected fact, feels himself under the necessity of accounting for it.

Mr. Whitehurst, too, seems as ready, as his French predecessors, to make postulates, to enable him to get over his difficulties. I have shewn, in more instances than one, the modes they have devised, to account for the total want of volcanic features, in countries, according to their theories, decidedly volcanic. Mr. Whitehurst's conjecture is new: the reader must judge of its ingenuity.

He says, "an immense tract of land, towards the north, "has been absolutely sunk, and swallowed up into the "earth, at some remote period of time, and become the "bottom of the Atlantic ocean."

Whence, "he is almost tempted to think, that Ireland "was, originally, a part of the island Atlantis; which, ac- "cording

" cording to Plato's Timæus, was totally swallowed up by " a prodigious earthquake."

Here (for we must not press upon the contradictory account, of the submersion, in one place, of a *part;* in the other, of the *whole* island) we have a complete solution of the difficulty. The volcanos were all in the part called Atlantis; their lavas spread into the part now called Ireland; the former was swallowed up, but the latter remains.

Mr. Whitehurst can also misrepresent facts, with great ease and confidence. The rocks, at Portrush strand, he says, " *consist altogether of masses of black lava, so extremely " replete with bladder holes, that it perfectly resembles the scoria of iron; and, therefore, leaves not the least doubt of its " being a volcanic production."* (Page 249.)

These rocks, at Portrush strand, are opposite to my door. I have often examined them, and affirm, they are composed of strata of solid table basalt, sometimes thickly studded with zeolite: their fracture, like that of other basalt; no resemblance whatsoever to *scoria;* nor do they contain a single bladder hole. I can also assure the reader, that Mr. Whitehurst did not alight from his horse, to examine these rocks, which, by his own account, so effectually establish his favourite theory.

Bladder holes, or internal cavities, *(I pori nell interno,)* are admitted, by most of the foreign naturalists, to be essential to lava. Mr. Kirwan assigns the reason; as such cavities are the necessary effect of the fusion of earthy substances. Hence it comes, that the advocates for the igneous origin

origin of basalt, are so ready to give this fossil pores and bladder holes. For my own part, I never met with, in any of our basalts, internal cavities; except such as once contained water, or those from which zeolites had fallen out; and even these very rarely.

I shall now proceed to two other facts, which seem to countenance the volcanic origin of basalt.

The first is stated by Dr. Troil, who observed in Iceland, as he tells us, "basalt pillars, peeping out from "among the lava, and still oftener from among the tufa."

Iceland is, unquestionably, both a basaltic, and a volcanic country. The question to decide here, is: were these pillars formed out of the materials, among which they appeared? or, was the coincidence accidental? Now, as I apprehend, no one will maintain, that the *tufa* was formed into basalt pillars; they must necessarily have been enveloped by the *tufa*, that fell among them. The reader is, then, to determine, upon these scanty data, (for Dr. Troil does not give much assistance,) if it be not probable, that the pre-existing basalt was enveloped by the *lava*, as well as by the *tufa;* and if so, the original question rests as it stood.

The only remaining fact, that has come in my way, that seems to apply to this question, is related by Abbé Spalanzani. He found, at the bottom of the crater of Volcano, in the Lipari Islands, "*pentagonal basalt prisms.* On "looking up the sides of the crater, he perceived, they "came from a great bed of lava, almost vertical; divided,

" in its length, into articulate prisms: the lava, in which " they were, descended to the ground, and was inconsiderable."

I must observe, that Spalanzani, as well as other advocates for the volcanic origin of basalt, generally uses the terms, *lava*, and *basalt*, as synonimous; and that Spalanzani talks of the volcanos of Ireland, and of Antrim, with as much ease as Mr. St. Fond, or any of them.

The very critical situation, in which these prisms were found, to wit, the bottom of an unquestioned crater, will, I hope, procure my excuse, for entering into a minute investigation of the circumstances attending them, as related by the Abbé himself; and I will argue from his own facts alone.

Had this lava been melted in the crater, accompanied by an effervescence, and then a *retraite*, to which Spalanzani ascribes the formation of the pillars; it must have obeyed the laws of other fluids, and assumed an horizontal level: but never could have formed a narrow, vertical stripe, *the lava of which scarcely reached to the bottom of the crater.*

The material, too, of which these prisms were composed, is very important. Their base, Spalanzani says, was *petrosilex:* that he was well acquainted with such lavas; in all of which, the *petrosilex* bore strong marks of fire. On the contrary, the *petrosilex*, in these prisms, had not suffered the slightest alteration from the fire, *although it is very certain they had been fused.*

Now, this *certainty*, that these prisms had been fused, arises solely from the admission of the general position, that all articulated prisms were once fluid lava. Withdraw that admission, and then the total want of any mark of fire, on this *petrosilex*, is little short of demonstration, that it never had been in fusion.

For this we have good authority. Mr. Kirwan (Trans. R. I. A. Vol. V. page 7th) tells us, "petrosilex and other "fusible stones have a quite different aspect, when they "pass through a state of fusion, from that which they "present in their natural state."

These two circumstances, extracted from Spalanzani's own account of this horrible place (as he calls it), induce me to believe, that these prisms also (though found in so critical a situation, as the crater of an existing volcano), like the others, I have already mentioned, were antecedent to the first eruption.

Thus, it appears, that every fact, stated by the advocates for the volcanic origin of basalt, when minutely examined, leads to the same conclusion; that the basalts, supposed to be lava, existed, previous to the eruptions, or formation of the volcanos.

I would be glad to know, what ideas the advocates for this theory annex, to the terms they are perpetually using; *granitic lava*, *porphyritic lava*, or, as Spalanzani says, *petrosilex lava:* unless it be, that granite, porphyry, and petrosilex, were the mother stones, from the fusion of which, these lavas were formed; and, that the more common lava, generally called, by these gentlemen, *basaltique lave*, is merely fused basalt, as was first suggested, I believe, by Mr. Werner,

Hence, we can easily account for the resemblance between basalt and lava: and we are no longer surprised, that chemists have proved them to consist of exactly the same materials, and in the same proportions.

Whether Mr. St. Fond was aware, or not, that lava was merely fused basalt, I will not presume to inquire; as he is perpetually asserting the contrary. Yet, it appears rather extraordinary, that the truth of this proposition should have escaped him; as Mr. Werner could not have demonstrated it better, than Mr. St. Fond himself has done, in the fourteenth chapter of his "*Mineralogie des* "*Volcans*."

The title he gives this chapter is, "*Basaltes et Laves* "*compactes, passant à l'etat des Laves cellulaires:*" and he commences it, by pronouncing, "*les laves poreuses doivent* "*leur origine à lave compacte, ou basalte recuite.*" He then tells us, "*art peut imiter en petit, ce que la nature execute* "*en grand:*" which he explains, by shewing, that, while nature fuses basalt, and turns it into lava, in the craters of volcanos; art can do the same thing *en petit*, and change the basalt, of which lime-kilns are built, into porous lava.

This he confirms by a specimen, which, though the work of art, "*n'en est moins propre a repandre du jour sur* "*la theorie des laves poreuses.*"

His

His comment, upon this specimen, I shall also give, in his own words.

" *L'on voit dans cette echantillon, des parties, où la lave* " *est encore basaltique; tandis que le reste est entierement chan-* " *gée par l'action du feu, en lave poreuse.—Le passage du ba-* " *salte, et de la lave compacte, a l'etat de lave poreuse, est* " *ici fait par gradation.*"

I suspect this specimen of Mr. St. Fond, to be similar to the one, found by Mr. Whitehurst, at the Giant's Causeway, among the fragments of lava, as he calls our rubble, " a piece of iron ore, vitrified on one side: which " is some testimony, that the substances, supposed to be " lava, have, also, been in a state of fusion."

This must have been a paltry volcano of Mr. Whitehurst's, that could vitrify but one side of this fragment.

Dr. Troil, too, found, on the shore, in one of the western islands of Scotland, a fragment, as he says, " *exte-* " *riorly, full of holes, and, in a manner, burnt.*" This he sent, in great triumph, to Sir Torbern Bergman, as a proof, that volcanos had once burnt in these islands.

Had either of these gentlemen looked around them, they would soon have found the craters, in which their respective specimens had been acted upon, to wit, the ruins of *kelp-kilns*, with which the shores in both countries abound. Upon the walls of these, the fire produces the same effect on the basalt, of which they are built, as the same agent does, at Mr. St. Fond's *lime-kilns*.

An

An arch friend, amused at the discoveries these sagacious gentlemen were making, in natural history, gave me a neat view of the profile of the cliff, beyond the Giant's Causeway; with a *kelp-kiln*, burning on the Causeway itself, and people busily employed. Underneath, he gave the following explanation:

The natives, at the Giant's Causeway, making lava for Dr. Troil and Mr. Whitehurst.

A new theory has sprung out of the volcanic one; as maintained by Mr. Desmarest, and the other gentlemen, whose works I have just now observed upon. Of this theory, I cannot avoid taking notice; since it is warmly defended, in his Letters on Antrim, by Dr. Hamilton, who spent much time in our basaltic country; and also (as I hear) supported, from a chair in our university, by a gentleman, whose able discharge of his duty, as professor, has done him much honour.

This theory supposes basalt pillars to be formed, by crystallization, in the interior of the craters of volcanos; and not, as hitherto supposed, in the currents of lava. And Dr. Hamilton (Lett. VII. Part 2.) labours much to prove, that currents of liquid lava are totally unfit for the formation of crystals; while "*the interior of the mountain, at its* "*lowest base, beneath the surface of the earth,*" is admirably adapted for the purpose.

This new opinion seems to me to be founded, on a total dereliction of Mr. Desmarest's premises, and a pertinacious adherence

adherence to his conclusion. Had Dr. Hamilton forgotten, that the only proof ever given, of the igneous origin of basalt prisms, was, that they were found in actual currents of lava? Admit the validity of his arguments, that they could not have been so formed; and the question, whether basalt was once fluid lava? is to be taken up, *de novo*, not having as yet advanced a single step: for the aptitude of the new laboratories, which the advocates for this theory have discovered, proves nothing; unless they can also shew, that they have been actually employed, in the fabrication of such pillars and prisms.

Dr. Hamilton seems well aware of the necessity of this species of proof; and promises it to his readers, provided they will have patience: but, he says, "we must wait, "until those volcanic mountains, which, at present, burn "with so much fury, shall have completed the period of "their existence; until the immense vaults, which now lie "within their bowels, no longer able to support the incumbent weight, shall fall in, and disclose, to view, the wonders of the subterranean world: and then we may expect "to behold, all the varieties of crystallization; such as must "needs take place, in these vast laboratories of nature: "then may we hope to see banks and causeways of basalts."

I am sorry Dr. Hamilton has put off, to such a remote period, a proof, which would have effectually decided the question in his own favour. Many naturalists, who now take an interest in it, may happen to complete the period of their own existence, before they are favoured with such perfect

perfect demonstration; and, particularly, Mr. Hoepfner, of Viel, who was so anxious for the solution of this question, that he promised a premium, of twenty-five rixdollars, to whoever would satisfactorily resolve it. What a pity, should this gentleman be unfortunately carried off, before he had an opportunity of witnessing Dr. Hamilton's demonstration, and contemplating the magnificent spectacle he promises!

I do not insinuate, that he relies solely on the evidence to be produced at remote periods: for he tells us; "of such "phenomena as these, we have even some anticipation, in "the present living volcanos."

Thus, he says, "the mountain de la Coupe rests on a "columnar base; whose pillars have been laid bare, by "the impetuous torrents of the river Ardesche; whose "banks are formed of columnar basalts;" which, by this new theory, were formed in the bottom of the crater.

Here we have a happy instance of the dexterity, with which modern theorists select, from the same fact, such circumstances, as seem favourable to their opinions: never troubling their readers with those that make against them. For, though Dr. Hamilton refers us to Mr. St. Fond, for his account of this mountain, he takes no notice of the current of lava, which Mr. St. Fond traced from its crater to the plain; by which all the pavés about it were formed, as he says: and he both states, that basalt prisms were found in this current; and, also, in the view he gives of this mountain, and its current of lava, he exhibits the pillars, in the very current.

Of

Of this important fact, which Mr. Whitehurst quotes with triumph, Dr. Hamilton takes not the least notice; for, it would have been very awkward, when demonstrating the impossibility, of basalt pillars being formed in currents of lava, to have mentioned an instance, where Mr. St. Fond, whom he admires so much, had found them in an actual current.

As to the argument, drawn from Ætna and Mont de la Coupe, resting on columnar bases, I must observe, that, from the accounts, given by Mr. St. Fond and Mr. Dolomieu, of these mountains, it appears, that the whole country, surrounding the latter, was formed of columnar basalt; and, as to Ætna, Dr. Hamilton himself quotes Mr. Dolomieu, to shew, that, in its whole contour, basalt pillars were found, and that they formed a circular cincture about it, from twelve to eighteen hundred feet high.

Now, if we adopt Dr. Hamilton's theory, we must admit, that the whole country, round these volcanos, was once included in their craters; a concession, which the reader will not readily make.

Besides, Dr. Hamilton ascribes the formation of these prisms to *crystallization;* a principle totally different from that adopted by Mr. Desmarest and Mr St. Fond; who make the operations, by which they were formed, analogous to *desiccation;* and, like it, they seem to require exposure to the external air: and Mr. Kirwan has clearly proved, that basalt prisms do not acquire their regular forms

forms by crystallization; as the differences between them, and all known crystals, are numerous and essential.

I should now (as I do on similar occasions) proceed to shew, that, notwithstanding Dr. Hamilton's plausible arguments, *a priori*, the abrupt promontories of Antrim (whose *uncommon beauties*, as he tells us, page 147, second part, resemble what will be exhibited at the grand opening of his *vast laboratories of nature)* were not formed according to the principles of this theory.

But, as Dr. Hamilton has not given us any account whatsoever, of the volcanos, in whose craters *the mountain of* Dunmull, *the mountain of* Croaghmore, Fair-Head, *towering magnificently*, and *the lofty cliffs of* Magilligan, were formed; (and, to their summits, they are all composed of columnar basalt, by his own account;) I have no materials to proceed upon; and must, therefore, limit myself to one general argument, applicable to all other volcanic countries, as well as to our own.

The basalts of Auvergne are arranged in *plusieurs etages*, according to Mr. Desmarest. Mr. St. Fond applies the same phrase to Vivarais, and says, they were formed *a diverses reprises.* The account of Sicily is similar; and, with us, they are invariably disposed, in successive, distinct strata, which never could have been the result of fusion, in the crater of a volcano; as such an operation necessarily would have reduced them to *one* mass, *one* stratum.

PART III.

ARGUMENTS

AGAINST THE VOLCANIC ORIGIN OF BASALT,

DERIVED FROM ITS

ARRANGEMENT IN THE COUNTY OF ANTRIM,

AND FROM OTHER FACTS OBSERVED IN THAT COUNTRY.

CELEBRARE DOMESTICA FACTA, HORACE.

I HAVE, in the preceding parts of this Memoir, discussed most of the arguments, that have been adduced, by different writers, to support the volcanic origin of basalt: and I have examined the facts, stated by them, to try how far they apply to this question.

I now return to my own country, which seems more copiously furnished with curious basaltic facts, than any of those upon which foreign writers have dwelt so much.

The question (to us at least) is important; for it is the origin of the ground we live upon, that we are inquiring into: every particle of the surface of an extensive basaltic area, having merely a thin coat of most fertile earth, slightly covering basalt strata, accumulated upon each other to a great height; and, most frequently, as it were, bursting through this surface, and displaying, in perpendicular façades, the arrangement of the materials that support us.

 Whether

Whether these materials, so arranged, be formed by the hand of nature, in her original construction of the world; and thus our basaltic strata (in the language of naturalists) be entitled to the appellation of *primary:* or, whether this construction of our country is to be considered as produced by mighty agents, covering our quondam surface, with new, and *secondary* strata, poured forth from the bowels of the earth, is surely an interesting question, in the natural history of our country. And, as every writer, who has taken up the question, of the volcanic origin of basalt, and maintained the affirmative, has recurred to the county of Antrim for proofs; I hope that I, too, will be allowed to extract, from the same source, such proofs, as appear to me to support the negative.

In discussing this question, I shall abstain from all arguments *a priori*, and limit myself to *facts* alone: of which I hope to lay before the reader, several, that have escaped the notice of my predecessors; feeling, that I ought to make him some amends for having detained him so long, in a barren discussion of opinions, and an uninteresting detection of misrepresentations.

Before I proceed to compare the circumstances, in which our basaltic area resembles, or differs from, volcanic countries; I must answer a charge, that has been brought against me. I have been told, that it is presumption in me, who never saw a volcano, to take up a question, the solution of which must depend upon an intimate knowledge, both of basaltic, and volcanic countries.

I first

I first plead example; as not one of my predecessors, who have written upon this topic, has (so far as I can find) examined both volcanic countries, and our basaltic one.

I have also authority for saying, that an examination of existing volcanos is not very instructive. Mr. Kirwan tells us, Collini twice ascended Vesuvius, and witnessed its eruptions; but complains, he got no knowledge by it. Mr. Ferber's testimony is exactly similar. And, indeed, it is plain, that, in an eruption, the lighter materials first projected upwards; then, falling down, and accumulating upon the weightier, that had flowed in lava, must make it very difficult to trace arrangement: and this is the surest guide, in all questions relative to cosmogony.

Mr. Strange's observations on this topic are amusing: he lets out the secret, without knowing it, or availing himself of it. He says, "The phænomena of recent volcanos "are very little calculated to give us instruction. A few "days tour in Auvergne, Velay, or the Venetian State, "are worth a seven years apprenticeship at the foot of "Vesuvius or Ætna."

Mr. Strange was not aware, that Auvergne, Velay, and the parts of the Venetian state he alludes to, were originally basaltic countries, in which, afterwards, volcanos erupted. Here he found a rich variety of materials: for, besides the common volcanic substances, he found all the varieties of basalt, with the matters that usually accompany them, *ochres*, *zeolites*, *chalcedonies*, and *calcareous spar*; while

while at Ætna and Vesuvius, he met with burnt matters alone.

The points of view, in which I shall compare volcanic countries, as described by the most accredited writers, with our basaltic district, so often referred to, by the same authors, are:

First. The prominent features, and general resemblance.

Secondly. The different arrangement of the materials, in volcanic, and our basaltic countries.

Thirdly. Frequent change in the arrangement of the materials, in our basaltic country.

Fourthly. Striking and radical differences between our basalt strata, and all known currents of lava.

Fifthly. Substances found imbedded in our basalt, and never in lava.

Sixthly. Different effects produced upon foreign substances (particularly calcareous), when coming in contact with basalt, and with lava.

Seventhly. Divisibility of the mass into regular forms, essential to basalt, but never noticed in lava.

First. The general and leading features of volcanic countries are admitted to be, *isolated mountains*, generally conic, *truncated cones*, *vast craters*, with *currents of lava* issuing from them, which may be traced many miles. But, as all writers upon this topic candidly admit, that we have nothing similar in this country; I will not press the argument; nor enquire, whether their modes, of ac-

counting

counting for the want of these features, be satisfactory or not.

Secondly. If basalt be lava, and (as this theory supposes) once flowed from a volcano, we should expect to find it arranged in the same manner, with the currents of lava, which are contiguous to most known volcanos. But here the difference is most striking: for, while all writers, that describe volcanic countries, represent the ejected matters as confusedly arranged, and, altogether, a heap of disorder; with us, we observe, in the disposal of our basalt, the most consummate regularity: every separate stratum preserving steadily its own place, and never breaking into that of another.

Besides, most writers admit, that currents of lava are never parallel to one another: while our basalt strata, accumulated upon each other, preserve the most steady parallelism.

When we compare our accumulations of basalt strata, with accumulations of currents of lava, which have been heaped upon one another, by successive eruptions, we observe a most important difference. Currents of lava have always a layer of vegetable earth between them: this is admitted by all parties. For, while those, who wish to impeach the chronology of Moses, make a prodigious interval between the eruptions, necessary for the formation of this layer of earth; Moses's advocates prove, from facts, that it is often formed in a much shorter time.

Interposing

Interposing layers between currents of lava, being thus established, we are to look, if any thing similar can be observed between basalt strata: but no such thing is to be found. Our basalt strata, whether of the same, or of different varieties, pass into each other *per saltum*, without interrupting the solidity of the mass, or without exhibiting a particle of extraneous matter between them.*

Thirdly. I observed, in a former Memoir, that, on our basaltic coast, nature changes her materials, and the stile of her arrangement, every two or three miles; a fact, which opposes unsurmountable difficulties to the position, that the basalt strata, forming this coast, are of volcanic origin. I will select two or three of these numerous little systems, and state the order in which the strata are arranged in each of them, in a vertical direction; to give the advocates for their volcanic origin an opportunity of exerting their ingenuity, by shewing how they manage their

* I am aware, that the ochreous layers, or strata, lying between our greater basalt strata, may be stated, as contradicting this position.

The nature of these ochres (common to all basaltic countries) has given rise to much controversy; which were I to enter into now, I would be led too far from the present question. But, as this fossil makes a most conspicuous figure in many parts of Antrim, I think it well entitled to a place in the *statistical survey* of that county; the basaltic part of which I have undertaken, to oblige my friend, Mr. Dubourdieu.

On the present occasion I shall only say, that I accede to the conclusion, which Mr. St. Fond adopted, after long doubt, and much puzzling; to wit, "*That these ochres were pure basalt, altered by some chemical operation of* "*nature, with which we are unacquainted.*"

their volcanos, to make them produce such diversified effects.

From Dunluce to Seaport, the façade (here the base of the arrangement) is composed of strata of tabular basalt; upon which are accumulated, up to the summit of Dunmull, columnar strata, mixed with others, of the variety called *irregular prismatic*.

East from Carrickarede, the base of the façade is white limestone: upon which, as long as it continues perpendicular, we find ochreous and columnar strata alternating; while the hill of Knocksoghy, above, is an uniform alternation of columnar and irregular prismatic.

The strata, forming the promontory of Bengore, are more irregularly mixed: six of tabular basalt, five columnar, of four different varieties, three ochreous, and two irregular prismatic, sixteen in all; of which, after the tabular, that forms the base, no two of the same kind are contiguous to each other.

The volcanist will see, that he must find a distinct volcano for every separate little system, surrounding our area; and that he must make the same crater emit different varieties of lava, and frequently by alternation.

Fourthly. An examination of our basalt strata, taken separately, and so compared with distinct currents of lava, will, I apprehend, turn out as little favourable to their volcanic origin, as the comparison of their masses appear to do.

 Whoever

Whoever has read Mr. Desmarest's Memoir, or even my quotations from it, must admit, that, if his theory be well founded, all our basalt strata must have once been currents of liquid lava; and, of course, should resemble those known to have issued from existing volcanos. But, I apprehend, instead of similarity, the most decided differences will be found between them.

Currents of lava, we are told, are always narrower and deeper, in the vicinity of the crater; broader and shallower, as farther removed from it: but our basalt strata are of uniform thickness in their whole extent.

There is another point of view, in which the difference, between basalt strata, and currents of lava, is still more decided. Sir William Hamilton, Ferber, Spalanzani, and even Mr. Desmarest himself, inform us, that, in all currents of lava, the materials composing them are invariably arranged, in a regular gradation, according to their specific gravities: thus, at the lowest part of the current, compact lava, then cellular lava, then scoria, next cinders, and lastly, volcanic ashes. But, in our basalt strata, nothing similar is observed: the material is uniform; both density and specific gravity the same, through the whole thickness of our deepest strata.

Fifthly. That basalt never was in fusion, appears plainly, from the substances found in it, and never in lava; and which, from their nature, could not have sustained the heat of a volcano.

Of

Of these, zeolite, chalcedony, and calcareous spar, seem to abound in the basalt of all countries, but never have been noticed in unquestioned lava. The first fuses, and the third calcines, in a very moderate heat; and, though chalcedony be more refractory, yet exposed to a strong heat, it loses its beauty, and the delicacy it exhibits in its natural state. These substances are most copiously dispersed, also, through our basalts; but, as this topic has already been often urged, I will pass on to substances, peculiar to my own country.

A variety of basalt, found in abundance at Portrush, and the Skerrie Islands, is full of pectinites of belemnites, and, above all, of cornua ammonis: these are dispersed through the whole mass, equally abundant in the interior, and on the surface. This basalt vitrifies, and the marine substances, it contains, calcine, in the fire of a common salt-pan; of course, never could have sustained a volcanic heat.

Another fact occurs, which seems decisive against the volcanic origin of basalt. Some varieties of this fossil, contiguous to Portrush and the Giant's Causeway, upon being broken by a sledge, discover, in their interior, cavities, some filled with fresh water; others bearing evident marks of having once contained it. Of these basalts, some were of a different variety from that of the Giant's Causeway, but of similar grain and hardness; others were precisely of the same variety, *columnar*, *prismatic*, *articulated*, and exactly the same in grain. At the Causeway

 itself,

itself, I never found any; but, in some basalts very near it, on the west side, I have met with it: these had fallen from an upper stratum.

A most respectable correspondent, to whom I communicated this fact, as new in natural history, tells me, he suspects, the water passed in by percolation. Determined to pay all attention to any thing, suggested from such high authority, I took my friend, Mr. Joy, to the spot, where I used to find the water in the greatest abundance (Ballylagan). We broke several stones, and, where we found water, observed, that, at first, it wet the whole fracture evenly; but, as it evaporated gradually, the wet was confined to cracks, diverging from the little cavity that had contained the water. These, therefore, we at first supposed, must have been the passages, through which the water had made its way: but, on attentively examining the cracks, we perceived, that, as they radiated from the cavity, they diminished in breadth, and finally terminated in the solid stone; of course, that the water had not come in by them.

Another fact seems conclusive against percolation. I never found, in our basalt, any cavities, but those which contained water, or which bore evident marks of having been once filled with it. We have, therefore, this alternative:

Either the water first made its way through the compact tissue of the basalt, then collected, and dilated itself with such force, as to form rounded cavities, often larger

larger than a pistol bullet, which, on many occasions, it afterwards forsook:

Or, we must admit the water to have been coeval with the basalt; to which, of course, we cannot ascribe an igneous origin.

Sixthly. As we know the high state of ignition, in which lava issues from a volcano, it is reasonable to expect, that, when, in its course, it meets with extraneous substances, it should produce upon them such alterations, as are the usual effect of intense heat, applied to these same substances. Basalt, likewise, is often found in contact with similar matters. Hence, by a minute examination of these contacts, we have an obvious mode of ascertaining, whether the basalt also had encountered them, in the same state of ignition, we know the lava did.

As my country, to a great extent around me, is composed of nothing but basalt and limestone, I have no other substance but limestone, upon which I can make observations. This, however, I apprehend, will be found abundantly sufficient, to decide the question.

About one hundred yards from the beautiful cavern, called Long Gilbert, near the eastern extremity of the calcareous façade, a mile from Portrush, we find, half way up the precipice, a vast basaltic rock, inserted in the middle of the limestone mass; and, at the contact, so united to the limestone, as to form, with it, but one solid mass.

The

The peninsula of Kenbaan, near Ballycastle, is the spot, where basalt and limestone come in contact in every possible way. Pieces of limestone of all sizes, imbedded in the basaltic mass, and similar fragments of basalt, dispersed in like manner through the limestone; and, in the precipice above, strata of basalt, and limestone alternating. Here the opportunities, of examining the contact of basalt and limestone, are numberless; and, on every occasion, I found them united solidly; the line of demarcation correct, as if drawn by a pencil; not the least trace of calcination, such as might be expected from the calcareous matter, coming in contact with so glowing a mass, as this theory supposes our basalt to have been.*

This unexpected circumstance has somewhat embarrassed the volcanists; who, to account for it, have been driven to various exertions of their ingenuity: but not one of them seems ever to have inquired what was the result, when calcareous matters came in contact with actual lava, as it flowed. Here an obvious mode presents itself, of deciding the question, whether basalt and lava have a common origin. For, if their contacts with calcareous matter produce the same effects upon it, we have a strong presumption in favour of the affirmative. On

* The result of my observations, on the contacts of basalt and limestone, perfectly correspond with those of Mr. St. Fond, in Vivarais. (Min. des Volcans, chap. 13.) Dr. Hamilton, I admit, saw things in a different point of view; but, as he does not refer us to the places, where he examined these contacts, I cannot bring the point to issue in my country.

On the contrary, should the effects turn out to be totally different, we have a conclusive argument in support of the negative.

Whether this mode, of bringing the question to issue, did not occur to the gentlemen, who support the volcanic origin of basalt; or whether they did not like to commit a favourite theory to so rude a test, I will not presume to conjecture. Direct evidence, with a view to the question, I admit, I have none; yet, by an attentive examination of different writers on volcanic subjects, I find pretty good light is thrown upon this topic. The evidence I will adduce, is, I confess, indirect, and the mention of the subject incidental: yet I do not, therefore, give it less weight; for, since I engaged in polemic natural history, I have discovered, that a reliance on positive assertion, is not the surest mode of obtaining truth.

The first evidence I shall produce, to the effect of actual glowing lava, upon calcareous substances, is that of Lord Winchelsea: whose letter to King Charles II. (quoted by Sir William Hamilton), giving an account of the great eruption of Ætna in 1669, says; "Where the streams of "lava meet with rocks and stones of the same matter, "(as many are), they melt, and go away with the fire. "Where they meet with other compositions" (calcareous, no doubt), "they turn them to lime or ashes."

Mr. Ferber's testimony on the subject is decisive. He gives us, in his eleventh letter, a catalogue of ejections from Vesuvius; of which No. 6 is, by his account, "white

" white limestone or marble, in loose pieces; some burnt " and calcined." He observes, " they are found, likewise, " in the ashes and lava, and then constantly calcined and " farinaceous." Again, Letter 14, he says, " at Monte " Albano, the lava, as well as the piperino, contain cal- " cined fragments of limestone."

Tozzetti di Targioni, in his elaborate account of the mineralogical productions of his own country, confirms Ferber's testimony, as to the uniform calcination of calcareous substances.*

Since, then, glowing lava uniformly calcines the calcareous substances it comes in contact with, and basalt produces no effect whatsoever upon them; are we not to conclude, that it did not encounter them in a state of fusion? which is the point in question.

Seventhly. Upon the last difference I shall mention, between basalt and lava, I must dwell a little longer: both because it seems radical and essential; and also, because it lays open some new and curious facts, relative to basalt, which have hitherto escaped notice.

I allude

* Tozzetti is full on the subject. He says, (page 448, Vol. IX.) " Se " materiali sieno di natura *vitrescenti*, formeranno lave *vetrine*, se *calcarei* o " *apiri*, le formeranno *polverose*."

Page 250. " In essi (lave vesuviane) si vedono misti materie vetrificate, " con materie calcinate, e con altri quasi non punto tocche dal fuoco."

Page 252. " Il fuoco volcanico, nelle vescere della montagna di San " Fiora, abbia offeso—fuse le massolette di metalli, e calcinate o vetrifi- " cate, secondo la loro attitudine altre sostanze."

I allude to that property, which all basalt strata, that I ever examined, have, of dividing or separating into regular forms, generally with plain sides. For, that this is a principle inherent in the mass, and coeval with its original formation, is obvious, from the striking difference between the plain brown side of the figure, and the irregular, granular fracture, generally blue or grey: the former an arrangement of nature, the uniform effect of a cause, with which we are unacquainted; the latter the irregular effect of a violent stroke or impulse.

If the theory we are discussing be well founded, all our basalt strata were once currents of lava, flowing from volcanos. For this we have the authority, or, rather, the assertion, of the founder, and the most accredited supporters of the opinion. In substances, therefore, by their accounts, exactly the same, and of the same origin, (for they use basalt and lava as synonymous terms,) we have a right to expect similar properties; and to look for in lava, an internal arrangement of the mass into regular forms, conformable to what we meet with in all basalts. But nothing similar has been observed in lava, and the description of the Volvic lava is irreconcileable to this property; for we are told it breaks in all directions, *casse en tout sens:* and Mr. Desmarest himself mentions this, as a mark of distinction, between it and the neighbouring basalt.

In distinguishing the varieties of lava, we have a clew to guide us. We know the process by which it was

 formed:

formed; and often, upon inspection, we can discover the original material, the mother stone, by whose fusion it was made. The operation itself, too, enables us to make new distinctions, from the different intensity of heat, and different gradations in cooling.

On the contrary, we get little information from inspecting the fracture of basalt. We can tell, that in some, the constituent materials are more completely blended, than in others: which seems the same thing as to say, there is much difference in grain; a great interval between the coarsest and the finest. But all this is by insensible shades; no such thing as drawing lines, by which we can mark the varieties of this fossil. Even where other differences are most essential, between the varieties of basalt, inspection cannot be relied upon. For instance, the siliceous basalt, full of marine exuviæ, passes, by gradation, from a grain, as fine as jasper, until it becomes indistinguishable from the Giant's Causeway stone, and even coarser.

If we look to nature for assistance, in classing the varieties of basalt, we will be no longer at a loss: we will find, she has impressed an indelible character on each variety of this fossil; a specific figure, into which every stratum is divisible, in its whole extent: being formed, as it were, by an agglutination of similar figures;* in the same stratum,

* I do not use the word *similar*, in a strict mathematical sense; meaning no more than a strong, general likeness, so decided, that the figures of one variety cannot be mistaken for those of another.

stratum, all of nearly the same degree of perfection; but, when we compare different strata, of the same variety, the perfection or neatness of the work varies, until it passes into an amorphous mass.

Nature seems to have provided, as carefully, for the preservation of the distinctive characters, of the different varieties of basalt, as she has done, to prevent confusion in the several tribes of the animal and vegetable kingdoms. We see our basalts often, by gradation, losing their own forms, but never assuming that of another variety; and, in the last stage of evanescent form, we can trace an effort to preserve their own appropriate figure. This is very observable in our columnar basalt, and in the long horizontal prisms of our whyn dykes.

I can also trace something like a generic difference, between the varieties of our basalt: for some of them have but one principle of construction, to wit, the external, visible forms; into which, upon the slightest inspection, they appear to be divided: no internal construction; the fracture irregular, and generally conchoidal. The basalts of this class are, the columnar, the irregular prismatic, and the tabular. I have not been able to discover subordinate forms, or an internal construction, in any of these basalts.

Other varieties, on the contrary, are regularly arranged internally; the large prism breaking into smaller, sometimes to a great degree of minuteness, as in the Portrush siliceous basalt. The coarse Portrush basalt, whose prisms are mostly quadrangular, and the unarticulated pillars of Ballylagan, have, likewise, the same property, in an inferior degree; while the basalts of our whyn dykes have often their subordinate prisms finished with great neatness.*

But the forms, into which our basaltic masses divide, are, by no means, limited to prismatic alone. The pyramid is a common figure in our whyn dykes; and the most perfect joints, of the Giant's Causeway pillars, partake both of the prism and of the pyramid, and have also a mixture of curve, and plain surfaces: the latter in number equal to the denominator of the figure; while the former amounts to double that number, plus two. Thus, a pentagon joint, taken from one of our most perfect pillars, has five plain, and twelve curve surfaces; but curve surfaces are irreconcileable, either to *crystallization* or *desiccation.*†

We have another variety of basalt, whose surfaces external,

* This subordinate construction is well illustrated, in a drawing of three prismatic stones, taken from a great whyn dyke (now used as a quarry), nearly two miles west from Belfast.

The constituent figure here, is a triangular prism, whose angles, at the base, seem double the angle at the vertex.

My ingenious friend, Dr. M'Donnel, to whom I had mentioned the curious construction of our whyn dykes, was so struck, when he saw the prismatic stones, of which this dyke is formed, extracted from the quarry, that he employed a painter, to make a drawing of some of them; and he was so good as to give me a copy.

† The acute-angled, triangular *pyramids*, which ascend from each angle of the joint, and often reach up to the middle of the incumbent one, have their

ternal, and, if I be allowed the expression, internal, are all curves: its form is round, and it is composed of concentric spheres, like the pellicles of an onion.

This variety Mr. St. Fond himself admits not to be of volcanic origin. He says, (Min. des Volc. page 46,) *it must have taken this configuration naturally.* Its mode of arrangement, in the places where it is found, seems still more extraordinary. It is generally imbedded in an indurated basaltic paste; in Mr. St. Fond's language, *incorporeé et encastreé dans des massifs de basalte informe.* In this state, it is sometimes built in the form of a wall; of which the globular

their insides sloped away, in an hyperbolic curve; while the grooves, in the lower part of each joint, adapted to receive these, with similar curvature, added to the former, make twice as many curve surfaces, as the figure has angles. The concave and convex bases add two more; but, by Sir Torbern Bergman's definition, crystals are bounded by *plain surfaces.*

These facts cannot be exhibited in distinct joints; for, the cohesion is so strong, that the ascending pyramids invariably break off, as the joints are separated from the pillar. It is the projecting fracture that remains, which gives the joint the appearance of a *mural crown*, as was observed by the early writers on the subject.

The destruction of these ascending pyramids, makes the separate joint totally different from what it was, when existing in the perfect pillar.

To illustrate all this, I give a drawing of two pillars: one, as it appears, when long exposed to the air, which acts principally upon the joints; while the dilatation and contraction, from heat and cold, loosens the pyramids, and separates them from the pillar.

The second pillar exactly represents the state in which they appear; where the mass is lately quarried into, and the air has not had time to operate.

I add some joints in their natural state. This nicety of construction abates, as the pillars graduate through imperfection, to an amorphous mass; yet occasional traces of it are long observable.

bular basalt is the stones, and the unformed the cement.

I have great reason to believe, that the varieties of basalt, in other countries, are exactly the same as in our own; and that nature has taken the same pains to keep them distinct every where.

The columnar basalt, of all countries, corresponds precisely with that of the Giant's Causeway, and our other groups, as appears from the sameness of their curious articulations.

Our irregular prismatic exactly answers the descriptio of the basalt, incumbent on the columnar at Bolsena, as given by Ferber. It is obviously similar to those at La Trezza and Pont du Baume; and Mr. Mills's view of the isolated basaltic rock, at Ardlun (Phil. Trans. 1790), accurately represents this variety, in many façades, near the Giant's Causeway.

Sir Joseph Banks's account of the stratum, incumbent on the columnar, at Staffa, might serve for our irregular prismatic, in most places; and, the moment I shewed my friend, Mr. Joy, our neat pillars at Craigahuller, he perceived the striking likeness between the stratum, incumbent on them, and that covering the grand colonnade at Staffa.

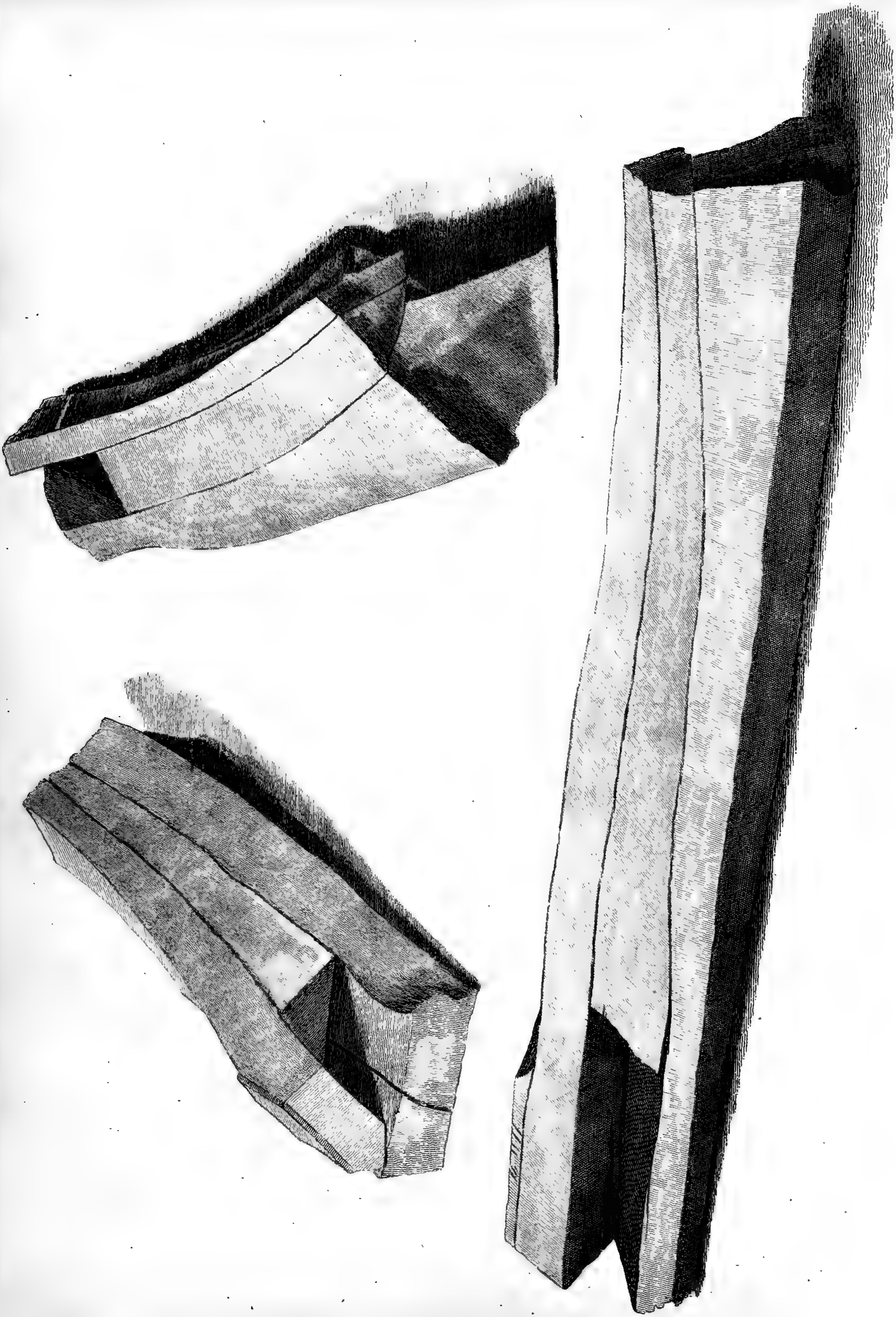
The slight accounts we have, of the Scotch whyn dykes, shew, that they are formed, like our own, of horizontal prisms.

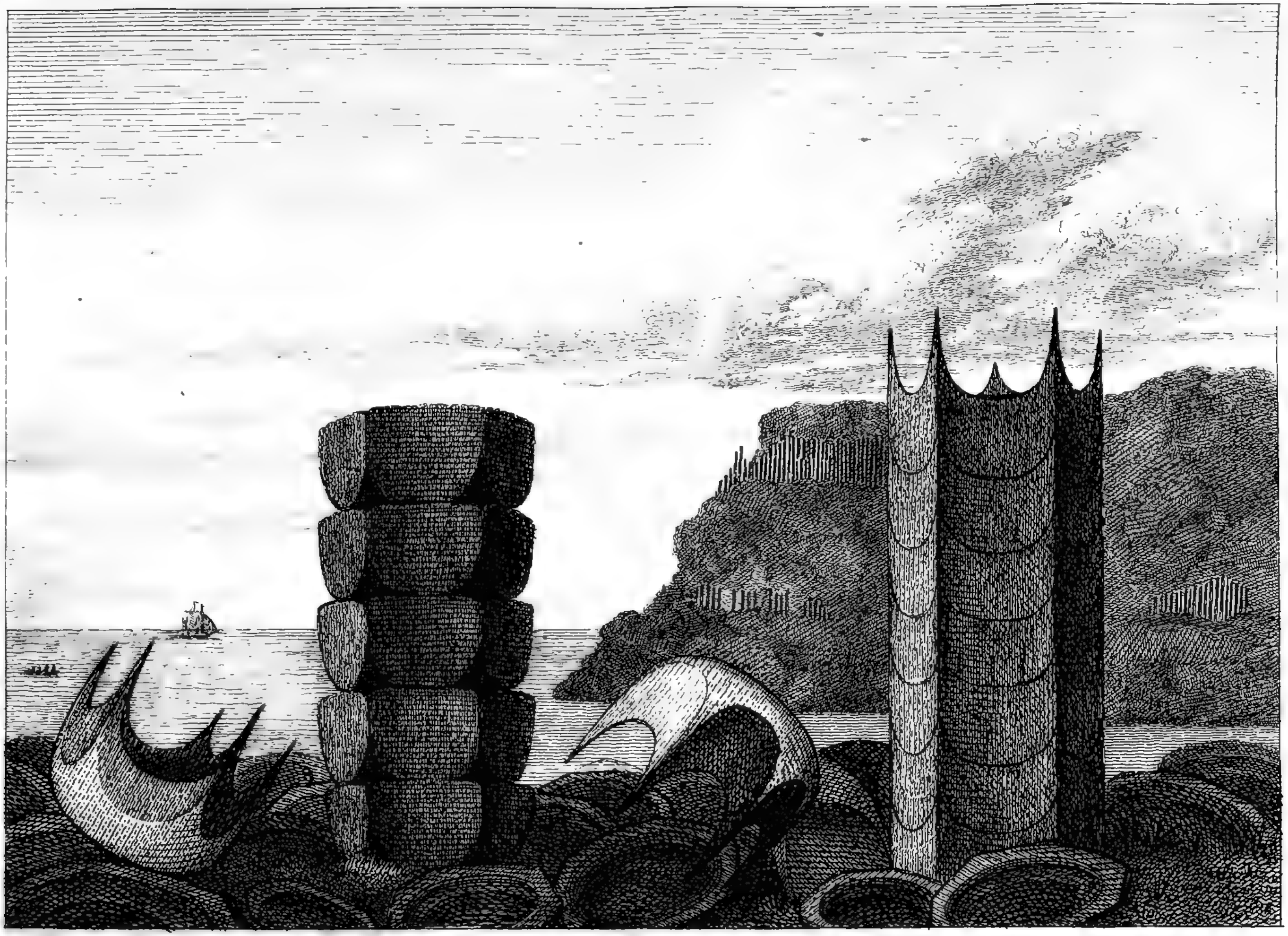
And our globular basalts, with concentric spheres, so curiously imbedded, as we find them, at Port Cooan, near the Giant's Causeway, and lining some whyn dykes, at

Belfast

Belfast Lough, are precisely the same with those, taken notice of by Mr. St. Fond, at Ardenne, at Cheidevant, at Montbrul; and also by Mr. Strange, in the Venetian state.

Until the advocates, for the volcanic origin of basalt, can discover, in lavas, something corresponding to these curious circumstances, attending our basalts; can they persist in pronouncing them to be identically the same? The one (if I may be allowed to use the expression), a *factitious* substance, of known, and posterior formation; the other, bearing evident marks of the hand of nature, both in its general arrangement in mighty strata, and also in its numerous varieties. For we know, that nature delights in diversifying her operations; and in executing, what seems to us, the same work, in many different ways.





ON COMPARATIVE MICROMETER MEASURES.

IN A LETTER

FROM THE REV. DR. J. A. HAMILTON, DEAN OF CLOYNE,

TO THE REV. J. BRINKLEY, F.R.S.

DEAR SIR, READ, FEB. 4th, 1805.

OBSERVATORY, ARMAGH, JAN. 10, 1805.

I BEG leave, through you, to communicate to our Academy the following paper, on comparative observations made with different kinds of micrometers; which, I hope, may be deemed worthy their notice. It was suggested to me, so long since as in the year 1794, that a comparative view of the result of the measures, made under similar circumstances, of the diameters of the heavenly bodies, with the different kinds of micrometers, that are now most generally used by astronomers, might have considerable use; as well in confirming the determinations of the values of the diameters, as given by former observations, as in deciding on the merits of the different instruments, and shewing, at one view, a sort of harmony of micrometers. My own opinion, on this subject, entirely coinciding with that of the learned friend, who made this proposal, I set about making comparative observations of the measures of the sun's diameters,

meters, as taken with the old wire micrometer, made in the best manner, by Mr. Dolland; with his divided object-glass micrometer; and with a ten-inch reflecting sextant, executed, in a very capital stile indeed, by Messrs. Troughton.

Before I proceed to the detail of the observations, it may be proper to premise a short account of the nature and adjustments of the several instruments, that were the subjects of this experiment. The wire micrometer, as its name denotes, measures intervals, by the separation of two moveable wires: these wires should perfectly coincide, when the index of the scale marks 0 or zero: and the quantity of the separation of the wires, made by the turning of the screw which effects it, is denoted by revolutions, and parts of revolutions, of the index, over a graduated circle, attached to the micrometer's screw; which, in this instrument, consists of fifty sub-divisions. There are several ways of ascertaining the values of these revolutions and sub-divisions, in arcs of a great circle in the heavens. The method which I adopted was this: the microscope being fitted to an achromatic telescope, on an equatorial stand, I carefully separated the wires by fifteen exact revolutions; and then turning round the whole system, till a fixed wire, at right angles to the measuring wires, was in a plane parallel to the equator, I measured, by the sydereal clock, the time the sun's limb, and various fixed stars took, to run along the fixed wire, from centre to centre of the measuring wires. This trial was very frequently and repeatedly made; and the stars and sun's limb, being all reduced to the equator, the

general

general result gave 121″,1, for the equatorial interval of the fifteen revolutions. This interval, reduced to space, made each revolution of the figured head = to 2′ and 1″ of measure; and, of course, each of the fifty sub-divisions = to 2″,42 nearly of an arch of the equator. In making the subsequent measures of the sun's diameter, or that of any other celestial arc, the measure was always finished, by moving the wire in the direction in which the fifteen revolutions were originally made. The advantage of this micrometer is principally this: that, in adjusting the telescope, and the micrometer wires, to distinct vision, no alteration is made, by the difference of the conformation of the eye, or of focal distance, that suits that of the observer, in the value of the arc to be measured. The principal defects of it are: the difficulty of judging accurately of bisections, or contacts of the fine wires, by the limbs to be measured; and the impossibility of observing any diameter, except the one perpendicular to the equator.

The object-glass micrometer is an instrument, now so familiar to every person conversant in the use of astronomical instruments, that it is only necessary to say, that mine was made, and adapted to a triple object-glass achromatic telescope, of 42 inches focal distance, by Mr. Dolland, and its scale very carefully verified by himself; and that the scale is, as usual, divided into inches, 10ths, 20ths, and vernier divisions: that, when it is applied, it lengthens the focal distance of the telescope about 6 inches; thus making it 48 inches, or 4 feet focal distance.

 The

The advantages of this species of micrometer are: the large scale, the fine images formed, and the facility of measuring diameters in every possible direction. Its imperfections are: that, to different eyes, and under different circumstances of the same eye, the length of the focal distance, that suits distinct vision, will vary; and, of course, the quantity of the measures, given by the scale, are liable to a small variation. The goodness of the telescope is, also, in some degree, impaired, by the application of this contrivance of a divided object-glass.

It should be noted, that the wire and object-glass micrometers, were both adapted, in their turns, to the same achromatic telescope; and the comparative observations made as near to each other, in point of time, as possible.

The diameters of the sun, measured by the ten-inch sextant, were taken with a small achromatic telescope, magnifying about twelve times, and were observed on the limb, and on the arch of excess, several times alternately; the measures being always finished in the same direction of the micrometer's screw: and the quarter of the double measure was used as the semidiameter, with the addition of 3″; which is the known diminution of the image of the sun's semidiameter, after the reflections and refractions it undergoes in the process. As the three kinds of micrometers, just described, are so completely different from each other, in their construction, adjustment, and mode of mensuration, I consider them as fully sufficient to make an experiment on the probable consistency of the results which may be obtained

obtained from different good micrometers; and shall now proceed to give a detail of the actual observations.

1794.		S. Dr. ☉.	Semidiameters of ☉, as given in the Nautical Almanack.
August 26,	D. O. G. Micr.	15′. 53″,835	15′. 53″,52.
	Wire Micr.	15′. 54″,03	
Septr 3,	D. O. G. Micr.	15′. 56″,01	15′. 55″,4.
	Wire Micr.	15′. 55″,9	
	A set of ten, all agreeing on the sextant, on the limb, and arch of excess	15′, 55″,0	
Septr 11,	D. O. G. Micr. 3. 5. 1. 19. (I. T. S. V.)	15′. 56″,54	15′. 57″,4.
	Error of V. + 2.		
	☉ S. Dr. W. Micr. 15. 41. (R. D.)	15′. 57″,1	
	Sextant, 15′. 55″. + 3″.	15′. 58″,0	
Septr 17,	Dr of ☉ 15. 43. (R. Ds.) W. Micr.	15′. 58″,3	15′. 58″,9.
	Sextant,	15′. 59″,3	
Septr 27,	D. O. G. Micr	16′. 1″,85	16′. 1″,7.
	Wire Micr	16′. 1″,95	
	Sextant + 3″,	16′. 1″,70	

1794,		S. D^{r}. $\odot$.	Semidiameters of $\odot$, as given in the Nautical Almanack.
Oct^{r} 4,	D. O. G. Micr^{r}.	16′. 3″,76	16′. 3″,6.
	Wire Micr^{r}.	16′. 4″,1	
Oct^{r} 6,	Sextant + 3″,	16′. 3″,0	

The wire micrometer measures, taken from this time till the next vernal equinox, are omitted; inasmuch, as being taken nearly in a vertical circle, the excess of the effect of refraction on the sun's L. L., required a correction from the tables of refraction; which is liable to some degree of uncertainty at low altitudes. They were found, however, to agree very nearly.

Dec^{r} 14. By a set of measures of the sun's diameters, on the limb and arch of excess, taken, with great care, parallel to the horizon, images extremely distinct, and no discernible spring whatever in the index.

	$\odot$'s S. D^{r}. + 3″ =	16′. 18″,0	
Dec^{r} 15,	D. O. G. Micr^{r}.	16′. 17″,83	

			Semidiameters of $\odot$, as given in the Nautical Almanack.
Dec^{r} 29,	D. O. G. Micr^{r}.	16′. 18″,9	16′. 19″,2.
	Sextant + 3″,	16′. 18″,0	

1795.			
Feb^{y} 16,	D. O. G. Micr^{r}.	16′. 13″,45	16′. 13″,7.
	Set of good observations with sextant,	16′. 13″,0	

1795.

March 30th and 31st. Day very favourable; various sets of measures taken with divided object-glass and wire micrometers. The extremes of the divided object-glass micrometer measures never exceeding 1″. Those of the wire micrometer 0.

	S. Dr. ☉.
D. O. G. Micr.	16′. 2″,45
* Wire Micr.	16′. 1″,9

June 8th. The two different micrometers were applied to the 42-inch achromatic telescope, and the scales verified.

			Semidiameters of ☉, as given in the Nautical Almanack.
Same day,	D. O. G. Micr.	15′. 46″,95	15′. 48″,1.
	Wire Micr.	15′. 46″,45	

June 9,	D. O. G. Micr.	15′. 46″,95	15′. 48″,0.
	Troughton's sextant + 3″,	15′. 48″,0	

June 15,	D. O. G. Micr.	15′. 45″,9	15′. 47″,4.
	Wire Micr.	15′. 46″,7	

* This curtation of the sun's semidiameter is the effect of the difference of refraction of the L. L. of the sun from the upper.

1795.
June 19. The measures, with the different micrometers, were taken with the greatest care; and a mean of internal and external contacts, of the sun's limb to the micrometer wires, was used as the measure of the sun's disk by the wire micrometer.

	S. Dr. ☉.	Mean apogeal semi-diameter of the sun.	Semidiameters of ☉, as given in the Nautical Almanack.
D. O. G. Micr.	15′. 45″,26	15′. 46″,38	15′. 47″,0.
* Wire Micr.	15′. 47″,505		

The sextant, on June 25th, shewed, from a careful set of measures, the apogeal semidiameter of the sun, 15′. 44″.

On attending to the difference of the sun's apogeal semidiameters, as shewn by the divided object-glass micrometer, and the wire micrometer, I had recourse to some former astronomical records on this subject. By referring to De la Lande's Astronomy, article 1387, I find, that, in the year 1758, De la Caille observed the apogeal semidiameter to be 15′. 47″,2; and that De la Lande, in 1760, made it 15′. 45″,25.

These two measures happen to correspond so exactly with mine, as made with the different micrometers, that it may be a matter of some consequence, to enquire, what kind of

* This measure comes nearer to the calculated apogeal semidiameter of the sun than the former; but as, at the making of these observations, the state of the air caused the sun's limb to undulate, perhaps the divided object-glass micrometer, having a much greater magnifying power, than was used with the wire micrometer, its observations may have been rendered more uncertain.

of micrometers they used to deduce their respective semi-diameters.

It is unnecessary to extend these observations any farther. I shall, therefore, only add to this paper, that it will appear, by comparing the divided object-glass micrometer's measures of the sun's diameters, of December 15, 1794, and of June 19, 1795, that the difference of the perigeal and apogeal diameters of the sun was found to be 65″,14. De la Lande found this difference 64″,8. but he calls it, in round numbers, 65″.

Note. Where no notice is taken of the time of observations, it is to be understood they were taken very near to noon, and as soon after each other as micrometers could be changed.

The originals of these observations, and several others, are to be seen in the registry of observations kept at the Observatory, Armagh, for the years 1794 and 1795.

I have the honor to be,

DEAR SIR,

Your faithful and obedient servant,

JAMES A. HAMILTON.

OBSERVATIONS ON THE METALLIC COMPOSITION

FOR

THE SPECULA OF REFLECTING TELESCOPES,

AND THE MANNER OF CASTING THEM:

Also a method of communicating to them any particular conoidal figure: with an attempt to explain, on scientific principles, the grounds of each process: and occasional remarks on the construction of telescopes.

BY THE REV. JAMES LITTLE.

READ, FEB. 4th, 1805.

THERE are but few things produced by the united effort of mechanical artifice and intellectual labour, which have done more honour to the ingenuity and invention of man, than the reflecting telescope; which has many advantages over any of the dioptrical kind, notwithstanding their improvement by achromatic glasses. It will bear a greater aperture, and may be made to magnify more, (as being more distinct,) in proportion to its length, than the others, as they are at present made; and its dimensions and powers are unlimited. What its excellence is, especially the Newtonian construction of it, has been proved by Dr. Herschell, to his own honour, and that of the age, and country, and patronage, which encouraged his labours. Accordingly, the persons, eminent for science and mechanical ingenuity, appear to have felt a peculiar and disinterested pleasure, in

 contributing

contributing to its improvement: and the late discovery of a metallic composition for the mirrors of it, which will bear as high a polish as glass, reflect as much light as glass transmits, and endure almost equally well, without contracting tarnish, is a farther encouragement to prosecute its improvement to perfection.

Among others, I had formerly, from admiration at its contrivance, bestowed some attention on the mechanism of this instrument: and, as it would have spared me some expence of time and trials, if any other person had previously suggested to me the hints, which I am to relate; I imagine they will be of use to others, in directing or assisting the course of their labour, in the same pursuit. I had also taken some pains, to understand the merits of the different constructions of this telescope: but, as this enquiry ended in a conviction, that the Newtonian form of it is the most perfect that can be hoped for; (it being the nature of its great author, to persevere in his researches, till he had arrived at a complete solution of his doubts, and comprehension of the subject;) so I have only to report what resulted from my experience in the mechanical fabrication of it, as to the method of casting the mirrors, and communicating to them the proper figure.

Before I had heard of the improvements of the Rev. Mr. Edwards, in the composition of the specula for telescopes, I had made many experiments myself with that view; which lead me to give full credit to his report of the superior excellence of that composition which he recommends: because I

had

had found, that the qualities of hardness, whiteness, and indisposition to contract tarnish, necessary to a speculum, could not, by any admixture that I could hit upon, be produced, unless the metal were so highly saturated with tin, as to be excessively brittle; and because I found that this brittleness, however inconvenient in some respects, was necessary to render it susceptible of the highest polish: for no metal yet known, except steel, (which, from its disposition to rust, is unfit for this purpose,) will take as high a polish as glass will, unless it be more brittle than glass. And indeed this property is common to all substances which we know, that are capable of such polish: they must be very hard, and, as such, brittle; for the polishing powder employed would stick and bed itself in any soft metal, instead of cutting and polishing it.

From the result of my trials, I contented myself with the composition mentioned hereafter, as being in every respect sufficient for the purpose, and inferior to none in whiteness, lustre, and exemption from tarnish: for, as to the addition of silver, I found that, when used even in a very small quantity, it had an extraordinary property of rendering the metal so soft, that I was deterred from employing it: and unless it shall be found that, without this effect, it makes the metal less porous than otherwise it might be, or less frail and brittle, I am certain that it may, in every other respect, be dispensed with. I had no opportunity to try it, in the precise quantity Mr. Edwards recommends, (though I did so before, in very nearly that proportion,) since I first saw his memoir on that subject. Sir Isaac Newton made trial of a very small portion of it, and found the same effects from it as I experienced: but it is possible, that, if it were added in the just proportion discovered by Mr. Edwards, it would be an improvement, and useful ingredient, in the composition.*

I must observe here, that a metal, not liable to contract tarnish from the air, is otherwise susceptible of it accidentally; when there happen to be minute holes in its surface, caused by the air, or sand, &c. in casting it. Such cavities will be filled with the dust, or rusty solution of the brass, in grinding; which will, in time, become a sort of vitriol, and act on the contiguous parts of the speculum, producing a canker in it, which will spread, in form of a cloud of tarnish, around each cavity. In such a case, to prevent this, I would advise, to lay the mirror, as soon as polished, in warm water, and, after drying, while it remains heated, to rub it over with spirit-varnish; from which it may be cleansed, by a piece of fine linen dipped in spirit of wine. The varnish will remain in the cavities; and, by defending the impurities in them from the action of the air, will probably preserve them from becoming corrosive to the metal.

From

* Having read somewhere, that zinc and gold made the best speculum-metal, I tried it; and found, that the zinc was sublimed from the gold in fusion, and arose to the top in the crucible, forming a white, hard, spongy mass. The metal, called tutanag, is fit for specula, when melted with tin; but I am certain, that what I procured, under the name of tutanag, was a mixture of brass and copper, &c.; for the zinc, in the brass, rose from it, during the fusion, in white flowers.

From numerous experiments, of the qualities of different compositions, made by several persons, it appears, that no combinations, of any other metals or semi-metals, are fit for specula, except those of copper, brass, tin, silver, and arsenic. I tried no semi-metal, except the latter, which whitens copper, and unites intimately with it; because it is stated, in the treatise of the *Art of Assaying*, by the observant and accurate *Cramer*, that all the semi-metals rise in flowers, during the fusion: which would certainly make the metal porous. On this account, I would have rejected the brass, because of the zinc contained in it; but that it seemed to render the composition whiter, and less apt to tarnish, than it would be without it. It will have little tendency to rise in flowers, if the speculum-metal be fused, with the lowest heat requisite, and if the brass be of the best kind; because, in this, the zinc is more perfectly united with the copper, and both are purer. I used, for this purpose, the brass of pin-wire: and, because the quantity of it was only the one eighth part of the copper employed, which, I imagined, would receive too fierce a heat, if put alone into the melted copper; I first added to the brass, in fusion, about an equal quantity of the tin, and put the mass cold into the melted copper; supplying afterward the remainder of the tin, and then the arsenic; the whole being generally in the following proportion: viz. 32 parts best bar copper, previously fluxed with the black flux, of two parts tartar, and one of nitre, 4 parts brass, 16½ parts

parts tin, and $1\frac{1}{4}$ arsenic. I suppose, with others, that, if the metal be granulated, by pouring it, when first melted, into water, and then fused a second time, it will be less porous than at first.

In this process, whatever metals are used, and in what proportions soever, the chief object is, to hit on the exact point of saturation of the copper, &c. by the tin. For, if the latter be added in too great quantity, the metal will be dull-coloured and soft; if too little, it will not attain the most perfect whiteness, and will certainly tarnish. It is too late to discover the imperfections of the metal, after the mirrors are cast and polished; and no tokens given of them (that I know) are sufficiently free from ambiguity. But I observed the following, which proved, in my trials, at first view, indubitable marks of the degree of saturation; and I think it fit to describe them particularly, as they have not, to my knowledge, been noticed by others.

When the metal was melted, and before I poured it into the flask, I always took about the quantity of an ounce of it, with a small ladle, out of the crucible, and poured it on a cold flag; and observed the following appearances.

First. If the metal assumed, in cooling, a lively blue, or purple colour, commonly intermixed with clouds, or shades of green or yellow; and if, when broken, the face of the fracture exhibited a silvery whiteness, as bright and glistening as quicksilver, without any appearance

pearance of grain, or inequality of texture; then the degree of saturation of the metal, with the tin, was complete and perfect.

Secondly. If the surface of the metal became of a dun or mouse colour, and especially if of a brown or red; and, when broken, the fracture exhibited a more yellow, or tawny hue, than that of quicksilver; then the quantity of tin in the composition was deficient, and it was necessary to add more.*

Thirdly. If the colour was an uniform dull blue, like lead, and, where broken, discovered a dull colour, with a coarse grain, like facetts; the due saturation was exceeded, and there was an over proportion of tin in the metal.

These colours would be more distinct, if a small quantity of the metal were cast in a flask, which had been previously smoaked, by a candle, made of resin mixed with tallow; in which way I used to prepare the moulds. I attribute the formation of the colours to this: that, as the calx of every metal has its own peculiar colour, so, the heat of the melted mass, calcining some of the particles on its surface, which are in contact with the air, these display the colour of the calces of those in-

 gredients,

* This can always be done by degrees, and without any trouble, till the point of saturation is found; whereas, if too much tin were added at first, there would be a necessity for melting more copper separately, and repeating the whole process: and different specimens of copper will require different proportions of tin; so that the due quantity can never be known, *à priori*, but on trial only.

gredients which prevail in the composition. Whence, it may be expected, that, if the copper is the redundant metal, the mass will exhibit a reddish tinge, which is appropriate to the calx of copper; and, if the tin be prevalent, a blueish die ought to appear. Either of these colours, therefore, appearing unmixed, shews the redundance of that metal, to which each belongs. And, as brass, when cast alone, has always a yellow tinge, so, when these three colours are exhibited in a cloud-like mixture, they shew an equality and due proportion of their respective metals in the composition. When too large a mass of the metal is cast together, its intense and lasting heat calcines the surface so deeply, as (when exposed to the air) to obscure the colours; so that a small quantity will best serve to exhibit them.

As to the method of casting the mirrors, it has been directed, to leave the ingate, or superfluous part of the cast, so large, as to contain a quantity of metal, equal to that in the mirror itself; which would occasion a great waste of it, and render it not easy to cast, at once, more than one mirror in each mould; and even this might be done so injudiciously, as not to afford security against a miscarriage of the cast. But it will appear, that this great quantity of metal, and incommodious manner of casting it, are by no means necessary. However, a judgment cannot be formed, of what may be the safest and most eligible method for casting the mirrors, unless it be considered, what are the circumstances attending this

operation,

operation, in the case of malleable metals; and how the management of speculum-metal, in this respect, must differ from that of them: since there must be peculiar difficulty in casting, in sand, a metal more brittle than glass.

When any fused metal is poured into the flask, the external parts of it, which are in contact with the mould, congeal and harden, sooner than the internal parts, and form a solid shell, filled with the rest of the metal, in a fluid state. This will, consequently, remain in a state of greater expansion, from its heat, than the external crust; and its particles will, in the act of shrinking as it cools, recede from one another, as being more easily separable, and cohere, on each side, with the particles already fixed and grown solid: by which means a vacuum will be formed in the middle, and this will be gradually filled by the superincumbent metal, which has been later poured in, and remains longer in a fluid state. But, when there is no more metal supplied, the void, which was in this way latest formed, remains unfilled; and then the shell of the metal, adjacent to the vacuum, as yet remaining soft, and unable to bear the weight of the atmosphere, resting on it, sinks, and is pressed down into the vacuum: by which means, a pit or cavity will be constantly and necessarily formed in the face of the cast, in that part of it which was last congealed; which cavity will commonly be larger or smaller, in proportion to the quantity of metal in the cast.

The event will, in this respect, be the same with speculum-

speculum-metal, as it is, in the case of that which is tough and malleable: only that, as the former, in cooling, arrives sooner at its natural state of hardness and brittleness, its external solid shell will not bend, but break, and fall into the void part under it; and thus form cracks, or abrupt chasms, in the places, where tougher metals would contract only regular depressions. And also, when the body of the cast is small, or the mould is so damp or cold, as to congeal, not only the surface, but the substance, of the cast too soon, and thus prevent a gradual influx of the fluid metal, to keep the central part as distended, as the exterior shell was, when it became fixed; the farther contraction of the interior parts of this brittle, refractory metal, after it has become solid, will be apt to form rents in it, because its substance will not bear extension, without rupture.

It would be an obvious remedy of the above inconvenience, if there could be contrived a reservoir of fluid metal, to descend into the interior part of the cast, and fill up the void made in it, as fast, and as long, as it is forming by the contraction of the metal. Now, this is effected, by having a jet or appendage to the cast, of such a size, form, and position, as will be effectual to retain the metal, composing it, in a state of fluidity; and also to suffer it to descend into the interior of the cast, until all parts of the same become fixed, and incapable of receiving any farther influx of metal. For thus, all the imperfections, that would otherwise be in the cast itself, will

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now exist only in the appendage to it, which is a supernumerary part, to be afterwards separated from it. This appendage ought to be of the form of a prism, and as nearly that of a cube, as the operation of moulding it in the sand will permit; for, in this gross shape, the metal in it will be the longer cooling. It should be connected with that part of the mirror, which is uppermost in the flask, and joined to it by a neck, equal in thickness to the edge of the mirror, (but so posited, that the face of the mirror may project a little above it,) and, in breadth, about twice the thickness. This neck ought to be as short as possible, i. e. just so as to permit it to be nicked round with the edge of a file, in order to break off the prism from the mirror when cast: for thus the heat of the large contiguous body of the prism will keep the neck from congealing; which, if it happened, would stop the liquefied metal, in the prism, from running down into the mirror. And, to prevent this, the prism ought not to form directly a part of the main jet or ingate, by which the metal is poured into the flask; for so the jet would cool sooner than the large mass of the mirror, and bear off the weight of the atmosphere, which ought to press on the fluid metal in the prism underneath, and force it down into the mirror, to fill up all vacuities in it. Both the prism and the mirror, therefore, ought to be filled by a lateral channel, opening (from the principal ingate) into the top of the prism; which latter should be formed broad and flat, and not taper upward, like a pyramid, lest, by cooling where it grows narrow, it might form a solid arch,

and

and oppose the pressure of the atmosphere. When it is fashioned, as here directed, and made of a bulk equal to a third or fourth part of the mass of the mirror, or even a fifth or sixth part, when the mirrors are of large size, there will ever be found, in the top of the prism, after the metal is cast, a deep pit or cavity, which contained the metal, that had ran down into the mirror, after the outer shell of the mirror, and sides of the prism, had become solid and congealed; and the mirror itself will be found perfect, without any sinking or cavity; which could only be formed by an injudicious disposition of the jet or appendage, permitting the metal in it to freeze sooner than the whole mass in the mirror, and thus stopping its descent into it. If several mirrors be cast together, in the same flask, there must be such a separate appendage made to each of them.

In this manner I have (without a failure in any) cast many mirrors of different sizes, and sometimes several of them together in one flask. But very small ones, such as the little mirrors for Gregorian telescopes, cannot be cast in this manner; for their masses being but small, they cool too quickly, to receive any additional infusion of metal; and their outer edges, suddenly forming a solid incompressible arch, the central parts, in contracting towards it on every side, separate, and are rent asunder. And this has happened, even when I cast them in brass moulds made red hot: on which account, I have been obliged to form them out of pieces of the metal, cast in long thin ingots or bars; which, by by nicking them across with a file, could be easily broken into square pieces, whose corners could be taken off, and rounded in the same manner.

I do not repeat the other precautions to be observed in this process, which have been already so well and sagaciously described by the Rev. Mr. Edwards: but the circumstances above-mentioned, a prudent attention to which is, in my opinion, essentially necessary to the success of it, are not to be collected from any directions published on the subject that are known to me. And though particular artists may, by large experience, arrive at a sufficient knowledge in this matter, for their own practice; yet, to render that knowledge general, and to contribute, as far as I could, to the improvement of this instrument in any hands, being the design of this essay, I thought it necessary to state the above particulars fully; though I doubt not that these, as well as other matters of moment in the operation, are known to many, who chuse not to make them public. Thus the great skill, in the construction of the telescope, acquired by Mr. Short, seems not to have been transmitted to any successor.

I come now to speak of the most difficult part of the mechanism of this instrument, that of communicating a proper figure to the mirrors; on which depends the powers of the telescope, when its dimensions are given: for the manner of polishing them, to the highest degree of lustre, has been already well understood and described. They who have tried this part of the work, and know how inconceivably

ceivably small is that incorrectness of form, which will produce grievous aberrations of the rays of light, will, I am sure, readily subscribe to the assertion, that '*hoc opus,* '*hic labor est.*' Methods have indeed been proposed for accomplishing it; but not a single hint given, that I know, of the *modus operandi,* or the grounds of these methods: insomuch, that, when I first tried to polish mirrors, I had no idea why any figure of them, different from that of a sphere, should result from the modes of polishing recommended. But, on my making the attempt, in the ways proposed by Mr. Mudge and by Mr. Edwards, I was surprised to find, that sometimes a spheroidal or other irregular figure, and sometimes (though rarely) a conoidal one, was produced by each: the cause of either being to me then unknown; and disappointment or success appearing to depend on mere accident, and not on the degree of pains and accuracy used in the process.

At length I began to suspect, that these variations, in the event of the process, (which will be hereafter accounted for,) arose from some property, not adverted to, in the pitch that covered the polishing tool; which material has been generally used for this purpose, of communicating a proper figure, as well as a high polish, to the mirror, since it was first recommended by Sir Isaac Newton; being commonly spread on the polisher, to about the thickness of a crown-piece, and then covered with the polishing powder; (the manner of doing which I suppose the reader to be acquainted with, as also with what has been made public

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on the subject, by Messrs. Hadley, Mudge, Edwards, &c.;) and I was confirmed in my suspicion, from the following reasons, after I had found them approved by many repeated and diversified experiments.

Pitch is a soft unelastic substance, which, as such, will suffer a permanent change of form, when it is made to sustain a degree of pressure sufficient to communicate an intestine motion to its particles: and this property directs us to consider, what may be the effect of the pressure of the mirror on it, when spread on the polisher, as to the figure it may then gradually acquire, during the operation of polishing, and the resistance and friction it will oppose to the mirror: for, by reason of the tenacity of its substance, it will resist a certain degree of pressure, without change of its form, but will yield to a greater pressure. But it is by its resistance the mirror is worn down and polished; if, therefore, that resistance be not uniform and equal, on the whole surface of the polisher, neither will the abrasion of the mirror be equal in every part; the consequence of which must be, that both will degenerate from an uniform curvature, i. e. from a spherical figure; the mirror from unequal friction, and the polisher from its mobility, by which it will adapt itself to the successive alterations produced in the figure of the mirror; their mutual action and reaction inducing a change in both.*

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* This change, however, being so little, as to be imperceptible by the senses, and, in the imagination, referable to various other causes, it becomes necessary, in

As the pitch is (in our present enquiry) to be considered as an homogeneous substance, we must suppose, that its resisting force, as well as that of the pressure of the mirror on it, are uniformly diffused over the surface of the polisher: and, from hence, it may not, perhaps, be easy to conceive, how the surface of the mirror could sustain from it any inequality of resistance and friction. In fact, these would be equal and uniform, in every part, if the pitch were a substance, either of perfect hardness, or perfect fluidity: but it will hereafter appear, that its consistence must not be so hard, as to render it incapable of any change of form; but, on the contrary, so soft, as to yield, in a small degree, to the pressure of the mirror: at the same time, opposing a resistance, sufficient to wear down and polish it: and the enquiry is, how that resistance is modified.

Bodies

in order to establish the true cause, not only to deduce its existence and effects solely from reasoning on physical principles, but also to obviate other different conjectures that might be formed, by stating fully those circumstances that take place in this operation; and which, indeed, are necessary to be clearly understood in judicious practice. Both these ends cannot be answered, in a disquisition new and intricate, without a minute explanation: and this, I hope, will be received as my apology, for the prolixity of this account, which I would gladly have curtailed, if I knew how to do so, without making it less intelligible or useful to the practical optician. This class of readers will forgive any diffusiveness on a mechanical subject, if the perusal may tend to spare them the greater labour of fruitless experiments; or afford any hint towards conducting them more judiciously: and as for their use this paper was designed, I have adverted to such various matters as I thought most worthy their attention; and which yet have not been so fully and familiarly explained by others, as they ought to be, for the instruction of an artist.

Bodies of perfect hardness, such as glass, flints, &c. will not admit a total intimate change of their form, in all their dimensions, without a dissolution and permanent separation of all the particles composing their masses, (except when they are brought to a state of fusion by heat). But soft, viscid, semifluid bodies, such as lead, pitch, &c. will suffer such change, preserving the cohesion of their particles, yet, at the same time, undergoing a general intestine motion of all the particles among themselves: so that the coat of pitch, pressed, on each side, between the parallel surfaces of the mirror and polisher, will, by their force, be equally extended laterally in every direction; by which an equal quantity of motion will be communicated to all its particles: since no particles, except those at the extremities, can move, without protruding others, and these, the rest, successively, as if the mass were a fluid body.

But, though all parts of the surface of the polisher receive an equal pressure and motion, all do not exert an equal degree of resistance to that pressure: for those parts, that cannot move without displacing and overcoming the resisting tenacity of a greater quantity of the surrounding mass of pitch, than other parts do, must oppose the greater resistance to the mirror, as having that of the other parts superadded to their own. For ascertaining this, the force impressed, and the quantity of pitch, confining any annular tract of the polisher, should be computed. In the present case, where the coat of pitch is a thin equal stratum, of circular form, we need regard only its superficial dimension, and consider

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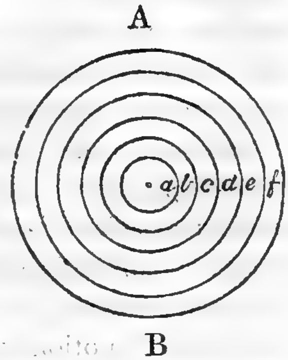
all parts of it as alike situated in the above respect, which are equidistant from the center, or from the outer edge of the polisher.



To this purpose, let the surface of the polisher, (supposed equal in size to the mirror,) be represented by the circle A B; and its area be conceived to be composed of an indefinite number of concentrical zones or annuli, *a*, *b*, *c*, *d*, &c. Each of these will sustain an uniform pressure, from the mirror, proportional to its area; because, the force impressed on the mirror, and its attraction to the polisher, is equably diffused on it. The areas of these annuli, taken separately, are the differences of the two circles, whose peripheries inscribe and circumscribe each of them; as the area of the annulus *d* (for instance) is the difference of the circles, whose radii are *a d* and *a c;* and they are, consequently, to each other, as the differences of the squares of their diameters, or as those of their radii; and the series of them, *a*, *b*, *c*, *d*, *e*, &c. taken, in order, from the center to the extremity, are strictly as a rank of figurate numbers proceeding from unity, viz. the odd numbers 1, 3, 5, 7, &c. But, since their breadth is supposed to be indefinitely small, they may be taken as proportional to their mean diameters or radii, i. e. as their distances from the center of the polisher; which distances will, therefore, represent the pressure

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on each annulus, and the quantity of motion communicated by that pressure; seeing it must be, as the number of particles the annulus contains that are moved; i. e. as its area.

But the resistance to the force impressed on any annulus, being as the quantity of pitch to be put in motion by it, will be different, not only as the annulus is nearer to, or farther from, the margin of the polisher, but different, also, as this has either one margin only, or two, i. e. when the polisher is entirely covered with pitch, or when it has a space left uncoated at the middle; which latter always is, and must be the case, when the great mirror of the Gregorian telescope is to be polished, which has a perforation at its center.

First. When there is no vacant space in the middle: the resistance to the several annuli will be as the circumambient spaces only; because, the pitch not being compressible, it is only into these, and not towards the center, it can, in yielding to the force or weight of the mirror, extend itself, by lateral motion: and the space, surrounding any annulus, is the difference between the circular area of the polisher, and that inscribed in the annulus; and is, relatively to the rest, measured by the difference of the squares of their radii, viz. of the distances of the edge of the polisher, and that of the annulus, from the center. But since, in this case, the bodies (of pitch) are unelastic, there can be no augmentation of motion; nor can the quantity of motion and action communicated, and, consequently, the resistance to it, and reaction, exceed that which is impressed: on

which

which account, I imagine, that the resistance to the several annuli is to be taken as proportional to the pressures they sustain, and measured by them, i. e. by their magnitudes or areas, or the number of particles in them, to which a motion is imparted; which were stated to be as their respective radii or distances from the center: and, consequently, I suppose the resistance to be the inverse of this, or as the distances of the annuli from the outer edge of the polisher; which distances measure the direct resistance, or the quantity of pitch, to which equal motion, with that in the respective annuli, is communicated.

And from hence it follows, that, if a mirror, previously ground to a spherical figure, were to be polished on such a polisher as this: the resistance and friction of the pitch, being greatest, and increasing to a maximum at the center, and diminishing towards the extremity, would wear down and polish the mirror, most in the central part, and least towards its edges; thus giving to it a curvature, the reverse of a conoid, which it ought to have, and which it can never at first acquire correctly, by any other mode of polishing, but that of wearing it most down (and thus reducing its curvature), towards its extremities.*

Secondly. When there is a hole made through the center of the polisher, or a void space left there, uncoated with pitch.†

In

* It will be hereafter shewn, for what particular purpose, solely, such a polisher may be employed.

† There ought always to be a hole made through the polisher, to prevent the confinement of air or water, near the center of it.

In these circumstances, the pitch will have liberty to expand itself (when yielding to the pressure of the mirror), towards the center, as well as the edges of the polisher: and, as the resistance and friction, in any annular tract of it, is as the direct extent of pitch, bounding it on either side, it follows, from what has been laid down, that it will encrease in any part, as the distance of the same annulus encreases, from each extremity of the coating of the polisher; and will be in a ratio compounded of the distances, from the interior and exterior margins of the pitch. So that, if the breadth of the polisher between these margins were, (for example,) 5 inches: then the pressure and friction in the middle tract, equidistant from the outer and inner edges, would be, to that prevailing at the distance of half an inch from either margin, as $6\frac{1}{4}$ to $2\frac{1}{4}$, (nearly as three to 1;) and the same, at proportionate distances, in polishers of any other size; which unequal pressure could never produce, in the mirror, a regular curvature of any species; and, in the spaces nearer to the margins, the inequality of pressure would be still greater. Whence may be conceived the impossibility of figuring mirrors correctly, on polishers disposed in this manner, without some remedial contrivance; whether the face, or area of them, be of a circular shape, as directed by Mr. Mudge and others, or oval, as proposed by Mr. Edwards: for the mirror would be thus least reduced, and left of a spherical form, at the middle and edges; and be worn down, and hollowed

hollowed into a different and irregular curvature, in the intermediate tract.

For these inconveniences, however, arising from the unequal friction of the polisher, there are the following easy and adequate remedies; which will, in the sequel, be more fully explained, and applied as in practice, to effect the degree of curvature, or any correction of the same, which may be requisite.

First. Since the curvature of the mirror ought to be gradually reduced towards its edges, which can only be effected by an increase of friction in the corresponding part of the polisher; and that this latter effect is to be produced in any part of it, by enlarging the surrounding coat of pitch: it follows, that, for this purpose, the breadth of the polisher must be enlarged above that of the mirror; and this in the same degree, as the curvature of the mirror is to be diminished: so that the polisher is to be of greatest breadth, for a mirror of an hyperbolic, and least, for one of a spherical figure. This, however, is to be done, under the limitations hereafter mentioned.

Secondly. To preserve the regular gradation of curvature towards the middle of the mirror, the uncoated space, at the center of the polisher, should be contracted to a certain limit, which will be defined; though, for the reasons above-mentioned, it can never be filled up altogether.

Thirdly. Where the resistance and friction of the pitch, in any tract on the face of the polisher, is computed

puted as above, or found in effect, to be too great; it may be lessened and regulated, in any degree, by cutting, out of that part of its surface, some of the pitch, at proper intervals, in narrow channels or furrows: the number and depth of which ought to be proportioned to their distance from the edges of the coat of pitch directly, and to the reduction of curvature, proper to the corresponding parts of the mirror inversely, and should be in a ratio compounded of both; for, by these cavities, the continuity of the pitch being dissolved, its resistance, depending thereon, may be modified at pleasure.

In this manner may the polisher be so disposed, as to communicate a correct figure to large mirrors, and even to those of smallest size. Now, whatever success may have attended the efforts of other persons, in communicating a proper figure to the *great* speculum, (especially Mr. Short, whom I have manifold reasons for believing to have been among the most eminent opticians, as well as artists, that have laboured in the improvement of this instrument;) I have not heard, that any method has been proposed, of communicating, to the *little* mirror of the Gregorian telescope, any other than a spherical form, which yet may in this manner be done. And it must, in this telescope, be a thing most desirable to accomplish; especially when its size and aperture is so great, that it would be difficult to impress, on the extensive surface of its great mirror, (merely by the small alteration of figure, which could be produced, in the delicate opera-

 tion

tion of polishing,) the degree of change, from its prior state of spherical curvature, which would be requisite; since the defect of form, in this mirror, may, in these cases, (as will be shewn,) be easily compensated, in the figuration of the little mirror. For the greater size of this latter, in such instances, will render it capable of more steady handling and motion, and more equal pressure; and so more manageable, and susceptible of a correct figure, in proportion as the encreased magnitude of the great mirror renders it unmanageable: which is, plainly, a great advantage, in the fabrication of this telescope; whose mirrors will thus, in the cases where it is most especially necessary and desirable, admit mutual correction and compensation for each other's defects.

The principles, or physical causes, operative in this process, as above stated, seem to be incontrovertibly evident; and, as I am not aware of any paralogism admitted in the reasoning upon them, I must suppose, that a mode of operation, conformable to these principles, is the thing chiefly requisite to ensure success. In this view, I have attempted to conduct the process; and, as the almost insuperable difficulties attending it are felt, even by those whose inventive powers and resources ought to afford the highest hopes of accomplishing the object, and yet disappoint them in their attempts at high perfection;* so I, among others, may be allowed

* Sir Isaac Newton, who had himself laboured in this undertaking, of polishing the concave mirror of his own telescope, and with such talents for the work, and such success, as to discover that method of doing it, which has, to this day,

allowed to state the difficulties, that, to my apprehension, occurred in the enterprize, and to obviate objections; as, from hence, there may be suggested some hints, to facilitate or abridge future labour to others, or to prevent hopeless trials.

I must observe, then, that different effects must necessarily follow, from using, in the process of polishing, pitch of a softer or harder consistence. If the pitch be of a

temper

day, been followed, observes, (to use his own words,) that "optic instruments "might be brought to any degree of perfection imaginable, provided a re-"flecting substance could be found, which would polish as finely as glass, and "reflect as much light as glass transmits, and the art of communicating to it "a parabolic figure be also attained. But there seemed (*said he*) very great "difficulties, and *I had almost thought them insuperable*, when I farther con-"sidered, that every irregularity, in a reflecting superficies, makes the rays "stray five or six times more out of their true course, than the like irregu-"larities in a refracting one; so that a much greater curiosity would be here "requisite, than in figuring glasses for refraction..... &c.

"But, having afterwards thought on a *tender way of polishing*, proper for "metal, whereby, as I imagined, *the figure would also be corrected to the last*, "(i. e. the utmost,) I began to try what might be effected in this kind; and, "by degrees, perfected an instrument..... &c. .... and afterwards another "one."

The tender way of polishing, which Sir Isaac Newton here mentions, was, (as he afterwards described it in his Optics,) to cover the polisher with pitch: and he declares, that he imagined the *figure*, as well as the *polish*, would, by means of this, be perfected. I cannot help thinking, that this extraordinary man, who was born to anticipate others in invention, as well as discovery, had the same ideas as are here detailed, though he did not explain, nor, perhaps, succeed in, the application of them in practice: for he states, (in his Principia,) that a spherical mirror will reflect the oblique pencils, issuing from the extremities of the field of view, as truly as a parabolic one, and seems to despair of effecting a more correct figure.

temper quite hard and unyielding, no part of the surface of the mirror can be made to suffer a higher degree of friction than the other parts of it, unless these latter parts be elevated and detached from the face of the polisher, and disengaged from contact with it; because, in this case, both mirror and polisher are supposed to preserve their general shape regular and unaltered: and, therefore, the contact, and, consequently, the friction, must be either complete and equal, on the whole surface, or none at all. For, if we suppose, that, by the wearing down of the mirror towards the extremities, it is made gradually to change its spherical form, the part of its area, so abraded and diminished, cannot subside into a state of actual contact with the polisher, unless the other parts of it are elevated and disengaged from the polisher, at the same time; or unless it may be imagined, that the particles, worn off the mirror by friction, are applied and adhere to the corresponding parts of the polisher, so as to raise and augment its surface, just as much as that of the mirror becomes depressed and reduced. If this effect could be supposed to take place, it would follow, that, in every variety in the direction of motion in the mirror, the friction must tend to wear down the edges, rather than the middle of the mirror; because the motive force is always applied to a part of the handle to which the metal is fastened, raised more or less above the surfaces in contact. The effect of which must be, to communicate to the foremost or advancing half of the mirror's surface, a pressure downward, on the face of the polisher, equal to to the force expended in moving the mirror forward; and thus to abrade and reduce the several parts of the mirror's surface, proportionally to their respective distances from the center; by which its curvature will be made to approach to that of a parabola, by its wearing down most towards the edges: and this, whether the motion be conducted in lines diametrically across the polisher, or with round strokes; so as that its center should describe, every time, a little circle, about the center of the polisher. This is, however, entirely on the supposition, that the edges of the polisher become raised, by the adhesion of the dust worn from those of the mirror: for, if this were not the case, but that the polisher were to retain its spherical form, while that of the mirror was altered, the contact could not be general between two surfaces of dissimilar shape. If these adhered together in one part, they must be dissevered in another; and the force, necessary to separate them in this latter part, which can never be greater than that required to move the mirror forward, must yet be more than equal to the force of cohesion, in the part of the mirror, which, in each stroke, is to be disengaged from the polisher. This pressure is found, in the case of bodies in contact, to be incomparably greater than the weight of the atmosphere, which is equal to about seventeen or eighteen pounds on every square inch of the surface of the mirror: and, when this latter is brought so near that of the polisher, as to suffer friction from the powder bedded in it, their mutual attraction will amount to a much greater force than is requisite to move forward

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the mirror; no part of which can, therefore, be disengaged from the polisher, nor, consequently, be unequally worn down, so as to produce, in its surface, a form different from a spherical one, or from that of the polisher.

This reasoning and conclusion will equally stand, whether it be supposed, that the force of cohesion is confined to the very surfaces in contact, or extends to a little distance from them, diminishing in the duplicate, or any other ratio of that distance; and that the bodies are not wholly removed out of the sphere of attraction, when there is a small interval between them. For, as this force is greatest at the very surface; so, the bodies in contact cannot be disjoined at all, to the smallest distance, but by a force superior to the whole cohesive force.

It may, perhaps, be imagined, that the pressure of the atmosphere ought to be taken into consideration, and be added to the force of cohesion, which keeps the surfaces in contact with each other. But this pressure acts as much upon the coat or plate of water, which must be interposed between the surfaces of the mirror and polisher, as upon these surfaces themselves: and, because the pressure, upon any part of a confined fluid, is propagated to the whole of it, in every direction; so, the weight of the atmosphere, resting on the edges of this fluid plate, tends as much, by the interposition of the same, to buoy up, and force asunder, the surfaces resting on it, as it does to compress together these surfaces,

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by its action on themselves; and exerts itself equally to prevent their approach on one side, as their recession on the other. I conceive the agency of these forces to be this: that the plate of water is so strongly attracted by the surfaces nearly in contact, as to be kept from running off, and has its outer edge exposed to the weight of the air; whose pressure is thus communicated to all the particles of the water, and, by its mediation, to the contiguous surfaces of the mirror and polisher. And, though all these are really compressed together, by the surrounding atmosphere, yet I conceive that this does not hinder their gradual separation from being effected: because, as fast as that separation takes place on any side, the air and water rush in between the surfaces, to fill up the vacuity, as it is formed; and no farther resistance arises to their disjunction, than what is owing to the viscidity of the fluid interposed, and to the force of cohesion: which latter acts, in this case, quite different from any external force of compression; and prevails, as I apprehend, to a small distance from the surface, diminishing in the ratio of some high power of that distance.*

And

* If it were supposed, that the force of cohesion is confined to the surface of bodies, and acts only in the state of actual contact; it would be hard to conceive, why a drop of liquor should ascend, in a conical glass-pipe, whose narrow end was elevated: since the drop ought, on this supposition, to be attracted as much by the surface below, as by that above it; and its weight ought to make it descend; and there would be nothing to make it spread beyond the space of contact which it occupies: whereas, if the

And hence I suppose, that the weight of the atmosphere is wholly inefficient, in keeping the mirror and polisher in mutual coherence, when any liquor of perfect fluidity is between them; and that the force of cohesion acts alone to this effect. Accordingly, it is found, that, when the polisher is so much wetted with water, that there is formed a continuous plate of this fluid between it and the mirror, an additional force, sufficient to squeeze out the water interposed, becomes requisite to bring the surfaces into actual contact, and to produce so much friction between them, as will serve to wear down and polish the metal; which process will be found, in these circumstances, to advance very slowly and irregularly. And, on the contrary, when so little water is applied to the polisher, that it is only made damp, and scarce wetted, (i. e. when there is not a continuous body of liquid interposed between it and the mirror,) then its contact with the metal will be so intimate and strong, that the latter will polish very quickly. For then their surfaces approach within the sphere of the attraction of cohesion: insomuch that, if all moisture were suffered to evaporate, the mirror and polisher would cohere so firmly, as not to permit any friction, or even a separation of their surfaces, and the polisher would be destroyed; for then the weight of the atmosphere, also, would be superadded,

the attraction extends, directly in right lines, to a distance from the sides of the pipe, the composition of their forces ought to make the drop ascend, and spread itself in its course, as it happens in fact.

superadded, when no fluid is interposed: all which shew that their cohesion, when a fluid does intervene, is not caused by the pressure of the atmosphere.

Agreeably to this, the sagacious Newton directs, that, toward the end of the operation, no more moisture should be applied to the polisher, than what it will contract, from the operator's breathing on it. Indeed, a person, who has formed a just conception of his genius and intense application of mind, and considered the hints and precepts he has given in this work, can hardly doubt, that he could, and, perhaps, would, have furnished a theory of the rules and method of this whole process; had he not imagined it would, at that time, be regarded as a matter of too little importance, to deserve so minute an explanation, which must be necessarily prolix, and seem unworthy of him, who was occupied in more sublime speculations.

From this it follows, that, when the pitch is of unyielding hardness, it will not, in any mode of polishing, communicate to the mirror the desired shape, if the dust, worn from the mirror, does not alter the shape of the polisher. And, as this seems not likely to happen, so I was not surprised, that my efforts, to effect the desired figuration of the mirror, by using very hard and refractory pitch, failed of success.

And there is this inconvenience, moreover, in the use of such pitch, viz. that it makes so great resistance to the sinking and bedding of the polishing powder in it,

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that the particles of the powder, however fine it may be, will, on any fresh application of it, or when any grains of it are accidentally dislodged from the pitch, roll about loose on the polisher, and scratch the face of the mirror, so as to destroy the polish before given; thus making any fresh application of the powder inadmissible, unless the pitch were to be softened by heating it, which would destroy its former figure, and render the operation uncertain and tedious. It was to allow the polishing powder to fix itself, without rolling loose on the polisher, and to suffer all its particles, however different in size, to sink in it, so as to form an even surface, that Sir Isaac Newton, in his sagacity, employed a coat of pitch on the polisher, as a soft substance, that would yield to the powder, when impressed on it by the mirror, and not afford such resistance, as to make it fret the face of the metal; and also as a substance endued with another property equally necessary, that of being perfectly unelastic. For no elastic substance will ever communicate an exquisite polish to a metallic speculum, though it would to glass, crystal, or jewels; because no metal can be cast, perfectly free from small pores: and any elastic substance, if employed to polish it, would insinuate itself, together with the polishing powder, into these pores, and wear down their edges in such a manner, as to convert every pore into a long furrow or cavity; which would occasion the destruction of the whole surface of the metal, as was truly observed by Sir Isaac Newton. And thus it ap-

pears,

pears, that, to make the pitch too hard and refractory, would be to destroy every property in it; which renders it eligible in this operation.

If the positions, before stated, be well founded, it seems to follow, that the desired change in the mirror, from a spherical to a conoidal figure, can only be effected, by a change in the shape of the polisher, gradually accommodating itself to the alteration, produced in that of the mirror, during the process of polishing. Nor, indeed, can it well be conceived, how the mirror could alter its spherical form, if that of the polisher remained unaltered; for a conoid could never, in the usual way, and without a partial separation of the surfaces in contact, be polished on a segment of a sphere, nor even on that of a conoid, if, during the friction of their surfaces, the center, or vertex of the one, were to be moved to any considerable distance from that of the other. So that the strokes, in polishing, must never ultimately be carried so far, as to remove the center of the mirror to too great a distance from that of the polisher; even though its surface were so hard, as to preserve its figure unaltered by the pressure of the mirror.*

* For the several reasons above-mentioned, I am inclined to think, it will be very difficult to discover a method, different from that here explained, of communicating, at the same time, a perfect figure and polish to a speculum. It is plain, that Newton could think of no better; though I imagine that, in this instance, he tried his inventive powers with those of Des Cartes, who had published a method (in theory elegantly geometrical) of figuring optic glasses.

Agreeable to these positions, I found, in my trials of polishing mirrors in the common way, by straight or round strokes of the mirror, on the polisher, that the operation was

glasses. And I cannot dissent from those, who think this was the method employed by Mr. Short, with such success, in figuring the mirrors of his telescopes; I mean a conduct in the operation, sagaciously adapted to the properties of the pitchy coating of the polisher.

It must be obvious to the reader, that none of the remarks or directions, contained in this essay, can be meant to apply directly to the polishing any speculum, whose magnitude is too great, to admit of being moved on a polisher, of equal size with itself. Where the friction, and force of cohesion, of such large surfaces in contact, and the weight of the mirror, exceed the motive power that can be employed, a polisher, of less extent than the whole surface of the mirror, must be applied, to traverse, in succession, the several parts of it; and the motion must be given, not to the mirror, but to the polisher. Instruments of far less enormous magnitude than Doctor Herschell's great telescope, are *sui generis*, and require particular methods of polishing the mirror adapted to their size. For such, no person should presume to propose any method, which he has not approved in practice: though, as the general principles here laid down, are, with due accommodation, applicable to a polisher of any shape or extent of surface; it should seem, that, if such great mirrors could be polished by a regular and uniform motion, their polishers might be made such segments or sectors, &c. of the area of each respective mirror, and of such breadths in different parts; and the furrows, made in the coating of pitch thereon, of such number, proximity, and depth, as to afford, in the tract of the motion of each part, a degree of pressure and friction, reciprocally proportional to the degree of curvature, proper to each concentric zone of the mirror's surface; which would tend to produce the desired figure, so far as a polisher, covered with pitch, could be made instrumental to this purpose. For, though the size and shape of the polisher were to remain unaltered, yet its resistence and abrading power might be considerably modified, by varying the number and depth of the furrows, made in the pitch which covers it. And the effect of a process, thus conducted, will be commensurate to the time it is persisted in.

was more easy and successful, when I used pitch of nearly the common consistence, than when I employed such as was made very hard, by long boiling it, or by the addition of much resin. Such softer pitch will admit more than one application of the polishing powder, without scratching the metal, or spoiling its previous polish; by which means, the process will be more expeditious. It will instantly accommodate itself to the successive alterations in the form of the metal; as this, by wearing down towards its edges, gradually changes, from a spherical, to a conoidal shape: and it will promote this effect, by opposing a greater resistance to the metal, and greater friction towards its extremities, when its previous disposition on the polisher has been judiciously provided, in the manner before explained.

But, to fulfil these intentions effectually, a certain kind of motion, of the mirror on the polisher, must be carefully observed, during the operation: for, as the softer pitch will continually yield, and sink under the pressure of the metal; so, the form of the polisher, degenerating in every stroke, must be recovered, and preserved correct. According to the principles before laid down, the face of the polisher must be considerably larger than that of the metal, in order to afford a greater resistance to the speculum, towards its extremities: so that, as the metal covers only a part of the polisher, if the former were to be confined in its motion, the pitch, sinking under it, would expand

expand itself laterally, and become heaped up suddenly, around the tract of the mirror's pressure; which must, therefore, to obviate this, be so conducted, as to traverse, in quick and regular succession, every part of the polisher, in order to recover the regularity of its figure as fast as it becomes vitiated. And this is effected in two ways: either by enlarged circular strokes of the metal, brought considerably beyond the edges of the polisher, in order to repress, towards the center, the pitch, which had become raised near its edges; or by strait diametral strokes, across its surface, in every direction, successively: either of which will tend to preserve the figure of the polisher, and, consequently, of the mirror, nearly spherical. As, however, a spherical figure is not that which is ultimately intended, so these modes of conducting the process are to be pursued only till the mirror has acquired a sufficient polish, and a figure nearly spherical: and then, in order to give it a parabolic or hyperbolic shape, the motion of the mirror, on the polisher, should be such, as that the center of it may describe a spiral line round the center of the polisher, by enlarging the circular strokes, till the edge of the mirror arrives at the edge of the polisher; and then contracting the motion gradually, till the mirror returns to the center, in the same spiral course. By which means, any sudden and irregular elevation of the pitch, beyond the place of the mirror, will be prevented; while, at the same time, it will become regularly elevated, from the center

center to the outer edge, in the form of a conoid, and thus be adapted for communicating the same figure to the mirror.

I have been led to adopt and practise this method of polishing mirrors, by the train of reflections and reasoning herein described; and with sufficient success, for its unreserved recommendation. In one particular, it corresponds with the method published by Mr. Mudge, in the Philosophical Transactions, viz. in the direction of the motion used in polishing the mirror. But this seems to have been prescribed by him, without any respect to the properties of mobility and inequality of friction, in the pitchy coating of the polisher; which things he has not noticed. And yet, as any sort of motion, without a proper regard and adaptation to the qualities of the pitch, would be ineffectual, it is here attempted to supply that defect; because no method can be rightly pursued in practice, nor its success be uniform, nor any figure already given to the mirror be altered, if those artists, who would follow it, are ignorant of the principles and agency on which it is really founded. For, in every process of so subtil and delicate a nature, some untoward accidents and circumstances must occur, which will grow above the control and correction of any person, who is not aware of the secret causes from whence they arise. In such cases, the practice will be as imperfect as the theory is.

It has been above explained, how the middle zone, or tract of the polisher, equidistant from its inner and outer

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edge, when there is a void at the center, will oppose a greater degree of friction to the mirror, than the other parts of the polisher. And, to prevent the unequal wearing of the mirror, by the increased action of this zone, it will be proper, that, agreeable to the methods of prevention of this effect before-mentioned, there should be circular furrows indented in the pitch within this zone, more or fewer, according to the size of the mirror, and the designed degree of its curvature; in order that the pitch may subside into the furrows, and thus the resistance and friction in that tract be diminished. This will be very easily accomplished, by putting the polisher on the arbor of a lathe, and cutting out some of the pitch in circular grooves, with a small and sharp concave turning chisel, wetted with water, in which some soap has been dissolved. And this may be performed and repeated, if necessary, without any injury to the surface of the polisher, if it be previously wetted, to prevent the splinters of the pitch from sticking to it; which may be washed off, by a soft brush or pencil, from the polisher, it being immersed in water.

Since, in the Gregorian telescope, the defect of figure or curvature, from that of a conoid, in one of the mirrors, may be compensated by a contrary curvature in the other; and since, in either of the mirrors, whose breadth is given, the degree of variation in its figure, from that of a sphere, ought to be so much the greater, as its focus, or radius of curvature, is shorter; it will, on this account, be far more difficult, to effect a proper figure of the small mirror in this

this telescope, than of the large one; because the former must be a greater segment of the sphere, than the latter. For which reason, instead of making the one of an elliptic, and the other of a parabolic form, I imagine it would (with the exceptions before-mentioned) be more proper to rest content with a spherical form in the little mirror, (by which means, several of these latter, being fastened, with cement, beside each other, on the same handle, might be accurately and easily ground and polished together, on one tool and polisher, made sufficiently large); and to employ the great efforts on the large mirror, in rendering it of an hyperbolic form; which is not at all more difficult than it is to make it parabolic: for, on account of the small extent of surface of the little mirror, it is very difficult to govern and regulate its motion and pressure, so as to communicate to it any certain figure, if polished by itself singly; as it must be, when it is to be of any other than a spherical form. Yet, even this may, by an intelligent and dexterous artist, be accomplished, to a considerable degree of perfection, in the manner above-mentioned, as I have repeatedly experienced; though the process is much more easy and certain, in figuring the large mirror (under that limitation of its size before intimated): for the greater the surface to be polished is, the less will any inequality of pressure, in the operation, alter the form of the mirror, or the polisher; such inequality, being a part only of the motive force employed; and the more extensive the surface is, the less proportion does the motive force bear to the force of cohesion, which tends to preserve an uniformity of pressure in the mirror, and of figure in the polisher. And I believe it is on this account, rather than that of preventing aberrations of the rays of light, from a supposed spherical shape of the mirrors, that telescopes of greater apertures and foci are more accurate; the larger surfaces of their mirrors having a tendency, during the operation of polishing, to preserve the regularity of their figure. For, let the aperture of a telescope be ever so large, with respect to the focus of the great mirror; yet, when the object is very remote, the central part of the field of view (the rays of light from which fall parallel to the axis,) ought to appear perfectly distinct, if the metals were wrought up to the correct figure of conoids: and the vulgar doctrine of aberrations, which relate only to spheres, is entirely inapplicable. The only standard, for the measures of the apertures and foci, is the degree of ingenuity in the workman, who fabricates the instrument. There are many defects in figure, beside a spherical form of the mirrors; and it happens but too frequently, that a telescope is very indistinct, from a bad figure of them, though that figure is the nearest to a conoid of any regular curve: for this is often the case, when the central, the extreme, and the intermediate parts of the mirror, successively and separately exposed to receive the light from the object, appear to have the same focus. And this mostly occurs, when the mirrors are small; certain tracts, or portions of their surface, being more worn down, by the grinding or polishing,

ing, than others, arising from the difficulty of preserving an uniform pressure during the operation, and, consequently, a regular figure of the polisher.

Another method, different from that now described, of communicating to mirrors a parabolic form, has been discovered by the late Rev. Mr. Edwards, and published in the Nautical Almanack, for the year 1787. He recommends, to make the edge of the polisher the periphery of an ellipse; so that the face or area of it may not be round, but oval: the shortest diameter of the ellipse being equal to that of the mirror; and its longest diameter to be to the shortest, as 10 to 9. And he affirms, that a mirror, finished on such a polisher, will prove to be of a parabolic form; if the process be conducted, by employing, throughout the operation, straight strokes of the mirror, diametrically across the polisher, in every direction. Now, in the method recommended by Mr. Mudge, whatever kind of motion be used, in bringing the face of the mirror to a polish, the parabolic form is directed to be acquired, only by a circular motion in polishing: Mr. Mudge having declared, that the effect of such straight strokes would be, to produce no other than a correct spherical figure in the mirror. Here, then, are opposite motions, and declared to be productive of contrary effects, proposed by two very intelligent artists, with a view of promoting the same effect; the only difference being this, that, in the one case, the face of the polisher

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is supposed to be round, and in the other, oval: a difference that a person may well imagine to be (as it really is) of very little importance; and he may be easily led to suspect, that the presumed effect of either mode is only imaginary; that a spherical figure of the mirror has been mistaken for a parabolical one; or that, if the latter has been produced, it may have been, not by method, but by chance; and he may naturally distrust any rule or method advanced for this purpose. Thus, when different instructions are given, by different persons, without any reasons or explanation assigned as the foundation of them, the whole rests on authority; authorities clash, and then the worst may be followed, or all be rejected; and, for want of a guide, an uncertain practice be adopted. It is for this reason, I have judged it necessary here, (as also in former essays, made public,) to be very minute, in attempting to investigate the grounds of any method to be pursued, and the principles of action, in the operation of the instruments I am treating of.

I have made a trial of the method of polishing, proposed by Mr. Edwards, with attention to all the circumstances, which he directs to be observed; and, from the result, I have reason to believe, that his method is a good one, and will, if judiciously applied, produce as correct a figure of the mirror, as, perhaps, any other, yet made public. But, whoever will attentively investigate the nature of the operation, will, I think, cease to wonder,

der, that modes of conducting it, seemingly so dissimilar, tend to the same effect; and perceive, that the contrariety is not real, but merely apparent.*

For, in either method, it is not the direction of the motion employed, nor the shape of the area of the polisher, which, in reality, produces a conoidal form in the mirror; but a gradual alteration in the curvature of the face of the polisher, by the yielding of the pitch, under the pressure. And, therefore, when any part of the area of the polisher, whether it be round or oval, is more extended than that of the mirror; the pitch, moving laterally, will become elevated, and its curvature lessened, in that part. So that, in a polisher of oval shape, whose conjugate diameter is equal to that of the mirror, the pitch will ascend and accumulate, in the part, which lies without the circular area of the mirror, inscribed in the ellipse. The extremities of the mirror will, therefore, be worn down, when each part of them is made in rotation, by

* In the methods of figuring the mirrors, published by Mr. Mudge, and by Mr. Edwards, it is stated by Mr. Mudge, that he frequently, during the process, applied to the polisher a concave tool, which he calls a bruiser; by which he must have preserved, or recovered, the figure of the polisher, and, consequently, of the mirror, that otherwise must have become vitiated, by the unequal resistance of the pitch; and Mr. Edwards made furrows in the coating of pitch, on his polishers. It is to these circumstances, and not to the direction of the motion employed, or the elliptic area of the polisher, that, I can think, was owing the success, attendant on their methods: the bruiser being necessary, to supply the defect of furrows in the pitch; and the oval form not essential, when there were such, duly disposed, and also the polisher of proper size, &c. as here directed.

by straight strokes across the polisher, in the transverse diameter of the ellipse, to traverse that part of it, which circumscribes the circle; and, by such strokes made twice, directly in that diameter, and oftener obliquely, in each rotation of the mirror, as the operator moves round the polisher, during the process, the regular shape of the polisher is preserved. But it is easy to conceive, that the same effects would follow, though the polishing were conducted, not by straight strokes across, but by round strokes, in a spiral direction, as above-mentioned. And I am doubtful, to which of these motions the preference should be given; or whether they ought not to be interchangeably used, to produce the most elaborate form in the mirror; as also, whether this method, of Mr. Edwards, is better than the former, by Mr. Mudge, above described. For I have been deprived of leisure and opportunity (by the war, and public troubles, during the French invasion and the rebellion; in which, most of my instruments, for such purposes, were lost, in the plunder and destruction of my house,) to prosecute the experiments, which might have enabled me to speak with more precision; and which I would have done, from the desire I had, to contribute to the perfection of so noble an instrument as the reflecting telescope.

I know, that both methods will, in judicious practice, produce the desired effect; but this effect will be limited, in degree of perfection, and sometimes frustrated, when the causes and circumstances, that operate in it,

are

are unknown. In either method, and with a polisher of round or oval shape, it is indispensably necessary, that there should be furrows made in the coating of pitch, (to allow it to subside, in regular gradation, from the middle to the edges,) by indenting it, either in squares, as is usually done, or in circular channel ; both which must be renewed, as they become filled up and obliterated; which will always happen soonest in the middle zone or tract of the polisher, between the center and outer edge, whether the furrows be circular or longitudinal: and, if this be not done, the regularity of curvature would not be preserved in the mirror, or the polisher. But, since there is no obstacle to the subsidence of the pitch, near its outer edge, and its inner edge, when there is a void space at the center, I believe the furrows ought not to be made there, but in the intermediate space only. And I am of opinion that it is, from the judicious disposition of these furrows, the most correct shape of the mirror is to be acquired; whether the polisher be round or oval, or the pitch hard or soft: for I found, that, in Mr. Edwards's method, and with pitch, even as hard as he recommends, the channels made in it were, towards the end of the operation, nearly obliterated, in the middle zone of the polisher. But this will not happen so soon, nor so dangerously, with hard as with soft pitch; nor will the correction of the impaired shape of the polisher be so difficult, when it is of an oval, as when of a circular area: there being, in the former case, less of irregular surface in it, to be reduced; and a

more

more steady, uniform, and simple motion, in grinding, may be pursued; which, as it will admit of a less degree of expertness and sagacity in the artificer, will be more commonly attended with eminent success.*

The consistence of the pitch is, in this business, an article of the first importance. Soft pitch will give to the polish a higher lustre, and will less expose the face of the mirror to scratches: but, if it be too soft, the mirror will sink in it, like a seal in soft wax; and the figure of the polisher cannot be preserved, nor the furrows in it, from

* I imagine, that a polisher, whose area is of an oval form, would be better adapted to the formation of a parabolic, than an hyperbolic curvature, in the speculum; and that the latter will be most correctly formed by a polisher, whose area is nearly circular. For, in order to make the speculum hyperbolic, the longest diameter of the oval polisher must be considerably greater than the shortest one, i. e. than the breadth of the mirror; as will be evident, from a consideration of the circumstances I have endeavoured to explain. And, as the mirror must be carried, by the strokes in polishing, to the extreme verge of the polisher; so, when it is to traverse it, in the direction of its longest diameter, it will have its center or vertex removed too far from that of the polisher, to acquire from it a true conoidal figure. Either, therefore, the face of the polisher should be round; or, if it be oval, it ought to be rendered a less eccentric ellipse, by having its shortest diameter greater than that of the mirror, which will allow the extent of the polisher to be reduced, by contracting proportionably its transverse diameter; i. e. it must be brought nearer to a circular figure. For the objection, mentioned by Mr. Edwards, to a round shape of the polisher, when it is to be considerably larger than the mirror, viz. "that it makes the latter grind perpetually into a segment of a "larger sphere, and by no means of a good figure," I apprehend to have chiefly arisen, from an omission, in those who tried it, to make furrows in the pitch, in the proper tract, on the surface of the polisher; which, if it had been done, would have produced, not a spherical, but a conoidal figure.

from being defaced. It must, therefore, be always harder than common pitch is, in a mean temperature of the air in this climate. And, after the polishing powder is bedded in it, (which must at first be laid on so copiously, that the pitch may not rise up to the surface, between the particles of it,) and when the mirror has been worked on it a little time, then all the loose particles of the powder ought to be washed off, from the edges and furrows of the pitch, with a sponge or brush, (made of fine hair,) under water, that no grains may get on the surface, and injure the polish. And, if this be attended to, and the pitch be a little softened by heat, when the powder is first applied, it may be used of a consistence hard enough, without inconvenience: but, if it be made so hard, as not to sink at all, or expand itself, under the mirror, I believe it will never communicate to it a perfect figure.

From what has been here laid down, it must be obvious, that, by diminishing the size of the polisher, whether it be of a circular or elliptic shape, the curvature of the mirror will be brought nearer to that of a circle; and, by enlarging the polisher, the curvature will approach to that of an hyperbola, when the precautions here given are observed. Both these may be done, by spreading the pitch on the polisher, to a greater or lesser extent.

In the Gregorian telescope, the excess of curvature, in the great mirror, may be remedied, by a defect of it in the little mirror, and vice versâ. It must be desirable, to a fabricator of this instrument, to understand why this is so; and how a change in the curvature may be effected: for an artist cannot well execute a project, the design of which is to him unknown; nor improve by trials, even repeated, if they are made in the dark. I apprehend, that, in this kind of telescope, the mirrors are commonly selected, out of a number finished of each size, as they happen to suit each other: and, if there should be but few pairs in the assortment, whose irregularities compensate one another, few good telescopes will be produced. This would be less frequently the case, and the Gregorian telescope be more improved, if a more certain method were known, of giving, to each pair, their appropriate figure at first, or of altering it in either, where it is defective. Perhaps persons, not much versed in optics or geometry, may be assisted, in discovering the evil, and the remedy, from the following remarks; which are given in words, in order to dispense with a diagram.

The curvature of the circumference of a circle is uniform in every part, being (in an arch of it, of a given length) so much the greater, as the radius is smaller, and vice versâ. But the curvature of the ellipse, parabola, and hyperbola, is not uniform, but continually diminishes, from the vertex of these curves, (which answers, in the present case, to the center of the mirror,) to the extremity on each side: but it diminishes less in the ellipsis than the parabola; and in this than in the hyperbola. So that, if we suppose a bow to be bent, at first, into an arch of a circle, and, when gradually relaxed, to become, towards its extremities,

extremities, more and more straitened, as it unbends, while the curvature, at the very middle, remains the same, it will successively form these three curves, in the above order. And, if concave mirrors had the same curvature with them, they would have the following properties.

If the speculum be of a parabolic form, rays of light, falling on it, parallel to its axis, or issuing from a luminous point in the same, so very distant, that they may be regarded as parallel, will converge, by reflection, to one point in the axis; which point is the focus. The same is nearly true of rays coming from luminous points not far from the axis, or lying in a very contracted field of view, so as to make but a very small angle with the axis: the rays, coming from each single distinct point in the object, are converged to so many single distinct points in the image, formed at the focus of the mirror. Hence, the excellence of a parabolic mirror, for the larger speculum of the Newtonian or Gregorian telescope.*

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* But, because a parabolic mirror reflects, to one point, rays, that fall on it, parallel to its axis, it follows, that it will not converge, to a point, rays, that are diverging or inclined to its axis. The former, (if the point, from whence they radiate, be in the axis of the mirror,) would be reflected from any line, drawn diametrically across the mirror, in a caustic curve double and cuspidated: the latter, (being in the same plane in which is the radiant point, infinitely distant, and the axis,) would form a curve nodated. So that the excellence of a parabolic mirror is for viewing remote, but not near objects. And a person might thus be deceived, who would judge of the goodness of a telescope, only from its rendering print legible, at a small distance, from whence the breadth of the great mirror would subtend an angle of sensible

If the mirror be of an elliptic, or oval, curvature, rays, issuing from single points, in, or extremely near to one of its foci, and falling on it, (such as the rays proceeding from the single points in the image, formed by the parabolic larger speculum,) will be converged to so many single distinct points, in the other focus of the elliptic mirror. Hence,

sible magnitude: for the pencils of rays that issue, diverging from each point of the printed letters, will be reflected, by the central part of the mirror, to a focus nearest to it; and the rays of each pencil, that fall on the exterior annuli of the mirror, will be reflected to points more remote from it. So that if, in the Newtonian and Gregorian telescope, the great mirror were of the correct figure of a parabola, and the little mirror, of the latter, were that of an ellipsis: and, if either telescope were adjusted to distinct vision, when the innermost zone only of the great speculum is exposed to the light; yet, the object would be indistinct, if seen by the rays reflected from the outer zone, unless the little mirror were removed farther from the great one. Hence, a spherical mirror is better than a parabolic one, for viewing very near objects; and neither of them can be equally adapted for viewing these and very remote objects. The distinctness of the telescope is, therefore, best proved, by directing it to the stars: if it shews, clearly, the fasciæ, on the disk of the planet Jupiter, or the ring of Saturn, it will deserve to be approved of. I have ground and polished, in the manner here described, the mirrors of a little Gregorian telescope, of nine inches focus, which shewed these objects most distinctly; and I could not afterward, with much greater pains, execute another one, (neither indeed did I ever see one,) of that size, of equal accuracy: which served to convince me, of the exquisite correctness required in the figure of the mirrors, and of how great perfection the instrument is susceptible. Telescopes have been recommended, for their enabling persons to read gilded letters, at a considerable distance: but this is an improper method for determining their merits; for (beside the ground of error now mentioned) a much greater quantity of light is reflected from gilt letters, than from those of common print on paper.

Hence, the excellence of an elliptic figure, for the smaller speculum of the Gregorian telescope.* But the case is very different, in a spherical or hyperbolic mirror. From either

* But this will not be the case, if the rays diverge from points, so remote from the axis of this speculum, as to make a considerable angle with it, and to fall very obliquely on the speculum: which would be the case, if the field of the telescope were too large, or if the focus of the great speculum were too long, with respect to that of the lesser concave one: because, in either case, the image, formed, by the great mirror, which is the object, with regard to the lesser, will have too great latitude; and the extreme pencils, diverging from it, fall, with too much obliquity, on the latter, to be collected by it, to single points, in the second image. And, on this account, there is, in the Gregorian telescope, a limit set to the degree of magnifying, so far as this depends on the mirrors, be their figure ever so correct. And, if any aberrations prevail, in the image formed by the larger concave, they will be magnified by the lesser, were it perfect, in the proportion of the focus of the former to that of the latter. I am of opinion, that it is better not to aim at, a high degree of magnifying, by the little mirror of this telescope; but, to endeavour to secure the correctness of the second image; and to lay the chief stress of the amplification (as it is in the Newtonian telescope) on the eye-glasses; because of the above circumstance, which no correctness, nor compensation of the mirrors, can remedy. From this inconvenience, here stated, the Newtonian telescope (the most perfect of all the constructions, that ever were or ever will be devised) is entirely free. This the author effected, by putting the eye-glasses on a different axis from that of the mirrors; by which he was enabled to make the lesser mirror a plane surface. And it will appear, on due consideration, that he was obliged to introduce this change, in Gregory's telescope, of necessity; and not from a low ambition, to which his mind was superior, that of obtruding his own inventions, to supplant those of equal merit by other men; though he has not stated all the imperfections of the Gregorian form, nor the advantages of his own; having only, in answer to objections, and, as it were, reluctantly, mentioned the chief circumstances, justifying the alteration he had recommended.

either of these, the rays, which issue in a cone or pencil, from single, luminous, distinct points, in a very remote object, and fall on them, will not converge again, to so many single points; but will, in the mean focus of the mirror, be dispersed, and blended together in a small degree, yet sufficient to produce an universal haziness and indistinctness, over the whole surface of the object viewed in a telescope, having its large mirror of these forms, because it occurs, with respect to every point in such object; of which the following are the circumstances.

If the mirror be spherical, those, rays, nearly parallel of each pencil, which fall on it, next to its center, will converge to a point more distant from the mirror, than the focus of any rays, that fall between the center and outer edge of the mirror. And those, that fall on the outer extremity of it, will converge to a different point, nearest to the mirror: and the rays, which are incident on the several concentrical annuli, indefinitely narrow, of which the face of the mirror is composed, will have an indefinite number of points of convergence; each annulus its own point, and all lying in a series, in the axis of the pencil, between the points, or foci, of the extreme, and of the innermost annulus.* So that no entire incident pencil

* This property of a spherical mirror has never, so far as I know, been synthetically demonstrated, by any optic writer, though it is a fundamental theorem in catoptrics. Mr. Robins derisively objected to Dr. Smith, that he had

pencil will, after reflection, converge to one point, unless the radiant point were in the center of curvature of the mirror.

The property of an hyperbolic mirror is of the same nature, but with effects reversed: for, in this, the rays parallel to its axis, which are incident on its outer annulus, will converge to a point the most distant from it; and the rays, falling on its innermost annulus, will have their focus the nearest to it. And this is easy to comprehend: for, as the curvature of the hyperbola continually diminishes from its vertex, on each side, a parallel, or diverging pencil, falling at a distance from the vertex, on a mirror of this form, must (as in the case of a mirror of greater radius, i. e. of less curvature) have its focus formed farther from it, than if it were incident near the middle or vertex, where the curvature of the mirror is that of a circle of lesser radius.

And thus it is evident, that, as the several pencils, reflected by the great mirror, when it is spherical or hyperbolical, do not converge, each to a single point, but to a series of points, whose length is the depth of the focus of the mirror; so, neither do these pencils, in proceeding on to the little mirror, diverge each from a single point, but from the same series of points. So that, though

had not demonstrated it. The Doctor, I believe, might have retorted the same charge on Mr. Robins. I have some reason to think, it is difficult to give such a demonstration of it, and that it will reflect credit on the person who furnishes it.

though the little mirror were formed truly elliptical, it would not make each of these pencils converge again (at the place of the second image, formed behind the first eye-glass) to single points, but to another series of points; by which the rays of contiguous pencils would be blended with one another, and make the object which is viewed, by means of these pencils, so transmitted to the eye, and, by it, refracted to a third series of points, near the retina, at the bottom of the eye, appear hazy and indistinct.

These remarks will be applied to our present purpose, by considering:

First. That the rays, reflected by the several annuli, in the surface of the great mirror, will fall on the annuli of the same order, in the little mirror; the rays from the outer, inner, or intermediate annuli of the one, proceeding to the like annuli in the other.

Secondly. That the farther the focus, or point of convergence, of any annulus of the great mirror, is distant from that mirror, the nearer will be the point of divergence of this part of the whole pencil, (among the series of such points), to the little mirror. Also, that the interval, between any one point in the series and this mirror, cannot be altered, by moving the mirror, without altering the intervals of all the rest; which, after the telescope is brought to the distinctest vision, cannot be permitted.

Thirdly. That, if the focus of any annulus, of the great mirror, be farther from it, than those of the other annuli,

nuli, and, consequently, nearer to the little mirror than those; the rays, issuing from it, to this mirror, will not be reflected by it, to the same point with those of the other annuli, unless the curvature of the corresponding annulus, of the little mirror, be encreased, in the proportion of its radius to that of the great mirror: for, then only will the focus of rays, reflected by this annulus of the little mirror, be shortened, as much as, by the effect of that of the same annulus, of the great mirror, it would otherwise be lengthened. The same is true, vice versâ, if the focus of any annulus, of the great mirror, be shorter than those of the other annuli.

Fourthly. That, if there be any excess or defect, in the curvature of the great mirror, from that of a parabola, (and, consequently, a contraction, or elongation, of the foci, of the extreme rays of the reflected pencils,) there is no remedy, while this remains, but to make the little mirror so much deficient, or excessive in curvature, from that of an ellipse, (and, consequently, to lengthen or contract the foci of the extreme rays of the pencils reflected by it,) as its focus is, in proportion to the focus of the great mirror; there being no other means of reducing all the rays, of each pencil, to one point, at the second or conjugate focus of the little mirror: by which alone, the second image, consisting of such points, can be formed, and viewed distinctly, through the last eye-glass.

From all which, it is manifest, that, if the curvature of the great mirror be hyberbolical or deficient, then that of the little mirror ought to be spherical or excessive; and, if the great mirror be spherical, the other must be parabolical or hyperbolical, according as its focus is long or short, in respect of that of the great mirror.

Should the telescope be faulty, from indistinctness of vision, it may be corrected, by altering the figure of either of the mirrors, as shall be most practicable. And, to know what the alteration should be, the method, directed by Mr. Mudge, may be followed, of excluding the light from the central, middle, or extreme zone of the great mirror, by fixing, on the mouth of the tube, three annular diaphragms of pasteboard &c., answering, in size and shape, to these zones respectively; by removing any of which diaphragms, the light will be admitted to the corresponding part of the mirror. If, then, by help of the adjusting screw, the object be first viewed distinctly, when the inner or central zone, only, of the mirror is uncovered to the light; and it be necessary, afterward, when it is seen by means of the exterior zone only, to remove the little mirror farther from the great one, (by turning back the adjusting screw,) in order to distinct vision: then one, or both of the mirrors, is deficient in curvature, i. e. the great one is hyperbolical, or the small one parabolical. And, on the contrary, if it be necessary, in this process, to bring the little mirror nearer to the great one; then one or both of the mirrors is spherical. For, in the former case, it is plain, that the mean focus of the outer zone of the little mirror is nearer to the

the second eye-glass, than that of the inner zone; since it is necessary to withdraw that focus, by putting back the little mirror: and the contrary is evident, in the latter case. The former could happen, only by the focus of the extreme rays, of each single pencil, being too far from the great speculum, (i. e. from its being hyperbolical,) and too near to the little one; or from the latter being deficient in curvature, near its edges; and thus throwing the focus of the rays, that fall there, too far from it, and too near to the last eye-glass. The second effect could arise only from a figure of the mirrors, the reverse of this. In the Newtonian telescope, there can be no doubt, where the defect of curvature is, because it has but one concave mirror.

When it has been thus determined what the defect is, means must be employed to correct it; and it may be expected, that, unless some certain mode, of effecting a different curvature of the great mirror, from that of the little one, is discovered, and skilfully practiced, there will be but few good telescopes, of the Gregorian form, constructed. For, if both mirrors be polished, in the same manner and method, it is likely, that the defects in their figure, and the species of their curvature, will be the same in both. Whereas, it has been shewn, that all these ought to be directly contrary in one, from what they are in the other; referring to the parabola and ellipse, as the standard degrees of curvature.

 Now,

Now, the circumstances, which, in the method of polishing above-mentioned, have a tendency to produce particular species of conoids, have been already explained, and need not be repeated. But, as to the means of altering any figure already given, to the great mirror, in the Newtonian telescope, or to either of the mirrors in the Gregorian, which happens to be unsuitable to the other one; I have to observe, that, in my trials, I have found this could be effected on the polisher, without putting the metal to be ground again upon the hones. For if it has, at first, been formed to a tolerably correct figure, of any species, then a very small reduction, of the substance of the metal, will produce a sufficient alteration of its form. If the change required consists in a diminution of curvature, a continuation of the process, under the regulation before-mentioned, will, without any alteration of the polisher, generally, be sufficient to produce it, from the degree of curvature of a circle, to that of the ellipse, parabola, or hyperbola, in order; or from any of these, to the others, in succession.* But, if the degree of curvature, already

* Here it may be proper to observe, that, as the curvature is constantly diminishing, by the mere continuance of the operation, so the process is not to be pursued any longer, after the polish, and the desired figure, are found to be perfected. And the metal must always be brought to a very fine face, and a correct spherical figure, on the hones, or on a leaden tool, bedded with the finest washed emery, before the process of polishing commences: because, if all scratches, from the grinding, be not previously obliterated, the polishing must,

already given, is to be increased, and to verge more towards the circle, as the limit, (beyond which no contrivance could carry it,) then the polisher must undergo an alteration. Its breadth should be diminished; the space, at the center, left uncoated with pitch, should be greatly contracted; and, in the case of the little mirror, which has no perforation in it, entirely filled up; save that a small hole, through the polisher, tapering, from the back of it, upwards, to its surface, should be left, for the pitch to sink into, when it becomes closed, and too much compressed, at the center; and the furrows, in the pitch, gradually deepened towards the edges. I believe, that (for the reason before given) the uncoated space, at the center, ought always to be as much smaller, on every side, than the perforation in the mirror, as the greatest range of the strokes, in polishing, advances the center of the mirror beyond that of the polisher, having the same shape as the polisher itself; and that it ought to be smallest, or no other than as just mentioned, when there is no hole in the mirror.

I have,

must, in order to efface them, be continued so long, as to diminish the curvature of the mirror beyond what is requisite; especially, if the area of the polisher be not of an oval, but of a round shape; which latter has a greater tendency, than the former, to diminish the curvature of the mirror, and to render it hyperbolical. And the correction of this, afterward, might require a troublesome alteration of the polisher, or even make it necessary to put the metal again upon the hones: and yet, in the Gregorian telescope, the hyperbolic figure is the proper one, for either of the mirrors, if that of the other speculum be spherical.

I have, in this method, with certainty of success, as verified by examination of the progressive change of curvature in the mirrors, from a greater degree to a less, and vice versâ, effected the desired configuration of them: which serves to confirm me in the belief, that the circumstances, above proposed, are those which are really operative, in communicating the diversity of figure to telescopic mirrors; and that neither the direction of the strokes in polishing, the size or form of the polisher, consistence of the pitch made use of, or other accidents, are of any farther moment in the process, than as they serve to modify the resistance of the pitch, in the several parts of the surface of the polisher. Whether, by attention to the principles here laid down, it would be possible to produce an hyperbolic form, in the convex mirror of the *Cassegrain* telescope, I have been prevented from endeavouring to ascertain by experiment, from those casualties, affecting my situation in life, which I have already intimated. But it should seem, that it would, to a certain degree, be practicable, from the means I have suggested, of producing a progressive, specific alteration in the figure of the polisher; if I have judged rightly of the existence and cause of that alteration.

And if it should be found possible to give, to a convex speculum, an hyperbolic curvature, the same could be done to the convex object glasses of dioptrical telescopes: which is a property still wanting to them; a want which makes them inferior to reflectors, even when they have been rendered

dered achromatic, if the aberrations from their spherical figure remain, after those from refrangibility are removed: which aberrations, taken laterally, as they always ought to be, are as the cubes of the apertures. So that, if the lineal aperture be doubled, and the light admitted, which is as the square of the aperture, quadrupled, in order to increase the magnifying power four times, (or to double the lineal amplification,) preserving an equal brightness in the image; the telescope must be made four times longer, that it may remain equally distinct;* an inconvenience, from which it must be very desirable to exempt this telescope, by correcting the figure, and, with it, the aberrations of its object glasses.

It is not the object of this essay, to investigate any particulars, in the construction of the telescope; (which would

* A conception of this may be, perhaps, most familiarly acquired, by considering, that if, of two object lenses, the aperture, and also the focus of one, be twice as great as those of the other, the angles of incidence, and refraction, of the extreme rays, which come from a very remote object, and form the cones or pencils made by both, will be equal; and the pencils themselves, and their aberrations, will be similar figures; all the lineal measures of that of the larger lens, being double those of the other. In order, therefore, to reduce the lateral error or diameter of the circle of aberrations of the former, to an equality with that of the latter, while the aperture, which is the base of the pencil, remains double; this pencil must be made twice more narrow or acute than before. And, to effect this, its length or focus (which, at first, was twice as great as that of the other pencil) must be doubled; so that now it must be four times as long as the smaller pencil: i. e. the lengths should be, as the squares of the apertures.

would open a large field of enquiry;) but to try to assist mechanical contrivance in its fabrication. To this end, I think it fit to add a remark, on the property of the pencils of rays, respecting the latitude of each of them, where they fall on the pupil of the eye; first discovered by the great Mr. Huygens: as I suspect, that the inconvenience he mentions, as resulting from a certain breadth of the pencil, may casually exceed the limit stated by him, and may admit of a practical remedy.

He observes, that if the latitude or breadth of the pencils, at the pupil of the eye, be very small, (so as not to exceed, if I remember right, the sixtieth part of an inch,) the vision, by the telescope or microscope, will be indistinct; so that, unless the pencils be of greater breadth than this space, at the place of the eye, the instrument will be defective: and he attributes this to something in the natural conformation, or in the humours of the eye; which, consequently, will admit of no remedy. On this may I presume to observe, that the latitude of the pencil, as it enters the eye, is the same as that with which it falls on the last eye-glass; and, that the effect of it, which Mr. Huygens attributes to the eye, may, therefore, as naturally, be attributed to the eye-glass, as to the eye; especially when an anatomical dissection of it will demonstrate, that the perfect transparency of its humours, and exquisite polish of its cornea, or outer coat, (not to talk of its achromatic property,) far exceed, in this optic instrument of the Deity, any thing that can be manufactured

by

by man. In fact, the polish given to the eye-glass, and the transparency of the glass itself, is always imperfect; and many points in its surface, which ought to serve for the regular transmission of light, will be obstructed by its roughness and opacity: so that, if the pencils occupy but a very little space on the lens, no points of fair transmission may there remain; and the few rays, that pass through, may be so distorted, by irregular refraction, and inflection, in the glass, and in the eye-hole, that the vision must be indistinct. And this was the more likely to happen, in Huygens's time; because, neither the fine polishing powder, of colcothar of vitriol, was then in use; (and Mr. Huygens used nothing but tripoli;) nor was the method of polishing, by the help of pitch, divulged by Sir Isaac Newton. If this conjecture be right, the remedy is, to use both these helps, in communicating an exquisite polish to the eye-glasses; especially the smaller one, where the breadth of the pencils is reduced, in the same proportion as its radius, or as the increase of its magnifying power: and, also, to avoid using flint glass for this purpose; as it is found to be the least transparent of any, as well as most dispersive.

I may here also observe, that, as the transparency and polish of glass must ever be, to a certain degree, imperfect; so the projected improvement of Mr. Ramsden, to avoid the dispersion of the rays, by throwing the image just before the first eye-glass, is unlikely to answer: because, in this case, each of the pencils would occupy little more

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than a point, on the surface of the lens; and, if that point should be opaque, or unpolished, or covered with dust, no rays of the whole pencil could be transmitted through it: which would, probably, happen to too many of the pencils, and affect the image, which is composed of these pencils; whose latitude, therefore, ought to be greater than the limiting measure stated by Mr. Huygens. And, to effect this, with as high a charge as the instrument will bear, a part of the amplification should be thrown away, on the first eye-glass, and diminished, by shortening its focus; that the pencils being, by it, rendered more obtuse, may fall, with greater divergence, and latitude, on the second eye-glass, which may thus be made shorter, and on the eye. For it is not to be supposed, that the image, formed in a telescope, can be viewed, by a small lens, with as much advantage as an object may. The rays, from each point of the latter, fall upon the whole surface of the lens; and, therefore, a sufficient number of them, to fill the pupil of the eye, must be transmitted: whereas, the rays, from each point of the image, occupy only a small speck on the lens; in no case larger, in effect, than the pupil of the eye: and must, when so contracted, be the more obstructed, by any imperfections in the glass.

As, therefore, the fineness of the powder, employed in giving the highest lustre and polish to the specula, and to the eye-glasses, is of great importance, in that process: and, as I found, that the crocus, or colcothar of green vitriol, (now used, as the fittest for that end,) could seldom be be procured, so free from grittiness, as to be capable of levigation, to a sufficient degree of fineness; insomuch, that I was obliged to attempt to make it myself: it may be useful to state, that, by the following easy method, I succeeded in producing some of excellent quality.

Considering that the vitriol, distilled in close vessels, might probably contract this grittiness, in its calx, from an union of some of its component parts, or principles, with the water contained in the vitriol, (which is the metallic salt of iron,) and that this might prevent its perfect calcination; I thought it best to perform the distillation in the open air, and to begin with exhaling the water. Accordingly, I commenced with slowly roasting the vitriol or copperas, broken into grains as small as shot, by holding it over the fire, on a fire-shovel, till the moisture in it appeared to be dried away. I then put it into a crucible, and kept it uncovered, in a clear fire, till it had been some time red hot;* by which, the spirit or oil of the vitriol was distilled from it, and the calx or colcothar remained, of a brownish red colour, and of a perfectly equal texture, entirely free from hard or gritty particles: and it was easily levigated, when moistened with water,

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* I suppose that the fire ought not to be too high, or too long continued, in this process, lest it should convert the calx of the iron into glassy scoria. Experiments will determine the due regulation of the heat, so as to ensure success to the operation in every instance. The heat ought to be so great, as to give the colcothar, not a brown, but a red colour.

on a piece of looking-glass-plate, by a piece of the like glass having a handle of brass cemented to it. This furnished a very fine and impalpable powder, capable of communicating to the specula, or lenses, the most exquisite polish and lustre.*

To apply with precision, and afford a fair trial of the method of polishing I have recommended, it is necessary farther to consider, that the advantages, resulting from correctness of figure, in the mirrors, may be frustrated, by an undue position of them, or of the lenses, in the instrument, or by a defect of form in the lenses, whose edges may happen to be thicker on one side than on the other; i. e. they may not be complete, or equally curtate segments of spheres; and, consequently, that a proper trial and estimate cannot be made, of the figure of the mirrors, unless these and the eye-glasses be right in these respects; especially in the Gregorian telescope, whose adjustment is a matter of more nicety and difficulty, than that of the Newtonian. And since, in the former, the surfaces of the mirrors and lenses ought all to have one and the same axis, viz. that of the instrument, in which are to be all their foci; it is necessary this should be cautiously ascertained: because contrary deviations of them, in this respect, might apparently compensate one another, and escape detection, though they would really be attended with the aberrations of enlarged apertures.

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* The same powder, spread on leather, would give the smoothest edge to razors and lancets, &c.

The center of the great mirror ought to be in the common axis of the instrument; and the position of it in its cell, in the tube, may be known thus. Let the little mirror be taken out of the tube; and let the round, central diaphragm, before-mentioned, (which ought to be made of a flat piece of tinned plate, or a brass plate, made clean and bright enough, to reflect the light strongly, but not polished,) be fastened across the mouth of the tube, exactly in the middle of it; and let a round hole be made through the plate, the center of which shall be in the axis of the tube, and its diameter so large, as that the whole disc of the sun may be viewed through it, at the eye-hole of the telescope, when the eye-glasses are taken out. Then, directing the instrument to the sun, or the full moon, when very bright, so as that its whole disc shall be seen through the hole in the diaphragm; (using a lightly tinged screen-glass, to look at the sun;) if the light, reflected from the great mirror to the diaphragm, occupies on it, a circular area, concentrical with the hole made at its center, the mirror is rightly placed, and its focus is in the axis of the tube. But, if the edge of the illuminated circle approaches nearer to the hole in the plate, on any side, the same side of the mirror inclines toward the axis of the tube, its cell not being exactly vertical to it; or otherwise, the center of the mirror is not in that axis, as it ought to have been. If the outer one, of the three aforesaid diaphragms, be, at the same time, applied to the mouth of the tube, so as to expose

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only the middle zone of the great mirror to the light; the circle of light, reflected by it, to the central diaphragm, will appear better defined on it.

But the adjustment of both mirrors and lenses may, at the same time, be proved, by the following most easy and certain method, if exactly pursued.

Having provided, that the little mirror shall be so supported, that its center may always move in the axis of the great tube; and proved that it is so, as Mr. Edwards prescribes, by taking off the mirror, and seeing, through the eye-tube of the telescope, (without the lenses,) that the hole, in the middle of the little round plate, to which that mirror is screwed, concentrical with the plate, corresponds with the intersection of two cross hairs, tied diametrically across the mouth of the tube: then let the little mirror be replaced, and the eye-tube taken out, and let the telescope be directed to the sun's center; which may be done, by the help of the little dioptrical telescope, called *a finder*, affixed to the instrument, if it be furnished with such; or otherwise, may be effected, with sufficient exactness for this purpose, by pointing the telescope to the sun, so as that the shadow of the little mirror may coincide with the hole, in the great mirror; which will be, when the great tube is so placed, as to project its shadow of a circular form. In these circumstances, let the light, reflected from the little mirror, through the round perforation in the great one, be received upon a plane, placed at some distance behind the latter,

latter, at right angles to the axis of the tube. The light will occupy a circular area on the plane; and, if the center of the light be coincident with that of the shadow of the little mirror, this mirror is not only parallel to the great one, but both are duly adjusted, at right angles, to the axis of the tube; which, also, then corresponds with their axes. But, because the little mirror and its shadow, and also the cone of light, reflected from this mirror, are of greater breadth than the perforation in the great one; the boundaries of the reflected light, and those of the shadow, cannot be seen wholly on the plane, through the hole in the great mirror; in any one position of the telescope. Let, therefore, the axis of the telescope be a little diverted from the center of the sun, till the shadow of the edge of the little mirror falls within the hole in the great one: by which, some direct light will pass through, next the shadow, and appear on the plane, in form of a crescent; and, at the same time, the circle of the reflected light of the sun will have moved across the shadow: till, by a certain degree of obliquity, in the direction of the telescope, the edge of the circle of the reflected light will be in contact, externally, with the crescent of the direct light. And, if the crescent be always of the same breadth, when this contact takes place, on every side, by a diverting of the telescope, from the center of the sun, successively, in every direction; then both the mirrors are parallel, and at right angles, to the axis of the instrument. But, if the crescent be broader, in any certain position of the tube, when the circle of reflected light just

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touches its edge: then the side of the little mirror, corresponding with that of the illuminated circle, where it is in contact with the crescent, makes too great an angle, with the axis of the instrument; and it must be reduced to a right angle, by screwing forward the adjusting screw of the little mirror, in that part, having previously withdrawn the opposite screws. When the mirrors are thus found to be rightly placed, and the eye-tube and lenses are restored to their places; if the whole image, of the great mirror, be not visible in the eye-hole, when this is in the common axis of the instrument, then the lenses are defective: either, some of them, or some of their surfaces, or the tube they are fixed in, being inclined to the common axis; and, by this means, distorting the cone of rays, from it. Which irregularities must be rectified, before a true estimate can be formed, of the correctness of the mirror's curvature.

The distance from the smaller lens, at which is the point of decussation of all the pencils of light, and the place where the eye-hole ought to be, may also be most easily and most accurately found, by directing the telescope to the sun, having taken off that part of the eye-tube behind the lenses; and letting the light fall on a plane, moveable back and forward, behind the second eye-glass, and kept at right angles, to the axis of the specula and lenses: the place, at which the image of the great mirror, with the shadow of the little mirror described on it, is seen most distinctly formed on the plane, ought to be the place of the eye-hole.

SYNOPTICAL VI

BY R

1804.	BAROMETER.			
	HIGHEST.	DAY IT HAPPENED.	LOWEST.	DAY IT HAP
January. . .	30,30	2d, 3d and 4th, var.—W. by N. S. to W.—S. E. to N. W.	28,86	28th, S.W. to
February . .	30,87	21st, W.	29,10	11th, N. . . .
March	30,20	21st, E.	29,30	6th, W. . . .
April	30,40	6th and 7th, W. to S. W.	29,44	25th, S. W. .
May	30,67	7th, W. by N.—E.	29,59	25th, W.—W
June	30,67	11th and 12th, E. to W.—W. to E.—E. foggy	29,80	7th, S. W. - N W.—S.W
July	30,50	12th, S. to W.—E. N. and W.	29,58	27th, S. to V
August . . .	30,60	1st, E.—E. by N.	29,50	10th, W. . .
September .	30,80	26th, W.—N. by E.	29,96	14th, S. by
October . .	30,34	9th, W.	29,23	30th, E. . . .
November .	30,66	3d, E. to E. by N.—E. to N. E.	29,45	10th, E. . .
December .	30,80	19th, E. to S. E.—E. by N.	28,96	13th, S.—W
MEAN OF THE YEAR	30,567		29,397	

SYNOPTICAL VIEW OF THE STATE OF THE WEATHER AT DUBLIN,

IN THE YEAR 1804.

BY RICHARD KIRWAN, ESQ. L. L. D. F. R. S. P. R. I. A. &c.

READ, FEBRUARY 11th, 1805.

1804.	BAROMETER.					THERMOMETER.			RAIN.		STORMS.
	HIGHEST.	DAY IT HAPPENED.	LOWEST.	DAY IT HAPPENED.	MEAN OF THE MONTH.	HIGHEST IN THE DAY.	LOWEST AT NIGHT.	MEAN OF THE MONTH.	NUMBER OF DAYS.	INCHES.	NO. WINDS THAT PREVAILED.
January . . .	30,30	2d, 3d and 4th, var.—W. by N. S. to W.—S. E. to N. W.	28,86	28th, S.W. to W. foggy	29,65	55,5	26,	43,095	23. And on 1 there fell some snow,	3,15078	2. S. W.—from W. to E.
February . .	30,87	21st, W.	29,10	11th, N.	30,33	49,5	24,	39,750	17. And on 2 of which fell snow,	0,709375	
March	30,20	21st, E.	29,30	6th, W.	29,78	55,5	29,	41,495	24. And on 8 some snow, ...	4,348204	2. W. and N.
April	30,10	6th and 7th, W. to S. W.	29,44	25th, S. W.	29,96	62,	28,	44,530	20. And on 3 some snow, ...	1,366191	
May	30,67	7th, W. by N.—E.	29,59	25th, W.—W. to S.	30,05	70,	41,	54,860	22.	2,220076	
June	30,67	11th and 12th, E. to W.—W. to E.—E. foggy	29,80	7th, S. W. W. and N. W.—S. W. to W.	30,34	77,	46,	59,790	12. And on 1 a shower of hail, . .	1,655209	
July	30,50	12th, S. to W.—E. N. and W.	29,58	27th, S. to W.—W.	30,07	73,5	46,	60,150	17. And on 1 thunder and lightning,	2,837502	
August . . .	[illegible]	1st, E.—E. by N.	[illegible]	10th, W.	30,42	71,	45,	59,750	21.	3,229609	1. W.
September .	[illegible]	[illegible]th, W.—N. by E.	[illegible]	11th, S. by W.	30,23	75,	40,	58,905	15.	0,709375	3. W.—S. W.
October . . .	30,31	9th, W.	[illegible]	30th, E.	29,82	65,	30,	51,150	24.	3,242729	5. E.—S.—W.—S. by W.
November . .	[illegible]	[illegible]d, E. to E. by N.—E. to N. E.	29,15	10th, E.	30,07	56,	35,	45,740	21. And on 1 some hail, ...	3,150780	4. W.—N. E.
December . .	[illegible]	14th, E. to S. E.—E. by N.	28,96	13th, S.—W. by N.	30,00	50,5	31,	[illegible]	17. On 1 some snow fell, and on 2 showers of hail,	4,115892	6. S. E.—W.—W. by N.
MEAN OF THE YEAR	30,567		29,397		30,060			49,916	251.	30,033722	23. Total.

ON SPACE AND DURATION.

BY RICHARD KIRWAN, ESQ. L.L.D. F.R.S. & P.R.I.A.

READ, MARCH 4th, 1805.

NOTHING has contributed more to the growth and diffusion of that general scepticism, so prevalent in the last century, with respect to all questions that cannot be decided by the immediate testimony of the senses, as the inextricable difficulties that were supposed to attend the nature of objects most familiar to all mankind, and unhesitantly conceived to be thoroughly understood; for it seemed natural to conclude, that if, upon examination, we find an exact notion, even of these, impossible to be attained, we have reason to suppose, that other objects, with which we are not so well acquainted, are placed beyond the reach of human faculties: thus argued Bayle (Zenon), thus Hume reasoned. Now, certainly, no objects are more familiar to us than space and duration; and, in perplexing the notions of these, they have exhausted the whole force of their subtlety. If, on the contrary, it can be shewn, that the notions of these are perfectly plain and intelligible, in the sense in which they are universally taken, and that the absurdities, that have occurred in explaining them, might easily be avoided, by only adhering to their known signification, one stumbling-block, in metaphysical inquiries, will be removed.* This, then, is the purport of the present paper. But moreover, to shew the necessity of investigating subjects, which seemingly require no discussion, the difficulties that occurred on considering them, with the different opinions they suggested, must previously be stated.

The different systems of the Epicureans and Peripatetics, gave the first occasion to the controversies concerning the nature of space. The Epicureans admitted a vacuum, or empty space, as one of their first principles. The Peripatetics allowed, indeed, the possibility of a vacuum, but denied its existence. Des Cartes, in examining the question, denied even its possibility; asserting, that space necessarily implies extension: but a mere nothing, or nonentity, such as a perfect vacuum, if it existed, must be allowed to be, can have no properties, and, consequently, cannot be extended; for it would be absurd to say, for instance, so many *acres of nothing*. His disciples farther insisted, that space must be either a substance, or the modification of some substance, as, between these, nothing intermediate can be supposed to exist: but *space* is not a mode of any substance; therefore, it must, itself, be a substance, and, consequently, can never be supposed empty.

To

* It is strange, that so eminent a metaphysician as Condillac should say, that we know nothing of the nature of space or duration. Art de Penser, p. 115, in 12mo.

To evade the force of this reasoning, the Peripatetics and Epicureans made different replies. The former said, that empty *space* is a mere capacity or possibility of receiving bodies; and, that its extension is only the possible extension of such bodies as may be placed in it. But this answer was soon found to be unsatisfactory; for the space, *actually* existing between two distant bodies, would remain unaltered, even if all the intervening bodies were annihilated. Moreover, the capacity of receiving bodies, is merely the consequence of the vacuity of space, and not space itself. The Epicureans, as Gassendi and Bernier, followed by Le Clerc, supposed it to be a peculiar kind of being, which possessed no other property but extension. It was not, therefore, a spiritual substance, this not being extended; nor a material being, as it possessed no solidity, but a being *sui generis*. This opinion, appearing as untenable as the foregoing, from whence it differed only by being more fully explained, was embraced by no one else.

David de Rodon, an eminent Calvinist professor at Nismes, sometime before the year 1660, and possibly during the life of Des Cartes, struck with the absurdity of supposing any thing real and eternal besides God, advanced a very different opinion; as I find, by a letter from Bayle to La Coste, 4 Bayle, Oeuvres Posth. 845. He maintained, that space was nothing else than the Divine immensity. This opinion was embraced by Otto Guericke, about 1670, as Leibnitz thinks, and afterwards by the ce-

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lebrated Dr. Samuel Clarke. It appears in the first edition of his Sermons, in 1706; and, more explicitly, in his several replies to Dr. Joseph Butler, in 1713, and his correspondence with the celebrated Leibnitz, in 1715, as I shall presently mention; and was, also, long before, obscurely hinted by many of the scholastics. In the mean time, that is about the year 1690, Leibnitz proposed a new system, namely, that of Monads, or simple substances absolutely unextended, but from whose disposition or order, with respect to each other, the *appearance* of space resulted. A system, so ingenious and well connected, that, for many years, it met the approbation of the most distinguished philosophers in Germany, and the admiration of the rest of Europe.

A few years after, Mr. Locke published his inestimable Essay on the Human Understanding; yet, his sentiments, concerning space, are confusedly and rather inconsistently stated. For, first, without giving any definition of space, he divides it into solid, and empty. He tells us, we acquire the idea of the first, when we conceive *it* so taken up, by a solid substance, as to exclude all other solid substances, and hinder two other bodies, moving towards each other in a straight line, from coming into contact with each other.—But, if we conceive two bodies, at a distance, to approach each other, without touching or displacing any solid thing, until their surfaces come to meet, we thus acquire the idea of space without solidity, or pure space. Lib. II. cap. iv. §. 2, 3. And (§. 5,) he adds, " the

"the extension of body being nothing but the continuity "of solid, separable, moveable parts, the extension of "space is that of unsolid, inseparable, and immoveable "parts."——Here he plainly asserts, that pure space is extended, and consists of immoveable and inseparable parts.

In his 13th chapter, he states the idea of space more accurately; for he says it is the *distance* between any two bodies, or between the parts of the same body: that, if it be considered only *lengthways*, without considering any thing else between, it is called *distance*; but, if considered in length, breadth, and thickness, it may be called *capacity*. The term *extension* is usually applied to it, in what manner soever it is considered, §. 2 and 3.—But, in §. 4, he no longer considers space as *distance*, but tells us, "that each "different distance is a different modification of space."—Yet, as different distances are rather different relations betwixt the distant bodies, I do not well understand how they can be called modifications of space; modification being a term usually applied to substances, and not to relations.

§. 16, he asks those, who inquire whether space be body or spirit, who told them, that there could be no other being but body and spirit? and, if they again inquire, "whe-"ther this space be a substance, or an accident? he fairly "tells them he does not know." From all which, it is plain, he considered simple pure space as something really existing, and distinct from distance.

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And, accordingly, §. 21, he says, "if body be not "supposed infinite, which he thinks no one will affirm, "he asks, whether, if God placed a man at the extre-"mity of corporeal beings, he could not stretch his hand "beyond his body? If he could, then he would put his "arm where there was before space without body." And, chap. xvii. §. 4. he adds, "so far as body reaches, so far "no one can doubt of extension; and, when we are come "to the utmost extremity of body, what is there that can "satisfy the mind, that it is at the end of space, when "it perceives it is not?" and finally concludes, "that "space is infinite." And, §. 20, he denies, that the existence of matter is any way necessary to the existence of space.

In 1713, Doctor Berkeley first published his immortal work, on the Principles of Human Knowledge, in the cxvi §. of which he asserts, that pure space is nothing more than the possibility of motion, without the least resistance; and that, if all bodies were annihilated, there could be no motion, and, consequently, no space. And thus, he says, (§. cxvii.) "we free ourselves from that dan-"gerous dilemma, to which several imagined themselves "reduced, to wit, of thinking that real space is God; or "else, that there is something besides God, eternal, un-"created, infinite, indivisible, immutable; both which may "justly be thought pernicious and absurd notions." This opinion was afterwards adopted by Dr. Doddridge, in his

Lectures,

Lectures, p. 139; and by Mr. Condillac. *Art de Penser*, chap. viii.

At the latter end of the same year, an anonymous writer, stiling himself a Gentleman of Gloucestershire, but thought to be Dr. Joseph Butler, represented, to Dr. Clarke, some difficulties, which had occurred to him, in the Doctor's excellent treatise, intitled, *a Demonstration of the Being and Attributes of God;* for having there asserted, that the necessity of the Supreme Being must have existed *every where*, as well as always, Dr. Butler informed him he did not perceive any connexion between ubiquity and necessary existence. Dr. Clarke replied, that he considered space as a *mode* of the self-existing substance; and, being evidently necessary itself, proves that the substance, of which it is a property, must also be necessary. Nay, he adds, that extension is necessary to the existence of every being. In his third reply, he is still more explicit: for he asserts, that all other substances are *in* space, and are penetrated by it; but the self-existing substance is not in space, nor penetrated by it; but is, itself, as if it were, the *substratum* of space, the ground of the existence of space and duration. Dr. Butler, in his fourth Letter, owns himself convinced of what he at first doubted, that a necessary being must exist every where; and Dr. Clarke, in his answer to that Letter, approaches much nearer to the truth than he had before done, though still far from it. He says, "the idea of space is an abstract or partial "idea, of a certain quality or relation, which we evi-"dently

"dently see to be necessarily existing; and, yet, (not being itself a substance,) necessarily presupposes a substance, without which it could not exist."

In his fifth Letter, Dr. Butler denies, that space can be supposed a property or modification of the Divine substance; for, if that were annihilated, still the idea of space would remain; and owns himself at a loss to define the nature of space. To which Dr. Clarke replies, "that, since space necessarily remains, even after it is supposed to be taken away, and is not itself a substance, as it is plain it is not, then the substance, on whose existence it depends, will necessarily remain also, even after it is supposed to be taken away; which shews the supposition to be impossible and contradictory."

Thus that correspondence ended. But, in an answer to another Gentleman, Dr. Clarke asserts, that infinite space is infinite extension; and, that to suppose it finite, is an express contradiction. And, that "they who remove the idea of infinity, by supposing space to be nothing but a relation between two bodies, are guilty of an absurdity, by supposing that which is nothing to have *real* quantities; for the space, betwixt two bodies, is always unalterably just what it was, and has the same dimensions, quantity, and figure, whether these, or any other bodies, be there, or any where else, or not at all."— To set bounds to space, is to suppose it bounded by something, which, itself, takes up space; and that is a contradiction.

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But the Doctor was engaged in a much more animated correspondence, on the nature of space, shortly after. It arose on the following occasion. Leibnitz, irritated by the decision of the Royal Society of London, in favour of Newton, on the disputed question, whether he or Sir Isaac was the discoverer of the differential or fluxionary calculus, criticized, with much asperity, some parts of Sir Isaac's philosophy; and particularly, his sentiments on the nature of space. This censure he conveyed, in a letter to the Princess Caroline of Wales, afterwards queen-consort of George II., who communicated it to Dr. Clarke, and engaged him to answer it. His answer she transmitted to Leibnitz, and became the medium of the correspondence that ensued, betwixt these two great metaphysicians. Of their successive answers and replies, I shall give a brief extract.

Clarke. Space, finite or infinite, is absolutely indivisible, even in thought. To imagine its parts moved from each other, is to imagine them moved out of themselves; and yet space is not a mere point.

Leibnitz. Space cannot be a real, absolute being, otherwise it should be eternal and infinite. But, as it consists of parts, it is not a thing that can belong to God. Space is something merely relative, as time is: it is the order of co-existing things; as time is, of successive things. If space were an absolute being, something would have happened, for which no sufficient reason can be assigned: for space is absolutely uniform; and, without the things placed in

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it, one does not differ from another: therefore there can be no reason, why God should have placed bodies, in space, after one particular manner, and not otherwise. But, if space is nothing else, but that *order* or *relation*, and *nothing at all* without bodies, but the *possibility* of placing them; then, two states, to wit, that which now is, and another, supposed the reverse, would not at all differ from each other. Their difference would only be found, in our chimerical supposition of the reality of space: but, in truth, one would be exactly the same as the other; they being absolutely *indiscernible* (undistinguishable), and consequently, leaving no room to inquire for the reason of the preference of one to the other.

Clarke. Undoubtedly, nothing happens without a sufficient reason, why it *is*, rather than *not;* why thus, rather than otherwise: but, in things perfectly indifferent, *mere will* is that sufficient reason; as, in the present instance, why matter was created in one place, rather than in another; all places being originally alike. And the case is the same, even though space were nothing real, but only the mere order of bodies: for it would still be indifferent, whether three equal particles should be placed in the order a, b, c, or in the order b, a, c; for different spaces are equally distinct, though perfectly alike. Besides, if space were nothing real, but the mere order of bodies, it would follow, that, if the earth, sun, and moon, had been placed where the remotest fixed stars now are, and in the same order and distance, with regard to one another, as they

they now are, they would then be in the same place too, as they are now; which is an evident contradiction.

Space is not a being, an eternal and infinite being; but the property, or consequence of a Being, eternal, and infinite. Infinite space is immensity, but immensity is not God. Infinite space is *one*, absolutely and essentially indivisible. To suppose it parted, is a contradiction in terms, as there must be space in the partition itself; which is to suppose it parted, and not parted, at the same time. The immensity, or omnipresence of God, is no more a division of his substance into parts, than his duration is a division of his existence into parts. There is no difficulty here, but from the figurative abuse of the word *parts*.

If space were nothing but the order of co-existing things, it would follow, that, if God should move, in a straight line, the whole material world, with any degree of velocity soever, yet it would still continue in the same place, and nothing would receive a shock on the sudden stopping of the motion.—Farther, space is a *quantity*, which order and situation are not.

To argue, that, because space is uniform, and one part does not differ from another, therefore, bodies created in one place, if they had been created in another, supposing them to keep the same situation, with regard to each other, would still be in the same place as before, is a manifest contradiction.

Leibnitz. To suppose two things indiscernible, is to suppose the same thing, under two names; therefore, to

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suppose that the universe could have had, at first, another position, or place, than that which it actually had; and yet, that all the parts should have had the same situation among themselves, as that which they actually had; such a supposition is an impossible fiction.—If space be a property, it must be the property of some substance; but of what substance will bounded empty space be the property?

If infinite space be immensity, finite space will be the opposite to immensity; it will be mensurability, or limited extension. Now, extension must be the affection of something extended: but, if that space be empty, it will be an attribute without a subject; an extension, without any thing extended.

If space is an absolute reality, far from being a property opposed to substance, it will have a greater reality than substances themselves. God cannot destroy it, nor even change it. It will be immense, immutable, and eternal.—To say, that God can cause the whole universe to move forward, in a right line, or any other line, without making any other alteration in it, is a chimerical supposition: for two states, indiscernible from each other, are the same state; and, consequently, it is a change without any change.

Clarke. Two things, by being exactly alike, do not cease to be *two*: the parts of time are exactly alike, yet two instants are not the same instant, nor are they two names of the same instant.

Extramundane

Extramundane space (if the world be finite) is not imaginary.

Space, void of body, is the property of an incorporeal substance. It is not bounded by bodies, but exists equally within and without bodies. It is not enclosed between bodies; but bodies, existing in unbounded space, are themselves only terminated by their own dimensions. Void space is not an attribute, without a subject; for God is certainly present, and possibly many other substances, which are not matter. Parts, in the corporeal sense of the word, are separable: but infinite space, though it may, by us, be *partially* apprehended, that is, may, in our imagination, be conceived, as composed of parts; yet these parts, (improperly so called,) being essentially indiscerptible and immoveable, are not partible, without an express contradiction in terms.

If the world be finite, it is moveable by the power of God. Two places, though exactly alike, are not the same place: nor is the motion or rest of the universe the same state, any more than the motion or rest of a ship is the same state, because a man, shut up in the cabin, perceives it not; but, upon a sudden stop, it would have other real effects. Space is the place of all things, and of all ideas; as duration is the duration of all things, and of all ideas.

Leibnitz. The parts of *time* or *place*, considered in themselves, are ideal things, and therefore perfectly resemble one another, like two abstract units; but it is not so with two

two concrete units, or two real times, or two spaces filled up, that is, truly actual.

If space is the property of the substance which is in space, the same space will, sometimes, be the property of one body, and sometimes of another. If the author denies, that limited space is a property of limited things, he must also deny, that infinite space is a property of an infinite thing.

Spaces are sometimes empty, and sometimes filled up; therefore, there will be, in the essence of God, parts sometimes empty, and sometimes full, and, consequently, liable to a perpetual change.

God's immensity makes him actually present in all spaces; but, now, if God is in space, how can it be said, that space is in God? We have often heard, that a property is in its subject; but never, that a subject is in its property.

The author departs from the received sense of words; maintaining, that space has no parts, because its parts are not separable. But they may be assigned in space, either by the bodies that are in it, or by lines and surfaces, drawn and described in it.

A man in a ship may not perceive its motion. The reality of motion does not depend on its being observed; but it does, on the possibility of its being observed. There can be no motion, where no change can be observed.

As to the objection, that space is a quantity, and that situation and order are not so; I answer, that order has

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its quantity: there is distance, there is interval. Relative things have their quantity, as well as absolute ones; for instance, ratios or proportions.

Space is not the place of all things, for it is not the place of God; nor can I see, how it can be said to be the place of ideas, for ideas are in the mind.

Clarke. It was affirmed, that the motion of the universe would produce no change at all: yet no answer was given to the argument, that a sudden increase, or cessation of the motion of the whole, would give a sensible shock to all the parts. And no way is shewn, to avoid this absurd consequence, that the mobility of one body depends on the existence of other bodies.

The space occupied by a body is not the extension of the body; but the extended body exists in that space. There is no such thing, in reality, as bounded space: we only imagine, or fix our attention, on what part we please. It does not pass from subject to subject, but is always, invariably, the immensity of one and the same *immensum.* God suffers no change, by the variety and changeableness of things; as St. Paul says, Acts, xvii. 28. *in him all things move,* and have their being.

God does not exist in space, but his existence causes space. Space is not absolutely nothing; for of nothing there is no quantity, no dimensions, no properties. Nor is it a mere idea, for no idea of space can be framed, larger than finite. And yet, reason demonstrates, that it is a contradiction, that space should not to be actually infinite.

nite. Nor is it a bare relation of one thing to another, arising from their situation or order; because space is a quantity, which relations (such as situation and order) are not.

If it were true, that ratios and proportions were quantities, yet it would not follow, that situation and order, which are relations of a different kind, would be quantities also. But, secondly, proportions are not quantities, but the proportions of quantities. A proportion is not a greater or less quantity of comparison or relation, but the comparison of a greater or lesser quantity. Space is the place of ideas, because it is the place of the substances themselves, in whose understandings ideas exist.

Death prevented Leibnitz from replying to these last paragraphs; but the objections they contain were replied to, by Lewis Philip Thummigius, in 1722. I have not as yet been able to procure his annotations.

In England, this controversy was again revived, in 1731, by Dr. Law, late Bishop of Carlisle, in his notes on Archbishop King's Essays on the Origin of Evil, who denied the reality of space; and was soon after answered (as is supposed) by Dr. Gregory Sharpe, who supported Dr. Clarke's opinion. This answer Dr. Law endeavoured to invalidate, in his notes to a second edition of King's Essay; and to his objections, Sharpe again replied.

The new combatants treated this subject in a manner somewhat different from the preceding. Of this I shall now give a summary view.

Law.

Law. I can form no other notion of space, than either, first; as the mere negation or absence of matter: or, secondly; as the extension of body, abstractedly considered, as separate from any particular body.*

Of space, considered as the absence or negation of matter, we may have a positive idea, as Mr. Locke has fully shewn, B. II. c. viii. §. 4, 5. as well as of silence, darkness, and many other privations. But, to argue from such an idea, that space is something external, and has a real existence, is as little reasonable as to say, that, because we have an idea of darkness, different from that of light, therefore, darkness must be something positive, and has as real an existence as light has.

To say, that space must have existence, because it has some properties, for instance, *penetrability*, or the capacity of receiving bodies; seems to me the same, as to say, that silence must be something, because it has the property of admitting sound.

To attribute extension, or parts to space, according to the first notion given of it, would be the same, as to talk of the extension or parts of *absence*, or any other privation.

Sharpe. To suppose that space is nothing but the absence of matter, is absurd; for, if we suppose two walls

* He adds a third mode of conceiving it, which is not, indeed, his own, but rather Cudworth's; namely, that of a subject, or substratum of extension, *in abstracto.* Of this, as too subtile, and scarcely intelligible, I shall take no notice.

not to touch one another, there must necessarily be something between them, otherwise there would be no difference between touching and not touching.

Whatever is indued with properties, must actually exist. Now space has the property, or capacity, of receiving all bodies. Darkness, abstractedly considered, has not the property of admitting light, nor silence that of admitting sound; but darkness is rather that part of space that is free from light.

Thus far the debate was intelligibly carried on, and some new matter advanced. The remainder consists chiefly of a repetition of the arguments, already adduced in the Leibnitzian correspondence, and therefore requires no farther notice.

We may now state the true notion of space; which is so obvious, that it is surprizing it should have escaped the notice of these profound metaphysicians.

Space is nothing more or less, than the relation of two, or more, distant bodies to each other, or of the distant parts of the same body to each other.

All relations are merely mental, but the objects related are real. The foundation of this relation is the standard extension; or the number of such extensions, as inches, feet, miles, &c., as we find or conceive necessary, to reach from one body to the other. Thus, all that can, with truth, be affirmed of space, may clearly be conceived.

Its primary notion is not the capacity of receiving bodies; this is merely a consequence, inferred from distance:

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in any other point of view, this capacity is merely fictitious. Otherwise, before any body was created, a capacity for receiving bodies existed: that is, when nothing whatsoever existed. As well might it be said, that a capacity of receiving spirits existed, before any spirit was created. From what principle this capacity is inferred, will presently be seen.

The notion of *distance* is originally acquired through the sense of feeling. By the repetition of tactile sensations, from one part of the body to another, we gain the notion of *extension;* which consists in nothing else, than in the number and continuity of tactile sensations, either perceived or conceived to be perceptible, betwixt two or more objects. The difference between the first and last of these sensations, is what is called *distance.* Neither the knowledge of distance, nor, consequently, that of extension, is originally gained by the sight, but gradually learned, by experience of the connexion betwixt distant objects, previously known by tact and visual appearances, and the motion and feelings of the eye itself; as Dr. Berkley has clearly shewn, in his admirable Essay on Vision, and has been amply proved, by the subsequent experiments of Dr. Cheselden.* From this connexion it happens, that the different visible appearances, of near and distant bodies, constantly suggest the idea of extension, as subsisting be-

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* Some of the most perspicacious of the scholastics, much despised as they are, reasoned in the same manner. Mastrius Log. 329.

tween them, even when a perfect vacuum is supposed: but this suggestion not being, in that case, founded in reality, is a mere imagination. It is this imagination that so far imposed on Dr. Clarke and others, as to persuade them to think there is *something*, where, in fact, there is nothing: an imagination which, arising from an early association, cannot be got rid of, as Clarke and his correspondent allowed; though, by an accurate investigation, it is proved to be a deception.

When bodies are distant from each other, there is nothing to prevent another body from being placed between them, if none be already so placed. This denial of any obstacle is what is called *capacity:* it is nothing positive, but merely a possibility, inferred from uncontinuous distance.

Still, it will be said, that there is an interval between distant bodies, otherwise they could not be distant; and this interval may be measured, and therefore it is extended. Now, this interval is what is called *space;* and, consequently, space is something real and extended.

To this argument, which comprehends every thing that can be said, in favour of the reality of space, I answer, that this interval is, in nothing real, different from distance: and this latter, indeed, is measurable, by means of a solid line, reaching from one of the distant bodies to the other, and consequently extended. To such a line measures may be applied: but, without conceiving such a line, the measures would be applied to nothing, which is an evident absurdity.

Hence

Hence we may infer, that, without two bodies at least, there can be no distance, nor, consequently, *space*. Still less can it be supposed to exist, when there are no bodies at all; and therefore, antemundane and extramundane spaces are merely imaginary.

If it be asked, where a single body would be placed, if no other body were created? I answer, *no where*, that is, in no place; *place* being, as Mr. Locke justly observes, B. II. chap. xiii. §. 7, the relation of distance, betwixt two or more points, which are considered as at rest. When, therefore, there are no such points, there is no place: and hence, as he remarks, ibid. §. 10, to say that the world is *somewhere*, means no more, than that it does exist, but not its location.

I shall now take a retrospective view of the opinions already mentioned; and observe how far they are just, and how far defective.

SECTION II.

Des Cartes, yielding to the suggestions of imagination, which we need not be surprized at, since it imposed on Newton, Clarke, and, at times, on Locke himself, asserted, that space necessarily implied extension. Now, extension is a mere abstraction, and, consequently, can have no real existence. The term *extension* means no more than *extended things*, taken *ad libitum*. Of these, like all other abstract

abstract terms, it is a compendious expression. In this respect, Des Cartes and his followers reasoned more consequentially than many succeeding philosophers: for he inferred an extended thing, namely, *matter*, to exist where-ever space exists; and thence denied the possibility of a vacuum. His opinion having been long since satisfactorily refuted, and now universally abandoned, requires no further notice.

Mr. Locke seems, at different times, to have entertained different opinions of the nature of space; for, after clearly stating, B. II. chap. iv. §. 2, 3, and chap. xiii. that space is the distance between two bodies, or between the parts of the same body, if the body be considered lengthways, (and the same may be said of the parts of the breadth and the thickness, for their extremes also are distant from each other,) he denies, chap. xvii. §. 20, that matter is any way necessary for the existence of space: and thus the notion of distance is completely abandoned. To this persuasion he was led, by the supposition, that, if a man were placed at the extremity of the material universe, and stretched out his arm, his arm would still be in space. But this is an evident mistake: his arm would be in nothing, or surrounded by nothing; but different parts of his arm, being at a distance from his body, would form a solid space. And hence Locke himself allows, that the world is, properly speaking, *no where*, as already mentioned: though, in a sense, which he justly calls confused, he he allows it may be said to be in the space which it takes up; which is thus improperly distinguished from its extension, that is, the distance of its parts from each other.

Almost all the assertions of Dr. Clarke originated in the erroneous supposition, that space does exist, where, in reality, there is nothing at all. He supposed it to exist beyond the bounds of the corporeal universe, where even distance cannot exist. And this for no other reason, than that he conceived an extension, to which he could set no bounds: not recollecting, that this extension was a mere creature of imagination, being barely the idea of visual distance extended at pleasure; and, consequently, derived from a sense, through which the knowledge of extension and distance is acquired only by experienced connexions with the sensations of touch. Whereas it is certain, that a man, born blind, would never imagine space to exist, where there were no objects of *touch* betwixt which a distance might be found. He inferred the necessity of God's existence *every where;* that is, in every *place*, when there was no place whatsoever: and, even if there were places, neither God, nor any spiritual being, can have any proper location. God is omnipresent, by his power, his knowledge, and his operation, and not by the fictitious attribute of immensity, which cannot be distinguished from unlimited extension.

Hence, he farther asserted, as I have already mentioned, that extension was necessary for every being. An opinion,

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as Dr. Priestley justly observes, at present rejected by the most consistent immaterialists.*

How God can act where he is not, is as easily conceived, and as justly admissible, even if inconceivable, as that he knows contingent events that are to happen in times, with which he does not at present co-exist. As infinite knowledge is sufficient in the one case, infinite power is sufficient in the other.

As all the subsequent assertions of Dr. Clarke proceed from the erroneous notions just mentioned, no farther notice need be taken of them. But, as some of his arguments, in favour of extramundane space, have an imposing appearance, I must shew that they are destitute of any reasonable ground.

First, he takes for granted, that if this world be not infinite, it is moveable by the power of God: and, consequently, that there are two places; one from which, and the other towards which it may be moved.

To this I make this short reply, that, if there were but one body in existence, there could be no motion: for there

* Disquisitions on Matter and Spirit, §. 6. But he was deceived in conceiving this opinion to be entirely modern; for it was the opinion of Clemens Alexandrinus, 2 Strom. circa Medium; and John Damascene, *De Fide*, cap. xiv. who expressly says, God is no where; and Gregory of Nyssus, adversus Eunom. Lib. I. denies that angels, or any intelligent beings, bear any relation to space. Bœtius Hebd. says, that incorporeal substances cannot be said to be in any place. The Thomists also hold, that angels cannot be said to be in any place but metaphorically. See Gonet, 342, folio.

there can be no motion, where there can be no direction, either upwards or downwards, eastwards or westwards, &c. And as, in the supposed case, these, or any other direction, exist only in imagination, there, and there only, motion can exist. This even the scholastics perceived, of whom Dr. Clarke thought too contemptuously.

Farther, he thinks it absurd to say, that space is absolutely nothing; for of nothing there is no quantity, dimensions, or property: nor is it a mere idea; for no idea of space can be formed larger than finite, yet space must be infinite. Nor is it a relation of one thing to another, arising from situation or order; for space is a quantity, which situation or order are not.

These objections arise from the wrong notion he held of space: its primary notion is distance. Distance implies an interval between the distant bodies; which interval, if filled up, is called solid space; and, if unoccupied, is called empty space: but this is nothing, real and physical; and, consequently, can have no dimension, or any property, but in proportion to the distance of the bodies betwixt which it intercedes, a capacity of receiving bodies, of certain dimensions, is inferred to exist; not as any thing physical, but as a mere possibility, and, like other relations, existing only in the mind; but whose foundation (that is, the distant bodies) is physical and real. Distance is a relation susceptible of degrees, and, consequently, of quantity, though order and situation may not.

Grotius probably understood the text quoted from St. Paul as well as any man; and was, certainly, an unprejudiced judge in this case, as he was dead many years before this controversy was started. He tells us, it is an Hebraism; *in him;* that is, through him, through God's beneficence we exist: he bestows life, and necessary motion, and is near us by his power.

On Leibnitz's opinion I need not animadvert: as far as it differs from the notion here given, it is satisfactorily refuted by Dr. Clarke; as may be seen in the preceding pages.

Dr. Law's idea of space agrees in effect with mine; yet I do not think it expressed with sufficient accuracy, which seems to give his adversary some apparent advantage.

OF

OF

DURATION, TIME, AND ETERNITY.

DURATION is a word applied indiscriminately to the existence of created beings, and to that of the Supreme Being; but its signification, when applied to the former, is widely different from that which it bears when applied to the latter. When applied to the former, it essentially includes a relation to succession: when applied to the latter, it essentially excludes any relation to succession. It cannot even be called *permanent* or *continued* existence, for, in such expressions, a relation to succession is implied, during which the existence is continued, repeated, or unaltered: hence, no definition common to both can be given. We must, therefore, separately mark what it denotes in each case.

Duration, when applied to created beings, denotes co-existence with succession. I say *co-existence*, because such beings are said to last or endure only by comparison with different parts of succession: a being, that existed only for one instant, that is, the minutest portion of succession, could not be said to have had any duration. Co-existence, with two instants at least, is requisite. Hence Locke justly observes, that we gain the idea (or rather notion) of dura-

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tion, by reflecting on the succession of our own thoughts; as during this succession we know that we exist.

To call duration a continuation of existence, is giving a definition merely verbal; as this barely denotes the signification of the word, and denotes the thing defined, only by implication.

But, as the succession of our thoughts is neither regular nor constant, and must be unknown to others; a regular, uninterrupted, and uniformly varied succession, (or at least, whose slight irregularities are discoverable only at distant periods,) has been universally adopted as the standard, by comparison with whose component parts, the duration or co-existence of all other created beings is determined and measured.

It is this succession, or co-existence with it, or some of its periods, that forms what is called *time;* for it is sometimes taken for the mere succession, and sometimes for co-existence with it, or with some of its periods.

The standard of succession which most nations have adopted, as a measure of the duration of every thing else, is the apparent annual, and diurnal, progression of the sun, or the different phases of the moon, or both. Thus, years, months, and days are obtained. The minuter portions, as hours, minutes, seconds, and thirds, are discovered, by the help of various machines well known.

That time consists of parts, ultimately indivisible, is briefly and clearly demonstrated, by Mr. Hume.* "It [illegible] "is

* Treatise on Human Nature, Vol. I. p. 61.

"is a property inseparable from time, and which, in a "manner, constitutes its essence, that each of its parts "succeeds another; and that none of them, however con- "tiguous, can ever be co-existent. For the same reason "that 1737 cannot concur with the present year, 1738, "every moment must be distinct from, and posterior or "antecedent to, another. It is certain, then, that time, "as it exists, must be composed of indivisible moments: "for if, in time, we could never arrive at an end of "division, and if each moment, as it succeeds another, "were not perfectly single and indivisible, there would "be an infinite number of co-existing moments; which, "I believe, will be allowed to be an arrant contradic- "tion." This last point he proves from Malezieu. "Ex- "istènce, it is evident, belongs only to unity, and is ap- "plicable to number, only on account of the units it "contains. Twenty men may be said to exist, but it is "only because one, two, three, &c. exist; and, if you "deny the existence of the latter, that of the former falls "of course. It is, therefore, absurd, to suppose any num- "ber to exist, and yet deny the existence of units." But how far this division may extend, cannot be perfectly ascertained. It is certain, it can be carried far beyond our ideas of it; and that, by our auricular perceptions, it may be carried much farther, than by our ocular perceptions.

Thus, by the experiments of Chevalier D'Arcy,* it appears, that five or six distinct sensations, of a luminous body,

* Mem. Par. 1765.

body wheeled about, may be had in one second. But, if the velocity of the rotation, and, consequently, the number of sensations, be increased, they cease to be distinct, and a continued luminous circle is formed: but, if an opaque coloured body be thus whirled about, a few more distinct sensations may be discerned. Of auricular sensations a far greater number may be distinguished: for our celebrated astronomer, Mr. Herschel, has discovered, that upwards of 160 of them may be discerned in a second of time, before they become confused and undistinguishable.* In general, where the greatest attention is not bestowed on the succession, particularly on that of visual sensations, the memory of those immediately past is so vigorous and lively, that many of them are confounded with, and appear belonging to, the present time, taken in the strictest sense. It is on this circumstance that many of the impositions of jugglers are founded.

The apparent length of time depends wholly on the attention paid to its succession; it appears short, to those whose attention is firmly fixed on one object. For, attention to succession, in such case, is, as much as possible, excluded. It appears still shorter, to those who sleep without dreaming or interruption; as they are not conscious of any succession, and judge of the length of time, occupied by sleep, only by the sensations usually associated with rest, and the changes resulting from succcession.

* See Mr. Watson's Treatise on Time, p. 32.

succession. So also, the duration of an agreeable state of mind appears short, even though it should co-exist with many successive perceptions; because, the pleasure arising from them, and not their mere succession, is that which chiefly occupies the attention.

On the other hand, when the attention is not attracted to any particular perception, but wanders, with indifference or disgust, from each of the ideas that present themselves, their number is increased; and as the mind flies rapidly from one to another, their number being thus increased, the time appears longer.

For a similar, but a much stronger reason, when we are in a painful state, its apparent duration is much longer than the real: its termination being every instant coveted, the succession of these instants is strictly attended to.

A learned and profound metaphysician endeavoured to prove, that, strictly speaking, there is no such thing as *present* time. The question, however, is merely verbal. Undoubtedly, the present, taken in the strictest sense, denotes an indivisible instant, which can neither be called time nor duration: but it is on a perceptible aggregate of such instants, of which the memory is as vigorous, or nearly so, as the sensation corresponding with a single instant, that we bestow the name of *present time*, in the usual sense.

Another lively, amusing, but eccentric writer, taking it for granted, that time consists only in the succession of

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our ideas and actions, asserts, that " however these may " be accelerated or retarded, time will be just the same, " that is, neither shorter nor longer, provided the same " ideas and actions succeed one another: as far, I mean, " as it relates to beings so thinking and acting. For in- " stance; were the earth, and all the celestial bodies, to " perform the same revolutions in one day, which they " now perform in a whole year; and were all the ideas, " actions, and lives of mankind, hastened on in the same " proportion; the period of our lives would not be in the " least shortened, but that day would be exactly equal " to the present year. If, in the space of seventy or " eighty of these days, a man was born, educated, and " grown up, had seen his children come to maturity, &c. " and, during this period, had all his ideas and actions, " all his enjoyments and sufferings, accelerated in the same " proportion, he would *not only seem* to himself, and to " all who lived in the same state with him, and measured " time by the same standard, to have lived as long, but " *actually, and in fact*, would have lived as long as one " who resides on this globe as great a number of our " present years."—Is not this to say, that, actually, and in fact, seventy or eighty of our days are equal to seventy or eighty of our years? It is plain, that, even if the hypothesis were possible, it is only in *appearance* that an equality could subsist between them. But the hypothesis itself is grounded on no analogy whatsoever; to deduce any consequences from it, is, therefore, an idle attempt.

Judging

Judging from experience, we find, that violent pain or anxiety, and not the mere number of succeeding ideas, apparently lengthens our notion of duration, or makes us think time longer than it really is. The number of ideas, that occupy our imagination, in reading an agreeable book, nay, the number of letters of which each line of it consists, and which must successively be perceived, must be very considerable; and yet the time seems short while we read it.*

ETERNITY.

Duration, when that of the Supreme Being is meant, denotes existence exempt from any commencement or termination. This mode of existence is what is commonly called *eternal.* It is incomprehensible and inconceivable; but implies no contradiction; for the notion of existence, and that of absence of commencement, and termination, are so far from being contradictory to each other, that a Being, so circumstanced, has been demonstrated to exist;—It is intelligible, though imperfectly.

By this definition it appears, that succession is essentially excluded from the notion of eternity; for succession necessarily implies a beginning, as will presently be seen.

 And,

* Whoever wishes for a more ample account of *Time*, will receive abundant satisfaction, on perusing the profound, and yet perspicuous treatise of Dr. Watson, Jun. on *Time*, published by Johnson, in 1785.

And, yet, eternity cannot be said to be a *perpetual instant*, as some have called it; for that is an express contradiction, and even more glaringly contradictory, than the *punctum stans* of some scholastics; for *instant* denotes the minutest portion of time or duration, and *perpetual*, the greatest duration.

Hence, we may learn the true import of some usual expressions.

From all eternity; that is, without beginning.

To all eternity; that is, without ever ending.

Hence, also, we may collect, that eternity cannot be called a *quantity;* for its notion implies no magnitude whatsoever, but barely existence unlimited; and, therefore, cannot be said to be infinite, nor even equivalent to an infinite succession; for such a succession is impossible, and purely chimerical.

The notion of eternity is positive, and not merely negative, as Locke supposes; though it includes a double negation. For notions, that are commonly called negative,* or privative, are those which directly import the non-existence or absence of something positive; as *darkness* does that of light, *silence* that of sound, *death* the cessation of life, &c.: whereas *eternity* directly imports existence; and, indirectly, the absence of something positive, namely, a beginning;

* I have substituted the term *notions* for that of *ideas*, which Locke has employed too generally. The word idea should never be used to denote any thing, but representations of objects perceived by sense.

beginning; and, also, of something negative, namely, a termination: or, in other words, existence, unoriginated and interminable. It cannot be even called continued existence: for continuance implies a beginning, an existence begun, and thenceforward prolonged.

The Supreme Being, to whom alone the notion of eternity is applicable, having bestowed existence on other beings; on comparing the commencement of these, with the existence of that Being, from whose will and power they originated, the relations of the priority of the latter, and the posteriority of the former, necessarily arise. Now, priority and posteriority constitute succession: but this succession is not that of *time*; for, in this, the prior parts of the succession instantaneously become *past*; whereas, in the former, the prior existence is constant and unaltered. The interval betwixt both is unmeasurable; as we have no standard, nor indeed is any possible, which can be applied to it. Thus, we cannot say, that the existence of God preceded that of any created being, a million of years, or only a single instant; as the quantity of the interval, or distance, is necessarily unknown.

Hence, the question, whether God could not have created the universe sooner, implies an absurdity: for the word *sooner* expresses a comparison of times; whereas *time* began only on the creation of succession.

In reply to some captious questions, it should be observed, that, since the creation, the duration of God coexists with succession. Hence, though it cannot be said,

that

that the duration of God has now subsisted longer than it has done, at any other period, subsequent to the creation; yet, it may be said, that its co-existence, with created beings, is now longer than it was at any period preceding the present.

The only important point, that now remains to be considered, is, whether any created being could have been eternal; as some imagine the universe, or at least some part of it, to have been? To me it appears sufficiently clear, that creation, and eternity, exclude each other. Creation implies, at least, an instant, in which the created being did not exist; otherwise existence could not have been bestowed upon it; it must, therefore, have had a beginning; whereas eternity excludes a beginning.

In answer to this, it has been said, that, if the sun were eternal, its light would also be eternal, though produced by it. But it is easy to see, that, if the sun were eternal, its light would indeed be eternal; because the sun is essentially lucid; for without light it would not be a sun. But it does not follow, that the light was produced by it, but rather that both were co-existent; the one being included in the notion of the other. This cannot be said of the notion of the Supreme Being, and any creature; for he may well be conceived to exist, without creating any being whatsoever.

Another much more plausible objection is made by the scholastics. The existence of the world, say they, is eternally possible; and the Divine Omnipotence is also eternal: all

all which is true. But their inference, that the effect, resulting from an eternally omnipotent cause, could also be eternal, is inadmissible; as causation essentially requires priority of existence: without priority it could not be understood; it would be perfectly unintelligible.—And the reply they make to this exactly confirms it; for they say, that priority of *nature* is sufficient. Now, what else is priority of nature, but that priority, which the nature or notion of causation essentially implies, namely, that of existence? Any other feigned priority is unintelligible.—Their further assertion, that, according to this statement, an infinite succession of ages must have been possible, before the creation of any being, is perfectly chimerical: not only because the interval betwixt the creation, and the pre-existence of the Creator, is unknown, as already said; but, also, because an infinite succession is impossible, even in the divine ideas; a commencement being essential to succession, as I shall now demonstrate.

Mr. Locke says, we derive the idea of eternity from those of succession, and duration, by adding the periods of duration as often as we please; and thus suppose it a duration, exceeding as many such periods as we can reckon,* without ever coming to an end. Now, it seems to me very clear, that this is rather a fruitless attempt to gain an idea, or rather notion of eternity, than an actual acquisition of that notion: for, after all these attempts,

* B. II. c. xiv. §. 28, 31, 32. and c. xvi. §. 8.

tempts, we are as far from gaining it as we were at first; as he himself acknowledges. Hence, he thinks, that "if "we cannot separate succession from any duration whatsoever, our idea of eternity can be nothing but that of "infinite succession of the moments of duration, wherein "any thing does exist."*

The notion, however, of an actual infinite succession of moments, implies an evident absurdity: for such a succession should consist of as many years, nay millions and centillions of years, as it should of moments; and thus the whole, and the parts composing the whole, would be equal. If we suppose an infinite number of years, assuredly the number of moments, of which those years consist, must be still greater, and exceed infinity; which is absurd. Thus, if an infinite succession of moments had passed before the creation of the world, must it not be increased by the number of them that have elapsed betwixt that time and the present?

And, as to the eternity of our world, let it be considered, that motion, namely, a successive progression round a common center, is necessarily attributable to those planets, which form what we call the world: and that our globe, in particular, includes numberless beings, that exist in endless succession to each other. Now, an unoriginated or eternal succession, implies an absurdity, as has been just shewn; and may be farther demonstrated thus.

From

* Chap. xvii. §. 16.

From the motion of the earth, for instance, round its axis, and round the sun, the succession of days, nights, and years, originates. Now, the days necessarily precede the years: therefore, the years must have had a beginning, and could not, therefore, have been eternal. In like manner, the days must have preceded the nights, or the nights the days: one or other of them must, therefore, have had a beginning. Moreover, no portion of time can be said to be *past*, that was not once *present*, and antecedently *future:* therefore, the whole infinite collection must be supposed to have contained an infinite number of days and years *past*, and the same infinite number of days and years *future;* which is a contradiction so palpable, that Doctor Gregory Sharpe* found no other way of avoiding it, than by asserting, that there is a time, now actually *past*, that never was present; which is equivalent to saying, that a time *has* existed, which never *was* in existence.

The opinion of some scholastics, that eternity is a *punctum stans*, or a permanent moment, being utterly unintelligible, is, I believe, at present, generally abandoned.

* See his Defence of Dr. Clarke's Discourse on the Attributes, &c. p. 27.

[illegible]

... and ... [illegible]

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... manner ... [illegible]

... nights ... [illegible]

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days and years ... [illegible]

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AN

EXPERIMENTAL ENQUIRY

INTO THE NATURE OF

GRAVELLY AND CALCULUS CONCRETIONS,

IN THE HUMAN SUBJECT;

AND THE EFFECTS OF

ALKALINE AND ACID SUBSTANCES ON THEM,

IN AND OUT OF THE BODY.

BY THOMAS EGAN, M. D. M. R. I. A.

READ, MARCH 6th, 1805:

THE constant occurrence of these afflicting complaints, in Simpson's Gouty Hospital, to which I have been physician for several years, first turned my serious attention to the most probable means of alleviating or removing them. But, to obtain this desirable end, an examination into the nature of the predisposing and proximate causes; of the chemical and other properties of gravelly matter itself; and that species of calculus, most generally resulting from its aggregation; as well as of the remedies, and their mode of operation; became indispensably necessary. I must also acknowledge, that I was not a little excited to this enquiry, by the consideration, that, whilst the medicines, now most confided in, by modern practitioners, are

 supposed

supposed to exert no energy on those substances, out of the body; yet their beneficial effects, taken internally, stand uncontroverted, by the experience of almost every physician.

Induced by these motives, I had, as far back as the year 1799, instituted a series of experiments, in hopes of throwing some more light on this subject: and, perhaps, chemically explaining, upon what ground, alkaline substances in general alleviate, whilst acids as constantly aggravate, this afflicting disease.

But, knowing that Messrs. Fourcroy and Vauquelin had been, for many years, particularly engaged in the analysis of urine, and its morbid concretions; and expecting, from their superior abilities in researches of this kind, that the object, which I had in view, would be more satisfactorily fulfilled; I did not wish to intrude any observations of my own on the public.

After, however, most anxiously attending to the result of their scientific labours on this subject, as they have been, since that period, successively detailed by M. Fourcroy, in the Annales de Chimie, Memoirs of the National Institute, and latterly, in his great and elaborate work, the Connoissances Chimiques; and finding little, if, indeed, any thing, illustrative of the subject, to which I would wish to point the attention of the Faculty, as well as the public in general; I again latterly repeated, with much care, my experiments of 1799, and added some more, which

which may probably prove interesting, in a practical point of view.

These, with some observations, and deductions from them, I now, with diffidence, offer to the candor and consideration of the Academy.

I must here premise, that the limits of an academic dissertation necessarily confine me, chiefly, to the consideration of gravelly matter itself, and that species of calculus, which most generally results from its aggregation.

Though determined to intrude as little as possible on their time, by an useless quotation from ancient authors, who could have no clear ideas of the subject: yet the better illustration of my object, as well as a sense of justice, oblige me to go as far back as Van Helmont, whose great, though eccentric genius first observed, that the subject matter of calculus existed in the urine itself. But the flighty extravagance of his ideas, of which he has given us a specimen on this subject, in his *Treatise de Lithiasi*, (a wonderful production for the time,) caused little attention to be paid to his opinion; and it was reserved for the capacious and learned genius of Boerhaave, first to ascertain, beyond future doubt, the presence of gravelly matter, as a natural constituent part of urine, kept in chemical solution in it, and eliminated by it, out of the system. Of this important fact, no material use was made, until the all-prying genius of the immortal Linnæus induced him to request his friend Scheele, to turn, for a moment, his great chemical abilities, to the investigation of this subject; with what success is but too well known. And from this again had arisen the further prosecution of this enquiry, by the celebrated Bergman.

The result of the analysis of the latter was highly honourable to the former chemist; as they perfectly agreed in almost every particular, with the exception of some small quantity of insoluble matter, and the presence of lime, observed by Bergman: a difference now very easily accounted for; the former having examined calculi of the pure lithic acid, or, as it is now termed, uric kind, (by far the most common species,) and entirely soluble in pure alkaline lixivia, and nitric acid. The latter, those of the mixed kind, consisting, also, chiefly, of lithic acid, but with interposed laminæ; or, probably, a nucleus of either calcareous phosphat, or oxalt of lime, which frequently occurs, in a very large proportion of these concretions. We may also observe, that Bergman had not, at this period, an adequate idea of the large proportion and insolubility of animal matter, contained in them.

From their joint analysis, it was, for the first time, proved, that the subject matter of gravel, and of a very large proportion of calculi, was present, in a state of real chemical solution, in all healthy urine; that it was possessed of the following distinguishing chemical properties.

Insipidity, inodorous, crystallizable, nearly insoluble in cold water, and only soluble in some thousandth parts of its weight of boiling water: separable again from this,

this, upon cooling, in a beautiful and peculiar crystalline form, of easy solubility, in pure alkaline lixivia, which it renders sweetish, and neutralizes: precipitable from these again, by the weakest acids, and still possessing its original crystalline form and properties. That, from these circumstances, with that of turning the vegetable blues *red*, it was of an acid nature, soluble in nitrous acid with effervescence: this solution tinging the skin, and other animal matters, red, and, upon evaporation to dryness, assuming a red rose colour: this last property being peculiarly characteristic of this substance; subliming in part by distillation, without any alteration in its properties, and affording carbonate of ammonia, and other usual animal products, partly from the admixture of animal matter, and propably some adhering urea. To these distinguishing chemical properties of the Swedish chemist, Fourcroy has since added the following. When triturated with a lixivium of either of the fixed alkalies, it forms a matter of a saponaceous consistence, very soluble with excess of alkali, but little so without it. The saturated urats of pot-ash and soda are little sapid, soluble, or crystallizable. By precipitating their dilute solution, by muriatic acid, we obtain the lithic acid, in brilliant, needle-like crystals, very voluminous, a little coloured, tending to the yellow, or *fauve*, (as he calls it). Ammonia exerts little, if any, solvent power upon it: lime-water takes up a little. The alkaline carbonates have no action upon it: and this last circumstance, I would beg leave to observe, has continued to

be

be the opinion, to this day; but how far founded, will appear in the sequel. To this matter Scheele gave the name of lithic acid; by which it continued to be known, until our countryman, Dr. Pearson, has latterly proposed that of uric; a change greedily adopted by the French chemists, as being more particularly indicative of its origin. And, though I would presume to think, that the former known appellation might be retained, without danger of leading into error, as to its nature; yet, in compliance with the philosophers of both nations, I shall, in future, term it uric acid, and the concretions of that nature, calculi of the *uric acid* kind. We must naturally suppose, that the publication of Scheele's Essay excited the experimental enquiries of both chemists and physicians. His experiments were, accordingly, repeated, by several of our countrymen in particular; but with various, and, in many instances, different results.

It was already cursorily observed, that Bergman's analysis differed from Scheele's, in some circumstances, which he, even at that period, was disposed to attribute to a difference in the nature of the calculi, which they respectively examined; and this conjecture has been fully established, by every subsequent inquiry, since that time. We accordingly find a paper of Dr. Dawson's, in the London Medical Transactions for the year 1769, shewing these concretions to be of very different and opposite kinds, and, of course, soluble in very different and opposite kinds of menstrua: as also a letter from Dr. Saunders to Dr.

Percival,

Percival, of Manchester, published in the third volume of Percival's Philosophical and Experimental Essays, in 1776, detailing several experiments; from which he fairly concludes, that the Doctor's enthusiastic hope, of dissolving all calculi, in a solution of carbonic acid, must prove groundless, from the very different nature of their component parts, as ascertained by his own experiments. This was placed beyond further doubt, by our own learned and ingenious professor, Mr. William Higgins; who, in an analysis of a calculus, of which he gives an account, in his comparative View of the Phlogistic and Antiphlogistic Theories, (a work of singular merit for that period, to which we will afterwards refer,) and published so far back as 1789, enumerates the many various substances contained in one specimen only. The researches of Austin, Lane, and Brugnatelli, led to similar results. But to the learned and accurate Dr. Wollaston we stand indebted, for the first clear and distinct discrimination of the component parts of these substances. In a paper, read to the Royal Society in the year 1797, which would not discredit either a Bergman or a Klaproth, he has most accurately demonstrated, both analytically and synthetically, the component parts of three distinct species of calculi; namely, the fusible, as he terms it, or the ammonico-magnesian phosphat of Fourcroy; the mulberry, or oxalt of lime kind; and bone earth calculus, or phosphat of lime; which, with the uric, well known to us since the time of Scheele, left us then acquainted with the four species of calculi, of most frequent occurrence.

Under

Under these circumstances, I cannot help expressing my surprise, at finding M. Fourcroy still assuming the merit of the discovery, of all the different component parts of calculi; the uric acid, and phosphat of lime, excepted. This circumstance must appear the more unaccountable, when we consider, that the communication of Doctor Wollaston's experiments, was through the medium of the Transactions of the Royal Society for 1797. Finally, M. Fourcroy, to whom Europe stands not a little indebted, for the present general diffusion of chemical knowledge; and to whom the medical profession owe the greatest obligations, for his unremitted application to animal chemistry, has, in conjunction with Vauquelin, given us the result of his researches upon five hundred calculi: from which it appears that they contain the seven following ingredients.

1. Uric acid.
2. Urat of ammonia.
3. Phosphat of lime.
4. Ammonico magnesian phosphat.
5. Oxalt of lime.
6. Silica.
7. Animal matter.

From the prevalence of any of these ingredients, or their relative proportions, he divides them into four genera; and these again into twelve species: for an account of which I must refer to the tenth volume of the Connoissances

Chimiques,

Chimiques, and the Memoires of the National Institute; not proposing to go into their chemical properties, farther than may be necessary to my present inquiry; namely, of how far acids may be conducive to the formation, or alkalescent substances to the prevention, or even solution, of a large proportion of gravelly and calculus concretions. We have already remarked, that, to the sagacity of Boerhaave, we are indebted, for the knowledge of gravelly matter being a constituent part of urine, kept in chemical solution in it; and, happily for mankind, only separable from it, after being some considerable time out of the body. After minutely detailing the ingenious means made use of by Boerhaave, to ascertain this important point, to which I beg leave to refer, his commentator, Van Swieten, goes on to observe.

" Hoc calculi rudimenta adsunt etiam in urina homi-
" num sanissimorum; quæ, si una cum urina secernuntur,
" antequam ab urina secesserint, et concrescere inceperint,
" nullo modo sanitatem lædent. Cum autem observatum
" fuerit, illam separationem rudimentorum calculi citius
" fieri in quibusdam hominibus, tardius in aliis, patet,
" illos magis calculo obnoxios vivere, in quibus citius hæc
" separatio arenularum obtinet. An quandoque illa sepa-
" ratio contingit jam in renibus, et in vesica, antequam
" urina expellatur de corpore? Certe videtur. Vidi sæpius,
" una cum urina excretum sabulum nephriticum expulsum
" fuisse, statimque, calente adhuc et fumante urina, in
" fundo matulæ subsedisse. Contigit aliquoties, inventam

" fuisse, in linteis sanorum infantum urina madidis, co-
" piam sabuli nephritici, satis duri, quod videtur una cum
" urina excretum fuisse. Cum enim magna cura habere-
" tur, ne hi infantes, (illustri genere nati,) diutius urinâ,
" vel aliis sordibus, conspurcati manerent, et urina statim
" per lintea penetret, vix videtur possibile fuisse, ut in
" urina jam emissa hoc sabulum productum fuerit, intra
" unam alteramve horm."

And, again, he adds, " Hoc sabulum, in urina etiam
" sanissima concrescens, vocari posset calculus nativus;
" a quo nemo liber est; at qui tunc tantum metuendus
" videtur, si cito in urina concrescat. Felices illi, in qui-
" bus tardissime hoc fit. Propriam sæpius examinavi uri-
" nam, lætusque vidi, rudimenta illa prima caculi sepa-
" rari quam tardissime, requiri quandoque horas viginti
" quatuor et ultra, antequam in sabulum majoris molis
" concrescere potuerint. Sed et, licet decimum tertium
" ætatis lustrum emensus jam fuerim, ab omni lithiasi
" immunis vixi."

The mode and appearances, attending the separation and crystallization of this substance, from healthy urine, is one of the most beautiful, that, probably, chemistry affords. But, as the circumstances are so minutely and correctly detailed by Boerhaave, and his commentator, Van Swieten, in his treatise De Calculo, Vol. V. page 201 and 202, and correspond so much with my own experiments, so often repeated; I must refer to him. On this passage, however, I must observe, that the space of twenty-four hours,

hours, mentioned by him, as the period of spontaneous separation, is by far, in the healthy state, too short, and that it extends to two, three, and, sometimes, more days, according to the existing temperature, and other circumstances. Nothing, therefore, I will presume to say, is more erroneous, than the assertion, repeated in almost every chemical book, that the uric acid separates from urine, upon cooling. When this occurs, which frequently happens, particularly with children, the urine is certainly surcharged with this very insoluble substance.

An increased temperature hastens the incipient decomposition of urine; and its first ammoniacal degeneration is always attended by the deposition of its uric acid, in its crystalline form.

This did not escape the observation of Hales, who tells us, that urine, tending to putrefaction, affords most of this acid substance: and, indeed, were it to be deposited upon cooling, or within the space of twenty-four hours, or even more, as is so generally asserted, it should, every day, present itself to physicians, who so constantly attend to the state of urine in glasses; but this is by no means the case: and we find Fourcroy, in his last publication, mentioning from twenty-four to forty-eight hours, which certainly only applies to summer heat, or the circumstance already mentioned.

Our next great obligation is, undoubtedly, to Scheele; who has made us acquainted with its nature, and the very distinct chemical properties already enumerated.

While, in the state of gravel, it is ever the same, whether passed immediately with the urine, or spontaneously deposited, or precipitated from it: a circumstance that, for a long time, continued to give me much surprize, considering the variety of calculi; but of the truth of which I was convinced, by the examination of many hundred specimens, for many years back.

I was, therefore, pleased to find, that Fourcroy, for the first time, in his Connoissances Chimiques, asserts, "les "sables des reins sont presqué toujours de l'acide urique." And, in another place, he says, speaking of the uric acid, "cèt lui qui forme les sables, qui se crystallize et s'at-"tache aux parrois de vaissaux."

No wonder, then, that calculi of this kind should be of most frequent occurrence; and that, of five hundred, analyzed by Fourcroy, one fourth should entirely consist of it, besides its occasional admixture with the remainder: and, of three hundred, examined by Pearson, the greater number were found to be of this nature.

Having premised these necessary observations, we have now to consider, to what circumstances we may attribute its separation, in a crystallized or aggregate state, from its natural solvent: the only condition, in which it can be productive of inconvenience, or diseases of this kind. And first; I would observe, that, being a natural secretion, of which the urine is only the vehicle, destined to carry it out of the system, it must be subject to the same derangements, with the other secretions of the human body;

body; and may, of course, sometimes exceed in quantity, and, at other times, be more deficient; which last circumstance seems to take place, during the continuance of acute diseases.

That a morbidly increased secretion does frequently occur, and that, too, independent of external causes, we have the most satisfactory proof of, in the hereditary dispositions of many families to this complaint. And, indeed, when we consider the same to take place, relative to the functions, and secretions of the liver, we must not be surprised at similar deviations in those of the kidneys. Here, truly, they are of more mischievous tendency, as, from the very sparing solubility of the uric acid, (even in its own natural menstruum,) the smallest excess in quantity must subject it to precipitation.

Having premised these necessary considerations, I shall proceed to enquire into those circumstances, which the experience and observation of all times have pointed out to us, as the most frequent occasional causes of these maladies; and how far these opinions may be confirmed by experiments, instituted for that purpose.

And first. It is a matter of notoriety, that the period of life, from infancy to about fifteen inclusive, is most subject to disorders of this kind.

Of this practical observation, we have an interesting confirmation, inserted in the second volume of the Memoires of the French National Institute, Mathematical and Physical Sciences, year 7. Under the former happy regime,

gime, there was instituted, about forty years ago, at Luneville, in Lorraine, an hospital for the exclusive relief of calculus and gravelly patients. In that interval, sixteen hundred and twenty-nine, of both sexes, were admitted, and operated upon. Of these, fifteen hundred and sixty-four were males, and only sixty-five females.

Citizen Saucerotte, an associate of the institute, to whom we are indebted for these interesting details, annexes tables indicative of the number of these patients, that occurred at the different periods of life, from the age of one, up to seventy-eight. To these, as too extensive to be inserted here, I would beg leave to refer; and shall satisfy myself with some extracts only, expressive of the general result.

AGE OF PATIENTS.	NUMBER OF PATIENTS.
MALE SEX.	
1 year to 2	1
2 years	14
3	79
4	131
5	145
6	147

From this age, which afforded the maximum of the number of patients, we find a gradual declension, as follows.

AGE

AGE OF PATIENTS.	NUMBER OF PATIENTS.
8 years	121
10	79
15	39
20	16
25	7
30	8
35	4
50	5
60	2
70	2
78	1

Of the sixty-five females.

AGE OF PATIENTS.	NUMBER OF PATIENTS.
1 year to 3	1
4	8
5	7
6	4
7	6
8	5
9	3
12	4
14	1

From which period, down to seventy-eight, there occurs but one or two upon each year. From these then we learn, how

how much more subject the male sex is, to those complaints, than the female; and the earlier periods of life, than the more advanced, For, among the males in the sixth year, we find 147, (the greatest number,) and among the females, only five at eight. From these periods, in both sexes, the numbers rapidly diminish.

These facts would lead us to conclude, that some physiological cause, peculiar to the functions of this early stage, may give rise to this difference; and I will not pretend to say, but this may possibly exist: but, when we consider, that, in every country, the infant poor are the greatest sufferers, we are induced to inquire further, and suspect the existence of some general cause, affecting and applicable to them all. That a similarity of diet, (in the children of this class of society, in particular,) must every where nearly take place, is evident: and that this is, but too often, of the kind most prone to the acescent tendency, such as pap, gruel, sour milk, &c.; all which it is not always in the power of the parents to renew, or administer, in a recent and sound state; an error not unfrequently occurring, from the negligence of nurses, even in the upper ranks, but irremediable in the lower: where this acescent tendency cannot be corrected, by the seasonable admixture of broth, or other light animal food; their unhappy situation confining them exclusively, like their cattle, to the sole use of vegetables, and the farinacea.

To pass on, from infancy, to the advanced periods of life,

life, and begin with our own island; we find, that, considering the extent of our population, the disease is of relative rare occurrence. So much so, that the late Mr. Dease, (whose premature death we have still to deplore, as a national calamity,) with all his well deserved celebrity, as a lithotomist, never operated upon more than sixty. A small number indeed, when we consider, that the operation is seldom, if ever, attempted in the country. And why this should happen here, we shall be presently, perhaps, better able to judge.

The reverse of this occurs in the sister kingdom; and the Irish student feels astonished, at the frequency of the operation in all the London hospitals, though also performed in these of the more considerable country towns: and, upon enquiry, he finds, that a large proportion of these patients come up from the cider countries of Hereford, Devon, &c. And it must naturally occur to him, that the general use of fermented liquors of every kind, beer, cider, perry, and factitious wines, which prevail in England, renders the disease of more frequent occurrence there, than with us; the great mass of our people being deprived of these luxuries.

If we pass over to the Continent, we find our neighbouring provinces, Picardy, Normandy, and Brittany, in particular, still more subject to affections of this kind: so much so, that the late Mr. Dease could not give credit to the extraordinary number of patients operated on, in one year only, in the hospital of Rouen; though many must have, of course, repaired to Paris. The same, though, in a lesser degree, takes place in Champagne; and it is almost unnecessary to observe, that the general beverage of the northern provinces consists of cider, or of poor wine, equally acescent in its nature, and prone to the acetous fermentation. The Champagne, though somewhat less so, is replete with carbonic acid gas, and disengaged tartarous acid; and though, in the more southern provinces, this malady cannot be considered as endemial, yet it is of frequent occurrence in the hospitals of Montpellier.

For, even in these favoured climes, where wine is of so little value, and withal so spirituous, the unfortunate peasant is obliged to content himself with an inferior quality, prepared by a second maceration of the *marc* of the grape, which he denominates *picquet;* a *patois* appellation, most happily applied to its highly acid quality.

In that once happy country, Switzerland, on the contrary, as Baron Haller assures us, the disease is by no means frequent, and chiefly confined to the children of the poorer sort; their mountainous and elevated situations affording them little or no vinous liquors: whereas their neighbours, the inhabitants of the Rhine and Moselle, as well as some tracts on the banks of the Danube, are peculiarly afflicted.

The truth of this observation we find confirmed, by the medical authors of all times. Silvius observes, "Vina acida "tenuia et Rhenana, magis nocere calculosis quam opi- "ma;" and the same is particularly insisted on, in Dolæus's "Encyclopœdia, Ephemerides naturæ curiosorum," and Rivinus's "Morbi endemici," &c. Now, the wines in these

these countries are well known to be of an acid quality; and Hoffman asserts, and that too from experiments, that they abound in the tartarous acid; having found them to contain a double relative quantity of that in other wines; and to this we may add no small proportion of carbonic acid. Linnæus, in his dissertation "De Genesi Calculi," inserted in the second volume of the "Amenitates Academicæ," seems more particularly to point out acids, and acescent drinks, as the chief causes of calculus affections. He says, "acida fermentescentia omnia calculum promovent; hinc vina acida genesi calculi magis favent, quam dulcia. Qui acida vina copiose ingurgitant, podagræ et calculo plus exponuntur, quam illi, qui terras calidiores inhabitant, et dulcia vina hauriunt. Nec mirum, cum vini Rhenani libræ quatuor destillatione dant spiritus acidi drachmas quinque; et vini Tocariensis præbet spiritus acidi tantum semidrachmam, teste Hoffmanno. Sanissimus quisque a potu acido sæpe stranguriam incurrit, eo quod ab acidis ingestis particulæ terrestres præcipitantur." And again; "quin podagra igitur et calculus ab acido generentur, nullum est dubium, id etiam ab eorum communi cura, ad quam pergimus, luculentius patebit." Beverovie, De Calculo, 80, also observes, "in nullo vino tantum tartari apud nos accrescit, quam Rhenano. De me ipso, quod etiam ex plurimis audivisse memini, possum testari, nunquam Rhenanum assumsisse paulo largius, quin copiose arenulas excernerem."

The reverse of all this is observed to take place, where the use of wine is prohibited. Rivinus observes, that, in the city of Batavia, where the pursuit of commerce brings together a vast assemblage of the neighbouring Asiatic nations, whenever the disease occurs, it is almost always in the instance of some Hollander, who, in his passage to India, drank freely of bottled beer, and used sour crout. In Persia, the same author, in his excellent treatise, De Morbis Endemicis, observes, that whenever calculus affection occurs, either in Ispahan, or the provinces, it is, assuredly, in the instance of some Armenian, (fellows, to use his words,) who, in every latitude, drink more wine than water.

Again, in Grand Cairo, where the proximity of the Grecian islands, and ready conveyance by the Nile, render wine of easy acquisition, and drunkenness and public-houses as common, as in any city of Germany; we learn, from Prosper Alpinus, that the disease is of very frequent occurrence; for, besides a mixed population of Franks, Armenians, Arabs, &c. the Mamelukes, as well as many other Turks of the higher ranks, do not, in deference to the Mahometan law, refrain from wine. The Cyprian and Grecian wines, if not adulterated, or become acescent by dilution, and the warm temperature of that city, are, in themselves, among the least objectionable. But, when we consider, that Paris is chiefly supplied with Burgundy, and that, yet, in no part of the world does there occur more mischief, from the attempts to keep down and correct its acescency, we will easily form an opinion of the quality of the wine retailed in Cairo.

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To this abstinence, then, from wine and fermented liquors; as also, perhaps, to the admixture of a large proportion of the warmest spices, in their vegetable food, tending to correct its acescent tendency; we may ascribe the rare occurrence of this disease, in the more southern climates.

Now, these more general remarks, we find peculiarly to coincide with the observations of the patients themselves, as well as that of the physician: for such as have laboured under these complaints, a sufficient length of time to become acquainted with the *juvantia* and *lædentia*, most scrupulously abstain from acids, and acescent drinks of all kinds, and, what they find most particularly pernicious, beer, or ales, turning over to the acetous fermentation, or *hard*, as they are generally termed. And, indeed, nothing is more common, than that an indulgence in cyder, claret, or acidulated punch, nay, a draft of hard beer or porter, should be followed by a fit of the gout and gravel.

The connection between these diseases forms an interesting and curious subject of physological, as well as pathological inquiry: but, proposing to offer some observations on this subject on a future occasion, I shall, at present, decline entering upon it, and pass on to observe, that the bad effects of all acidulous drinks, are fully confirmed, by the experience of our many sufferers in Simpson's Hospital. Hewson, who lately died there, at the advanced age of 102, never tasted the beer of the house, during the summer months, and substituted milk to it; being

being taught by experience, that its acid tendency, during that period, always induced his gravelly paroxisms. And Clapham, who suffered much from gout and gravel, and was, for many years, a ship-captain, informed me, his voyages to America were always succeeded by fits of both; which he attributed to a free indulgence in the use of cyder, a beverage to which he was then peculiarly attached: and that, at any time, he could excite a paroxism of one or the other, or both, by drinking acidulated punch, or claret. Khensk, our greatest martyr, (having all his articulations distorted by gouty concretions, and who once lived in easy circumstances,) assured me, that the severest and longest protracted fit of the gout and gravel, he ever experienced, was occasioned by a surfeit of a poor vapid claret. And I shall conclude this part of my subject, by observing, that the clergy of the Roman Catholic church are peculiarly liable to these complaints, and form no small proportion of the number operated upon in this city: which I would attribute to the use of a small and sour wine, during their residence in their seminaries abroad.

These facts being pretty well established and acknowledged, it is time to inquire, how far we may account for them; and whether experiments, instituted out of the body, may not throw some light on this subject. Dr. Saunders, in a letter to Dr. Percival, "Percival's Essays Medical and Experimental," Vol. III. on the subject of carbonic acid, as a solvent of calculous concretions, observes, "if

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"a more powerful and active solvent, than any hitherto "known, shall be discovered; it is highly probable, that "such a discovery can only be made, by a rational and "chemical inquiry, into the powers of different bodies of "combining with the contents of the urine, and preserving "them in a fluid state out of the body." Now, on the other hand, we may presume, that, whatever substances cause a separation, or precipitation of uric acid, in an aggregate state, from healthy urine, will give rise to these disorders: For, we are not to forget, that the uric acid, which forms so large a proportion of caculous concretions, and the entire of the gravelly, is a natural secretion from the blood; performed by the functions of the kidneys, and excreted by the urine; and can only be prejudicial, by a previous morbid separation from it, within the body. With this necessary view of the subject before us, (for which we are, as already observed, indebted to Boerhaave,) I resolved to try, First, what might be the effects of acids of different kinds, on healthy urine, as to their influence, in causing this same previous precipitation; and, Secondly, that of alkaline substances, in preventing it. And, here, it must be observed, that, to draw any satisfactory conclusions; from experiments, made with these substances out of the body; we must suppose they reach the kidneys, and blend with the urine, still possessing their relative distinctive properties: and, that this takes place, we have every reason to presume. Doctors Percival and Saunders, Mr. Bewley, and others, have ascertained the presence of carbonic acid,

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in an uncombined state, in the urine of those, who drank the mephitic water, for some days; an acid certainly foreign to its recent healthy state: for, after repeated trials, by heating it to nearly ebullition, in one of Priestley's air-bottles, I never could procure the separation, or transition of a single bubble of carbonic acid, into a jar of lime-water. And, if this weak acid reaches the kidneys, undecomposed or uncombined, we will have less difficulty in believing, the more powerful ones may do so. That the tartarous acid, in the combination of the acidulous tartarite of potash, exerts powerful effects on the functions of the kidneys, is well known; and, that the urine is, at the same time, rendered more acid, I have repeatedly ascertained, by the usual tests.

We may say the same of the other vegetable acids, which manifest also diuretic powers, and increase the natural acidity of the urine. Linnæus, in his second volume of the Amenitates Academicæ, De Genesi Calculi, already quoted, mentions his having made the following experiment to this purpose. He says, "hisce diebus ipse experimetum "instituti cum urina; hæc communiter a solutione lacmus "parum admodum rufescit; at si libram unam vel alteram vini Rhenani, vel alterius vini acidi hauserim, post "horam unam vel plures, valde rubra et rutilans evadit "urina, ab affusa solutione lacmus; certo indicio, acidum "vini totum corpus permeasse, et urinam infecisse." Nor should we wonder, that these energetic substances should pass unaltered to the kidneys, when we find so many mild vegetable

vegetable matters do so. I will not mention the communication of so volatile a principle as odour, but will more particularly dwell on that of colour. Rhubarb, turmerick, madder, and many other substances, so completely impart their colour to urine, that they would appear to be very little altered. Nay, the juice of the beta vulgaris, a mild esculent of the pentandrious class, so deeply reddens it, as to cause it to be mistaken for bloody urine, of which a late instance has occurred in my practice.

As to alkaline substances, it has been at all times known, that they communicate their properties to this excrementious liquor. A perseverance in the use of the *aqua kali puri*, of the shops, for a few days, even in small doses, converts its acescent into the alkaline state; and we have every reason to suppose, that the same takes place with the carabonates, which are taken in so much larger quantities. This seems confirmed, by experiments made in London and Paris; and the alkalescent impregnation of the urine was ascertained by the formation and precipitation of the acidulous tartarite of potash, upon the addition of the tartarous acid. Yet, from a good deal of experience in these matters, I may aver, that, as to the carbonates, the dose must be considerable, (which was the case in London,) and continued for some time; having frequently given two scruples of desiccated soda, (containing, according to Mr. Kirwan, 23,94 grs.) in the twenty-four hours, for some days together, without any diminution of the usual acidity of this liquor.

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For the information of such of my readers, as may not be of the medical profession, I must here observe, that physicians distinguish two kinds of urine: the one rendered immediately after meals, and much dilution, before the process of digestion, or state of sleep can take place; always more or less limpid; being comparatively less charged with the natural component parts of urine, (the urée, or extractive colouring matter, in particular,) and called *urina potus*, to distinguish it from the *urina sanguinis*, rendered, many hours after meals and sleep, the taking no more than a necessary quantity of liquids, and containing the usual proportion of saline, and other ingredients; more especially the urée, to which it owes its natural citrine colour.

This last, therefore, was that employed in the following experiments, if not otherwise specified: with the chemical history of which I must suppose gentlemen of the profession now tolerably well acquainted; being so fully and accurately detailed, in the tenth volume of the Connoissances Chimiques.

Having, in the preceding pages, insisted so much on the acids, and acescent drinks, as occasional causes of these complaints, the first object seemed to be, to ascertain whether the urine of those most subject to them, or actually labouring under them, was more relatively acid. We have already seen, from a register of these patients, kept for forty years in the hospital of Luneville, that the early period of life, from two to six years of age inclusive, is is most liable to calculus affections. Now, the urine of healthy children is always found more acid than that of adults; generally, in the proportion of two to one. Whilst several drops of the latter are requisite to redden a given quantity of infusion of litmus, a single drop of the former turns it to a clear red. Paper, stained with an infusion of turmerick, and reddened by an alkali, was immediately restored to its colour, by a single immersion in the urine of children: an effect, which required some time in that of adults. And that this should be the case, we will not be so much surprised at, when we consider the nature of their diet; and that, in addition to the phosphoric and uric, their urine contains the benzoic acid in considerable quantity: the proportion of which is found afterwards progressively to diminish with their advancement in life.

The constant opportunity I have, of attending to those subjects, enables me to say, that the urine of gravelly patients, when fresh rendered, nay, after standing many hours, in a temperature of sixty degrees, is relatively more acid than the healthy; sometimes as much so as the gouty; and frequently continues so, even after depositing its gravelly matter. An exception to this, however, sometimes occurs in gouty habits; their urine depositing copiously this acid substance, and yet manifesting no increased, but sometimes rather decreased acescency: for, with them, a considerable diminution of the quantity of the usually excreated super-acidulated phosphoric salt often takes place, as shall be fully explained upon another occasion.

Having premised these observations, it is now time to consider what effects acid substances are productive of, when mixed, out of the body, with this very complicated liquor. And here, to prevent repetition, I will observe, that that generally used, was rendered fresh in the morning, in the quantity of from three to four ounces, (unless otherwise specified;) being that most easily retained at one time in the bladder. The quantity of acid extremely small, for obvious reasons, and seldom increasing its acescent properties (as ascertained by the usual tests) beyond what frequently occurs, in the urine of those who use acescent drinks, or are afflicted with gout or gravel. A standard quantity was always laid by for comparison; and the temperature from sixty to seventy-five degrees, being in autumn, 1799. And to begin with the vegetable acids.

EXPERIMENT I.

To four ounces of the urine of an adult, was added one drachm of common acetous acid, which (like every other acid) caused no immediate change in it; but, in a very short time, and before it cooled down to the temperature of the atmosphere, some extremely minute shining spiculæ, observable only by a lens, were seen floating in it: these gradually increased in number and size, began to reflect the light, and, from being perfectly transparent, soon became coloured, to settle upon the usual cloud, or *nubecula*, which now began to form, adhere to the sides of of the glass, and partly fall to the bottom, in the shape of small bright red crystals. In the standard, after twelve hours, nothing more observable, than the usual *nubecula;* nor was there any sign of crystallization, or separation of uric acid, even after twenty-four.

EXPERIMENT II.

To the same quantity of adult urine, were added one drachm and half of acetous acid, which caused a more copious separation and crystallization of this substance, with the foregoing appearances. None observable in the standard after twenty-four hours.

EXPERIMENT III.

To four ounces of urine of a healthy child, who never was observed to pass gravel, and of the usual degree of acidity, was added one drachm of acetous acid, which soon caused an evident and copious separation of crystallized uric acid. The crystals were, however, not quite so coloured; the urine of children not being so much impregnated with the urée, or colouring matter. No such appearance in the standard after twelve hours or more.

EXPERIMENT IV.

To four ounces of adult urine, rendered very soon after a tea breakfast, and nearly in a state of *urina potus,* was added

added one drachm of acetous acid. After three hours, a crystallization of minute sandy particles took place. None in the standard, even after three days.

EXPERIMENT V.

Thirty drops only, of acetous acid, were added to four ounces of the urine of a gouty patient, æt. sixty, and who sometimes felt some slight gravelly tendency. A very copious precipitation of this matter quickly took place. Some observable in the standard, also, the next day.

EXPERIMENT VI.

To three ounces of healthy adult urine, were added a few drops only of citric acid. A distinct crystallization, but extremely minute, took place. No appearance of any in the standard, after many hours. The experiment was repeated with one drachm of filtered citric acid, which only hastened the separation, and increased the quantity of crystalline matter.

Finding, by these experiments, and numberless others, with a detail of which it would be unnecessary to take up the time of the Academy, that the acetous and citric acids, blended with the urine, separated its uric acid in a crystallized state; I thought it might be interesting, to investigate what the effect of the tartarous acid might be: being that, which, in an uncombined, and partly combined state of acidule, as in the acidulous tartarite of potash, chiefly

chiefly prevails in the wines and beverage of those countries most subject to these complaints.

EXPERIMENT VII.

To four ounces of healthy adult urine, were added some drops only of pure tartarous acid. To the same quantity, one drachm of acetous acid; which brought them nearly to the same standard of acidity: a circumstance always attended to in the comparative trials with different acids. In that with the tartarous acid, the crystals were not only larger and darker coloured, but exceeded in quantity any thing before observed. In that with the acetous acid, a much smaller proportion of minute crystals took place.

EXPERIMENT VIII.

To four ounces of urine, were added two drachms of a filtered solution of acidulous tartarite of potash, of the temperature 55 degrees. The usual separation and crystallization took place, in large proportion: the crystals, however, much smaller, and less coloured, than those with the uncombined tartarous acid. The two last experiments, frequently repeated, presented the same results.

EXPERIMENT IX.

The result of the above experiments having led to some doubt, as to the good effects of the carbonic acid gas, so much,

much, at one time, recommended by Doctors Percival and Saunders, previous to its more modern alkaline combination, in our mephitic, as well as super-aerated soda waters.

Into the middle part of Nooth's apparatus, were introduced four pounds of fresh rendered healthy urine, and exposed to a stream of carbonic acid gas. After a few hours, a copious and beautiful precipitation of uric crystals took place, (notwithstanding the constant agitation, from the transmission of the gazeous bubbles,) larger than any I before observed, that from the tartarous acid excepted. In a standard quantity, no distinct crystallization, even after two days. A repetition of the same experiment afforded similar results.

EXPERIMEMT X.

Finding the carbonic acid gas productive of similar effects, with the other acids hitherto examined; it was natural to inquire, how far its combination with the portion of alkaline matter, contained in our mephitic and soda waters, so highly surcharged with it, may prevent a separation of this uric acid.

Half an ounce, only, of the common soda water of the shops, prepared by Mr. Kinsley, was added to four ounces of healthy urine. A similar quantity was impregnated with carbonic acid gas. In the former, after forty-eight hours, or more, no more than the usual *nubecula:* nor could a single crystal be discovered, even by a magnifier. In the latter, an early, copious, and beautifal crystallization.

tion. On the result of this experiment, frequently repeated, with various proportions of the mephitic alkaline water, I shall afterwards have occasion to make some remarks.

Though the mineral acids, in an uncombined state, enter not into the matter of our diet, and are no longer considered as lithontriptics, since the notion of the earthy nature of these concretions has been abandoned; yet, as they are sometimes prescribed with other indications, I thought fit to extend my researches (though in a summary way) to them also.

EXPERIMENT XI.

To sixteen ounces of urine, were added eight drops of very dilute sulphuric acid. To a similar quantity, two scruples of citric acid, to bring them to nearly the same standard of acidity. After a very short interval, in that with citric acid, the usual appearance of transparent floating moleculæ reflecting light, and gradually becoming larger, were observed, and began to adhere to the glass; whilst in the other, after five hours, no such appearances took place. Yet, after forty-eight, here also a precipitation took place, of smaller crystals, and less in quantity; for, being collected on a filter, and carefully dried, they weighed only two grains; whilst the former amounted to three. And this is nearly the largest proportion I ever found the above quantity of healthy urine to contain.

EXPERIMENT XII.

As the nitrous acid is one of the most active solvents of this matter, out of the body, I was curious to ascertain, whether, in the very dilute state in which it must reach the kidneys and bladder, (where its action must have been facilitated, by the actual state of solution of this substance,) it would manifest its powers, in preventing its separation.

To three ounces of urine, rendered a few hours after breakfast, and, of course, scarcely acid, were added five drops of weak nitrous acid; which did not seem to add very materially to its acescent properties.

To a similar quantity were added four scruples of acetous acid. In less than an hour, the former deposited a distinct quantity of gravelly matter, in considerable proportion. This, perhaps, we should not be surprised at, when we consider how the action of this acid, in that fluid, may be determined by superior affinity. In the latter, the separation did not take place for a considerable time after. We see, then, that the nitrous acid speedily and powerfully precipitates this acid substance.

EXPERIMENT XIII.

To six ounces of urine, shewing a strong acescent quality, were added only three drops of strong marine acid. A cloudiness

A cloudiness and transparent granular precipitation took place, followed by the formation of extremely minute gravelly concretions, which, even after two days standing, did not assume so red a tinge as that with vegetable acids. This may, probably, depend upon some action of this acid upon the urée, or colouring matter: but, as to the smallness of the crystals, that evidently depends upon the more speedy precipitation, throwing them down before they can assume their natural size, and leaving but a shade of difference between the crystalline and pulverulent deposits.

EXPERIMENT XIV.

From the above, then, we are satisfied, that the vegetable and mineral acids cause a premature separation and crystallization of the lithic contents of recent healthy urine: but it may be observed, that this only takes place, under circumstances not at all applicable to the living system; viz. a much inferior temperature; and, in some instances, a contact with the atmospheric air: two powerful promoting causes of crystallization in general, but more especially of the less soluble salts. To determine, therefore, this most essential point:

To six ounces of cold but recent urine, (in a well closed phial,) were added five drops of very dilute nitrous acid, which were placed on a sand bath: temperature varying from 80 to about 100 degrees at most. The same quantity, with similar precautions, but without addition, was laid

 aside,

aside, in the laboratory, as a standard: temperature 56 degrees. After a very short interval indeed, and almost as soon as the urine acquired the temperature of between 80 and 90 degrees, small shining granular particles were observable with a magnifier, began gradually to settle upon a broken kind of *nubecula*, or rather *nubeculæ*, and to acquire colour and size, though carried up and down the liquor, which was in constant agitation. This experiment again twice latterly repeated, and always with the same result, (care being taken to keep the temperature, as nearly as possible, for a few hours, between 90 and 100 degrees,) afforded one of the most pleasing objects imaginable; viz. the formation of this crystalline matter, under all the disadvantages of elevated temperature, and constant agitation, from (I may almost say) their primordial moleculæ, to the accomplishment of their full size. And here, indeed, they are most beautiful, and not to be distinguished from these spontaneously deposited.

The whole experiment strikes us strongly with a semblance of what probably passes, under similar circumstances, in nature; and reminds us of the danger attendant upon acid impregnations, more particularly at bedtime, when the urine, by many hours retention and quiet, has ample time to deposit its uric acid contents in the bladder. From it, also, we learn, that the temperature of the human body, in place of retarding or preventing (as might be expected a priori) these pernicious effects, rather promotes them, and that to a considerable degree.

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But whilst we endeavoured to establish this point, from practical observation as well as experiment, we seem to have entirely forgot, that the urine itself is an acid liquor; and that, therefore, if acids were so prejudicial, it is not probable, that the provident wisdom of nature would commit the discharge of this necessary excretion to a fluid, which, by prematurely separating it within the body, would completely defeat the object of her humane attention. And would she not, in the infinity of her resources, dispose of it by some less objectionable emunctory?

I would, in the first place, observe, that though healthy urine manifests the properties of an acid liquor, it is in the very smallest possible degree; so much so, that though mentioned long since, by Moraung, Coldevillars, and other surgeons, yet it was not, either chemically or medically, acknowledged to be so, until the time of Scheele, who finally established this point, as well as the nature of the prevailing acid. And, secondly, that nothing can be more erroneous, than the opinion, which so long prevailed, that the phosphoric acid existed in it, in a naked or uncombined state. It is now well established, that it is only in that of a weak acidule, or acidulous phosphat of lime, very little short indeed of the point of saturation; and hence the weakness of its action, as an acid liquor: for were it not for litmus, and some of the more delicate of the vegetable blues, we would have been, even to this day, ignorant of this property; so very feeble indeed, that it will often not affect an infusion of red cabbage, whilst it it turns with litmus, and, sometimes, but feebly, with this most delicate of all acid tests. A single drop of phosphoric acid was added to one ounce of distilled water. Of this weak acid impregnation, one drop was sufficient to turn the infusion of litmus of as clear a red as the mineral acids do; whilst seven of urine manifested but very weak effects of acidity, and required some time to shew any. If the urine, therefore, does not exceed its natural standard of acidity, we have nothing to apprehend. And here, indeed, we must again admire the wonderful wisdom of Providence. The occasion (may I be allowed to say so, and that, too, before so competent an assembly?) required some chemical discrimination. It was necessary to carefully provide for the expulsion of the recrementitious part of the osseous fabric (which is very considerable) out of the system: but as this salt is insoluble in an aqueous vehicle, such as the urine, nothing more would be necessary, to obviate this difficulty, than a certain degree of super-saturation, or state of acidule, which would more effectually provide for its solubility, and its elimination. But by going thus far, whilst it attended to one excretion only, it would have entirely forsaken its charge of another, committed also to this fluid; and, by this degree of super-saturation, precipitate, retain in the system the uric acid, and occasion as frequent an occurrence of gravelly and calculus complaints, amongst mankind in general, as now occurs among the gouty. It, therefore, prudently formed that degree only of acidulous phosphat of lime, which, though insoluble out

of

of the body, was sufficiently soluble, when assisted by its temperature. Nay, even for wise purposes, it has given a degree of latitude to this temperature, which, though narrow and confined indeed, is sufficient for its purposes: but where it precisely terminates I am not at present prepared to say, though so easily determined.

Let us now, for a moment, consider how far any morbid deviation, from this healthy standard, (which sometimes happens,) may throw light on this subject. The most considerable, that I am acquainted with, occurs in the instance of gouty urine, rendered towards the decline of the paroxism. A single drop of this, though in a turbid state, affects the vegetable blues, with an energy, equal, or, perhaps, superior, to that of the strongest acetous acid; and requires a very considerable increased proportion of lime-water to decompose it, for obvious reasons. This we find always depositing, sometimes from the bladder itself, but, generally, before it has entirely parted with its natural temperature, a very large proportion of a reddish brick-dust like sediment, (a welcome harbinger to gouty patients,) gradually declining, and keeping pace with the alleviation of symptoms, and the progressive return of the urine to its natural degree of acidity. This sediment, Scheele, Bergman, and Fourcroy, consider of the uric acid kind: and so it (but in part only), undoubtedly is; being in a smaller proportion than they were aware of. For, considering that the enormous quantity, rendered in a few days, was incompatible with the known minute proportion of this acid

matter

matter in urine, I was determined to make the following experiment. To a considerable quantity of it, desiccated and well edulcorated with distilled water, were added three ounces of a weak alkaline lixivium; which, after a few hours digestion, completely discoloured it, acquired a golden yellow colour, a sweetish taste, and, on the addition of a few drops of dilute marine acid, precipitated a copious sediment of whitish minute needle-shaped crystals, of a silky appearance.

To this precipitate, well edulcorated, was added, by degrees, about one ounce of weak nitrous acid, which acted on it, with effervescence, and nearly took up the whole. This solution, being set to evaporate, began to redden the fingers, and other animal matters; no doubt, therefore, could subsist, as to its nature. To the remainder, which seemed very little diminished, and only deprived of colour, were added two ounces of dilute marine acid; which, after some time in digestion, nearly dissolved the whole: and, finding this acid solution precipitate with limewater, oxalt of ammonia, and fixed alkali, it must have been phosphat of lime. This forms, then, by far the largest proportion of the gouty sediment, which is coloured by the precipitated uric acid. Such, also, is the result of Crookshank's experiments; and so we should expect to find it, as I shall endeavour to point out, on a future occasion.

Let us now consider, how far these analytical results may be confirmed, in the synthetic way; having resolved, that

that experiment, as far as applicable, should form the basis of any opinions, offered in this essay. The phosphoric being the native acid, prevalent in urine, it was interesting to determine, whether, by the artificial super-addition of it, so as to bring this fluid to the standard of the gouty, we might not produce effects, somewhat analogous to what occur there.

Eighteen ounces of urine were divided into three equal parts. To the first were added, five drops of phosphoric acid; to the second, ten; and to the third, fifteen. In the first, the magnifier very soon discovered minute floating moleculæ, gradually assuming the crystalline form, &c., as so often before described. In the second, the same appearances, but more immediately and copiously produced. But in the third, so considerable, as to excite my astonishment. For here, besides the same extremely minute crystals, which adhered to the entire sides of the phial, the bottom appeared covered, with a mixture of crystalline, and red pulverulent matter: the latter in great proportion, and, probably, prevented from crystallization, by its hasty deposition. Here, then, that encreased proportion of calcareous phosphat and animal gelatinous matters, (which always takes place in gout, and could not be expected here,) would seem only wanting, to form a sort of synthetic approximation to the gouty sediment.

The unusual proportion of deposited uric acid, in this experiment, created some suspicion, that the phosphoric acid might, by a combination with some of the principles of of this very compound fluid, give rise to some artificial formation of it, on this occasion.

To the filtered liquor, therefore, of Number 3, were again superadded five drops, which, in twenty-four hours, caused a farther separation of a very few crystals only. It was filtered a third time, and eight drops more added; but without the smallest appearance of a single crystal, after four days. The additional acid, then, only more effectually and speedily determined the separation of the quantity, naturally contained in urine: its more divided pulverulent appearance adding considerably to its volume.

It now only remained, to demonstrate the identity of these various precipitates, with the naturally deposited matter of gravel. For, though it could not be well mistaken, for any other saline composition in urine; yet, as external characters are, even in the hands of a Romé de Lisle, or an Abbe Haüy, fallacious, the following, and concluding one, on the subject of acids, was instituted.

EXPERIMENT XV.

To two drachms of this artificial gravelly matter, was gradually added one ounce of nitrous acid; which acted on it, with effervescence, and dissolved the whole, with the exception of some small, floating, floculent, animal particles, so well described by Bergman.

The evaporated solution reddened the skin, and, after some time, deposited crystals of oxalic acid; as happens in all

all concentrated nitrous solutions of calculi, of the uric acid kind. To another small quantity, was added some pure alkaline lixivium; which very soon took it up, became coloured, sweetish, and deposited the usual silky crystalline sediment, upon the addition of acetous acid. No doubt, therefore, could remain, as to its identity, with that naturally deposited.

And here, though irrelevant to my present object, and merely with a view to excite the attention of the faculty, may I be permitted to ask, how it happens, that, in the very worst kinds of typhus fever, there is very little diminution of the secretion, or excretion of the acidulous phosphat of lime? as appears by the acidity of the urine, lime-water, and the *quantum* of precipitate, afforded by the oxalic acid: whilst a very considerable one of the uric acid takes place, and continues so, until nearly the termination of the disease, when it begins gradually again to manifest itself; first, by the usual tests only; but presently, upon the crisis taking place, in such quantity, as to become insoluble; and, therefore, quickly precipitates, (with some additional mixture of calcareous phosphat, and animal mucilaginous matter,) under the form of our critical sediment or deposit? Or, are we not here, again, to to admire the wise economy of the Author of nature, which, by keeping up the considerable and necessary bony excretion of the system, prevents the dangerous accumulation of it, which must ensue, from its retention, during the long protracted period of many fevers? I might

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here offer some conjectures, in explanation, but will reserve them for another place.

Having already trespassed so much upon the indulgence of the Academy, I shall here content myself with briefly stating, that, from the above experiments and observations, we may presume to say, acids of every kind are prejudicial, and give rise to the formation of gravelly and calculus affections, by causing a separation, and crystallization of the lithic acid contents of urine, within the body: not pretending, however, to deny the existence of other causes, inherent in the system itself, occasionally productive of similar effects, as has been already observed.

I shall now proceed to the second part of this inquiry, namely: how far, or in what manner, alkaline matters are conducive to the alleviation of these complaints.

PART II.

THE bad effects of all acid and acescent substances, being generally felt and acknowledged, we cannot be surprised, that sufferers from these maladies should naturally expect an alleviation of their complaints, from substances of a very opposite nature; or that, perhaps, in the general anxiety of mankind to discover a solvent of these concretions, the active agency of alkaline matters could not be overlooked. We accordingly find, that, from the remotest antiquity, up to this day, they were, and still are, though under various modifications, chiefly resorted to. Our ancient physicians prescribed waters with mineral alkaline impregnation; such as Seltzer, Carlsbad, and others: and, in latter times, we find our own countrymen more particularly engaged in these pursuits. Lime-water, recommended by White, (to whose numerous and interesting experiments I must beg leave to refer): lime, and pure alkaline matter, forming the bases of the celebrated remedies of Madam Stephens, Hartley, and others. And, in our own days, the caustic lixivium, again forgot, to make room for the more modern and fashionable introduction of both our alkaline, sub and super-carbonates; the vegetable, as in Faulknor's mephitic alkaline water, or in the crystallized carbonate of potash; the mineral, in a desic-

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cated state, as recommended by my learned and indefatigable friend, Dr. Beddoes; or in that of the well known soda waters, first introduced in Geneva and Paris.

Now, in whatever of the above forms these saline matters are employed, their decided good effects are universally experienced and acknowledged. The *Aqua mephitica alkalina* I consider the most valuable gift, bestowed upon mankind, by our modern chemistry: and, to Beddoes' desiccated soda pills, my colleagues must join with me, in acknowledging our greatest obligations. But how account for these good effects? or what can their *modus operandi* be? *Hic labor, hoc opus.* Carbonates, we have always been given to understand, exerted no solvent power on gravelly or calculus matter: and this continues to be the opinion of philosophers, as well as medical chemists, to this day. We find Fourcroy, in his late elaborate work on this subject, still continuing to assert, (in mentioning the action of various matters upon uric acid,) " les carbonates alkalines n'ont " aucune action sur lui." Nor does the difficulty diminish, with respect to the pure alkalies; for, in the stomach and *primæ viæ*, they must return again, to either a carbonated or saponaceous state. My ingenious friend, and master in chemistry, Mr. Wm. Higgins, (in the work already quoted,) emphatically exclaims, " why not at once give soap? why " not turn our attention to the mild mineral alkali?" With regard to the common alkaline carbonates in use, it may be observed, that the saturation is not complete; and that the uncombined portion of alkaline matter may still exert

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its specific powers, observable by its detergent quality; as has been so long since well explained by Mr. Kirwan. This explanation, however, could not extend to the *potassa carbonata*, or crystallized vegetable alkali, lately introduced, and with equal success. May I be permitted (notwithstanding its use as a test, and *non-deliquescence)* to entertain some doubt of its complete saturation? for that, prepared with the most scrupulous care, still retains its alkaline taste, and acts, with energy, on the vegetable blues. The carbonic may, probably, be too weak an acid, to entirely annul its alkaline property, in any proportion that we can possibly unite them, in the solid state. I am informed by Mr. Kirwan, however, that this can be effected; but the saturation is temporary, and continues only during its most recent state. This we now accomplish, by mechanical means, in the fluid one of our soda, and other mineral waters; where, indeed, the alkali may be considered as in the super-carbonated state. Now, the success attendant also upon their exhibition, completely does away my former hypothesis; and we are left to conclude, that either the opinion, of their want of action, upon gravelly and calculus matter, is unfounded, or that the animal economy may be possessed (among the multiplicity of its wonders) of some unknown chemical agency, whereby it may, in their course through the circulation, disengage their carbonic acid gas.

This would not appear more extraordinary, than the formation of the different and most opposite secretions; such

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as bile, and milk, from one and the same fluid: nor than what we every day observe to pass, in the functions of the vegetable department of the organized kingdom. The *salsola kali*, *salicornia*, and other maritime plants, afforded to Chaptal's analysis, in their early state of growth, muriate of soda: when the plant was more advanced, this salt, with excess of alkali; but in a full state of maturity, the same quite disengaged, and uncombined with muriatic acid. Here, then, we have one of our most refractory salts, and that resists the action of our greatest fires, completely decomposed, by the vegetative powers of an humble plant. In this state of uncertainty, I determined upon a course of some experiments, which might throw some light on this subject; and go to explain how, or upon what principle, alkaline earths, or carbonates, become remedies in those complaints. And here, again, I must bring to our recollection, that whatever retains the uric acid in a state of solution, whilst in the body, must prevent the formation of gravel, or calculus matter of that kind.

And to begin with lime-water, so generally prescribed since the time of White. In this, the quantity of pure earth in solution (being only one grain in 700 of water) is so minute, and it is, withal, so readily decomposed, that we could not, a priori, expect much from its agency.

On conversing, however, with my friend, Dr. Harvey, on this subject, (of whose professional acumen it is unnecessary to make mention here,) he observed, (with that strength

strength of reasoning peculiarly his own,) "Whatever may "be the result of your future inquiries, can you, for a "moment, imagine, that physicians of the first eminence, "and of all nations, would still consent to tread in the "path of empiricism, by persevering in the use of this "remedy, if they were not retained in it, by the irresist- "ible evidence of a successful practice and observation? "or that the late Dr. Smyth, a gentleman of great dis- "cernment, and extensive knowledge, would, so generally "and promiscuously, prescribe lime-water, in gout and "gravel, if he were not satisfied of its efficacy, as well "as of the great similarity of these complaints?"

EXPERIMENT I.

To four ounces of healthy urine, was added one ounce of lime-water. A similar quantity of urine was set aside as a standard; both in close vessels: temperature varying from 60 to 75 degrees, being in August, 1799. In the first, no sign of the slightest separation, or crystallization of uric acid, after three, five, or seven days. Some observable in the standard, after the third day, which encreased in quantity to the fifth.

EXPERIMENT II.

To the same quantity of urine, was added half an ounce only of lime-water, with the same appearances as before.

No sign of uric acid after several days. The standard deposited a few crystals, on the third morning.

EXPERIMENT III.

To the same quantity of urine, were added two drachms only of lime-water; which, though insufficient to neutralize the disengaged phosphoric acid, yet seemed as effectually to prevent the separation of uric acid, as the greater quantities employed in the former experiments.

EXPERIMENT IV.

To three ounces of the urine of a child, six years old, still warm, and subject to deposit gravel upon cooling, were added two drachms of lime-water; which effectually prevented all separation of this matter; whilst the standard precipitated, copiously, this saline substance, after three hours.

EXPERIMENT V.

To three ounces of the same kind of urine as in the preceding, was added one drachm of lime-water: the result the same as in the former. Some precipitation in the standard, as in the preceding experiment.

When we consider the small proportion of lime kept in solution in water, and that the lime-water, used in my experiments,

experiments, was far from being recent, we must be astonished at the minute quantity, that proves sufficient to keep the uric acid in solution: but this wonder ceases, when we recollect, that the proportion of it, in the above quantities of urine, is extremely small, and that it is scarcely acid; as we may learn from the controversy that took place, between two such able chemists as Pearson and Fourcroy, on this subject. Finding, then, our common lime-water exerting such powers, in preventing the separation or crystallization of this substance, it occurred to me, that much more might be expected from barytic lime-water, as containing a larger proportion of saline matter in solution; and that, though, from its poisonous effects in the carbonated state, the internal exhibition would be hazardous, yet it might prove an useful remedy, when injected into the bladder. But how uncertain are our apparently best founded theories, when not deduced from experiment!

EXPERIMENT VI.

To three ounces of urine, was added one drachm of barytic lime-water, which immediately seemed to decompose the whole, render it turbid, and give it the appearance of the *urina jumentosa;* for reasons easily and satisfactorily explained by Fourcroy, to whom I must refer. After two days, I was surprised to find some small crystalline matter adhering to the sides of the glass; and, upon examining

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the copious precipitate from this re-agent, I found it blended with as much crystallized uric acid, as appeared in the standard. A repetition of this experiment, both since, and at that time, afforded the same results. Now, the strength of barytic lime-water is, to that of the common, nearly as 13 to 1; the former keeping in solution, at the temperature 60 degrees, 13 grains to the ounce. Has the barytic, with all its superior energy, less affinity for the uric acid, than the calcareous earth? Or, does a superior affinity, to some other ingredients of the urinary compound, supersede its union to this?

I regret, that the small quantity of stronthian lime-water, which I possessed, did not permit me to extend my inquiries with it.

Finding, then, that our alkaline earth of lime, in the weakest possible state of solution, and in the smallest proportion, effectually prevents the crystallization, or keeps in solution, the lithic acid of urine: if we only suppose, that it reaches the kidneys and bladder, in the smallest quantity, it must produce similar effects there, obviate the further formation of gravelly matter, or further accumulation of pre-existing calculous concretions of this kind.

Let us now proceed to enquire into the effects of the pure and carbonated alkalies themselves. The action of the former being well known and acknowledged, I shall content myself with one experiment, and pass on to the latter.

EXPERIMENT VII.

To four ounces of the urine of a child, often depositing gravel, on cooling, were added ten drops of the *aqua kali puri* of the shops. After seven days, no sign of separation: some observable in the standard, after some hours.

EXPERIMENT VIII.

To four ounces of urine, were added three grains only of crystallized carbonate of potash, the purity of which was ascertained by Dr. Perceval and myself; and containing, according to Mr. Kirwan, 1,23 grains of alkali. After several days, no appearance of crystallized matter: some in the standard, after forty-eight hours.

EXPERIMENT IX.

To the same quantity of urine, were added two grains only of the same: with the like result.

From the pure and carbonated, let us now proceed to the super-carbonated and sub-carbonated states.

EXPERIMENT X.

To three ounces of urine, in a well closed phial, was added half an ounce of the *aqua mephitica alkalina*, prepared

pared according to Dr. Faulkner's proportions. No crystallized appearance, after seven days. This result we might well expect, from the relative large proportion of its alkaline salt; having already seen equally good effects, from half an ounce only, of Kinsley's soda water, containing a mere fraction of alkaline matter.

EXPERIMENT XI.

To three ounces of urine, were added two grains of the common salt of tartar of the shops; containing, according to Mr. Kirwan, 0,82 of alkali. The same results, as in the former experiments, even after six days.

EXPERIMENT XII.

Having no pure mineral alkali, three grains of the common crystallized soda of the shops, containing, according to Mr. Kirwan, 0,64 of alkali, were added to four ounces of urine. The result as in the former: which was equally produced, by two grains only; and, perhaps, would have been equally so, by one.

Wishing to be more fully convinced, that the very large proportion of disengaged carbonic acid gas, in our soda waters, did not counteract the usual alkaline effects:

EXPERIMENT XIII.

To four ounces of the urine of the same child, which was generally surcharged with gravelly matter, I added half an ounce of Kinsley's soda water, in its full state of effervescence; the phial well corked, and removed into a cold cellar, temperature 42 degrees. After four days, nay, a week, nothing but the usual calcareous sediment, without an atom of crystallized, or otherwise precipitated uric acid.

From the above experiments, then, we learn, that pure lime, in the state of lime-water, the pure alkalies, the sub-carbonated, carbonated, and super-carbonated, all prevent the separation of the uric acid, by uniting probably with, and retaining it in solution. That they should still exert their power, in the super-carbonated soda water, is rather singular: and we must suppose, that, in the temperature of the human body, this superabundant gas (which, for the greater part, is only retained by compression) would be disengaged, and leave the alkali to exert its usual properties; and so, I would presume, it happens.

A half-pint of soda water was poured into a large glass, and exposed to the influence of the atmosphere, in a temperature of from 60 to 75 degrees. After two days, it continued to turn litmus red, and only ceased to do so, at the end of three. But, in Experiment X. we find it in its full gazeous state, still possessing its alkaline influence on on the uric acid; which I would be disposed to attribute to its very weak union to the carbonic acid, in the fully carbonated and super-carbonated states; as well as to the very weak degree of acidity of the uric acid itself, rendering the most minute portion of all alkaline matter sufficient to its saturation. However this may be, it is obvious, that the extraordinary quantity of gas, with which these waters are surcharged, is undoubtedly superfluous, and may, probably, prove dangerous. In gouty habits (so subject to these complaints) there is always danger of their inducing spasmodic affections of the stomach. This has frequently occurred: and if, to prevent it, we are obliged to add spirituous tinctures, and brandy, why not as well omit this super-saturation at once, and content ourselves with that pleasing degree of it, which exceeds but little that of saturation?

Nor have the predisposed to apoplexy less to apprehend. And, in these cases, we find our own physicians, as well as those of the sister kingdom, preferring carbonated potash, or desiccated soda. But, recollecting that I am acting, on this occasion, the part only of the experimenter, I shall now proceed to consider, what the action of these saline substances may be, on the uric acid, in its concrete or calculous state, as well as on a few others of these concretions; which, though of a different nature, are of frequent occurrence, and easy solubility. The nature of those employed in the following experiments, was always previously ascertained and specified; they were also carefully weighed

weighed and dried, both before and after immersion in their several menstrua.

Dr. Percival, of Manchester, as well as others, having experienced the solvent power of the plain mephitic, or carbonated water, on urinary calculi, it was thought proper to repeat his experiments.

EXPERIMENT I.

A fragment of a calculus, weighing twenty-three grains, and of the uric acid kind, was suspended by a thread, for forty-eight hours, in Nooth's apparatus, already nearly filled with highly impregnated aerated water, and still exposed to a stream of carbonic acid gas: temperature 58 degrees. When taken out, and dried, weighed, as before, twenty-three grains.

EXPERIMENT II.

A fragment of a calculus, of the same kind, weighing forty grains and three quarters, was suspended, as before, in Nooth's apparatus, for forty-eight hours: temperature varying from forty to fifty-five degrees. On being taken out, and dried, was found to have sustained no loss.

EXPERIMENT III.

An entire calculus, of a rough and sandy appearance, chiefly of the uric acid kind, but with some extremely

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minute intermixed particles of the ammoniacal magnesian phosphat, weighing fifty-two grains, was suspended, as before, for forty-eight hours, in Nooth's apparatus. After being taken out and dried, was found to weigh fifty-one grains and a quarter; so that there was here a loss of three quarters of a grain: undoubtedly, of the ammoniacal magnesian phosphat.

EXPERIMENT IV.

Wishing to see, whether even increased temperature would add to the solvent power of carbonic acid, a fragment of calculus, of the uric acid kind, weighing twenty-two grains, was immersed, as before, for forty-eight hours, in three ounces and a half of highly impregnated carbonated water, in a well closed phial, and laid on a sand heat, which did not exceed the temperature of 100 degrees. After being taken out, and dried, the weight was found, as before, twenty-two grains.

From these experiments, then, we may conclude, that calculi, of the uric acid kind, are insoluble in carbonated water; and that Dr. Percival, whose character as a philosopher, as well as a physician, deservedly stands so high, must have operated upon concretions of a different kind; more especially as, in his experiments, there was a loss of several grains, in only a few ounces of mephitic water; whilst none appeared in ours, though in several pounds of

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that fluid. He must have then operated upon some of a different and highly soluble kind.

EXPERIMENT V.

One half of a calculus, of the ammoniacal magnesian kind, weighing 100,5 grains, was suspended, as usual, for forty-eight hours, in Nooth's apparatus: temperature 50 degrees. Upon being taken out, and dried, was found to weigh 92,63 grains; so that its loss amounted to 7,87, or rather more than seven grains three quarters. And here we have an explanation of the result of Doctor Percival's experiments; by supposing that the calculi he employed must have been of this species: the extreme solubility of which, in so weak and innocent a menstruum, should excite the earnest hope of our young gentlemen, in the surgical department, of effecting its solution, by injections of carbonated water into the bladder. To such safe trials they must be encouraged, by the pleasing consideration, that this kind forms a large proportion of the human urinary calculi. On these occasions, the water should not be too highly impregnated; lest the sudden expansion of the gas, under the human temperature, might excite the bladder to reject it too quickly. This inconvenience, however, must be in part obviated, by the necessity of previously warming the injection, to about the temperature of 80 degrees: a precaution never to be omitted. But to return to the alkaline earths and salts.

EXPERIMENT VI.

One half of a uric acid calculus, was suspended for forty-eight hours, in four ounces of lime-water: temperature as before. After being dried, was found to have lost seven grains three quarters; and the surface to be covered with a granular efflorescence, which, in drying, detaches itself. The calculus was so much softened, as to leave little doubt of its entire destruction, by a few more immersions. It was again suspended, for a month, in the same quantity of lime-water, in the temperature of the atmosphere only, without any renewal of the menstruum; when it was found to have lost twenty-four grains. Now, if the lime-water had been frequently renewed, and its energy assisted, by the standard heat of the human body, no doubt but it would have been entirely broken down, in a much shorter time. We find, then, lime-water, not only preventing the separation of uric acid from urine, but acting powerfully upon it, in its most compact form. How well founded, then, were the experiments of Whyte, as well as the opinion of Doctor Smyth; and how little deserving the latter the obloquy of his contemporaries, for his predilection to it. Now, this result, corresponding also with Scheele's, points it out to us, as one of our most safe and active agents, when injected into the bladder, with the necessary precautions. And we must feel surprised, that

no

no attempts of that kind have been made, since the time of Whyte.

EXPERIMENT VII.

A fragment of calculus, of the uric acid kind, weighing seventy-nine grains and a quarter, was suspended, for forty-eight hours, in a mixture, consisting of four ounces of distilled water, and twenty-five drops of the weak *aqua kali puri* of the shops, which merely gave it an alkaline taste. It was then placed on a sand heat: temperature varying, occasionally, from 60 to near 100 degrees. After being taken out, and dried, it weighed seventy-four grains and three quarters; so that the loss amounted to four grains and a half. This weak lixivium, it appears, then, operated upon it, acquired a yellow colour, a sweet taste, and precipitated, with a few drops of muriatic acid, a white sediment, easily recognizable, by the small, silky, needle-shaped, crystalline appearance, peculiar to the uric acid.

EXPERIMENT VIII.

This same fragment of calculus, after being well washed, and dried, was again immersed, for forty-eight hours, in a lixivium, consisting of only twenty drops of *aqua kali puri* to four ounces of distilled water, and under the same circumstances. Upon being taken out, and dried, it was found

found to have lost four grains and a quarter. The solution was of a yellowish green colour, lost all alkaline taste, and precipitated, as before, with either the acetous or muriatic acid.

EXPERIMENT IX.

A fragment of calculus, of the same kind, weighing eighty-one grains, was suspended, as before, for forty-eight hours, in a mixture, consisting only of fifteen drops of the same alkali, to four ounces of distilled water, which scarcely imparted an alkaline taste. After being taken out and dried, it was found to have lost one grain and three quarters; the specimen consisting chiefly of the external laminæ, much more slowly acted upon.

EXPERIMENT X.

This same fragment, washed and dried, was again immersed, for forty-eight hours, in a similar lixivium, and under the like circumstances. The loss now amounted to nearly four grains; and, from this we learn, how considerably the energy of the menstruum is increased, by each succeeding immersion; so much so, indeed, that a few repetitions enable it to disunite the laminæ, and cause them to crumble into a pulverulent state, easily voidable with the urine. To the happy result, therefore, of this experiment, let me earnestly solicit the attention of our young practitioners.

EXPERIMENT XI.

As children are such frequent sufferers, Mr. Richards suggested the propriety of ascertaining, whether the alkaline influence might be weakened, by the addition of sugar. One half of a calculus, of the uric acid kind, weighing 185½ grains, extracted by my friend Mr. Richard Dease, and (though under the most unpromising circumstances) with a dexterity and success, not to be exceeded by his late father, was suspended in a lixivium, consisting of eight ounces of distilled water, and twenty drops of weak *aqua kali puri* (partly aerated), and scarce imparting an alkaline taste. To this were added thirty-six grains of sugar, which were found adequate to sweeten it sufficiently. After remaining forty-eight hours, in a temperature, varying from 55 to near 100 degrees, or a medium one of 74°, being dried and weighed, it was found to lose ten grains three quarters. The addition, then, of saccharine matter cannot diminish, but may add to the alkaline energy.

EXPERIMENT XII.

Ten grains of very pure crystallized carbonate of potash were dissolved in four ounces of distilled water. In this filtered lixivium was suspended a fragment of calculus, of the uric acid kind, weighing seventy-two grains and a quarter, for forty-eight hours, on a sand heat, varying from 50 to to 100 degrees (for the fire was not kept up during the night). Being taken out, dried, and weighed, it was found to have lost seven grains and a quarter. The solution had a yellowish green colour, different from the light yellow tinge of the pure alkaline ones. It also lost its taste, but without becoming sweet. A quantity of flocculent animal matter was separated, and the dissolved uric acid was, for the greater part, again precipitated, upon the mixture cooling, to the temperature of the atmosphere.

EXPERIMENT XIII.

The crystallized carbonate of potash, being generally prescribed, in the proportion of one drachm to four ounces of water: in a similar mixture was suspended an entire calculus, of a very compact, rough, and gritty appearance, weighing forty grains and a quarter. After remaining forty-eight hours in the above temperature, it was taken out, dried, and weighed, and found to have lost three grains three quarters. The solution here more highly coloured than in the former: some spontaneous precipitation; and an immediate one, on the addition of a few drops of weak marine acid. We then find the vegetable alkali in the fullest state of saturation, with carbonic acid, that we can procure it, in the solid form, acting powerfully on these concretions, when assisted by degrees of temperature, even much inferior to that of the human body.

Now,

Now, as to the mineral alkali, nature presents us with similar, nay, more extraordinary results, in the mild, mineral, alkaline impregnation of the waters of Carlsbad in Bohemia. Here are several springs, varying in temperature from 114 degrees, to that of the Brudel, at 165°. According to Elliot, they contain, in the gallon, of aerated lime 36 grains; muriate of soda 48; aerated soda 102; vitriolated soda 6 drachms; some minute proportion of iron, and a considerable carbonic acid impregnation. But Klaproth rates the proportion of mineral alkali still higher.

Of the lithontriptic effects of these waters, Springfield gives us a very surprising account indeed: founded, however, upon numerous experiments, instituted upon the spot, by the immersion of many calculi, in the sources themselves; where they were either entirely dissolved, or acted upon, with an energy that must appear incredible, if we did not consider the nature of the menstruum, its high temperature, and constant renewal, by the flowing of the stream. Nay, the urine of patients, who used these waters for a few days, was found to possess powerful lithontriptic effects; as appeared by the immersion of many calculi in it. For an account of these highly interesting experiments, too numerous for insertion here, I must beg leave to refer to his Treatise *De Prærogativa Thermarum Carolinarum, in dissolvendo Calculo Vesicæ, præ Aqua Calcis vivæ.*

From these experiments, as well as the highly beneficial effects of these waters, taken internally, by the numerous calculous and gravelly patients, who frequent Carlsbad, he establishes

establishes their superiority over the different alkaline and other remedies, hitherto in use; not excepting Whyte's oyster-shell lime-water. Now, the lime in these being carbonated, and only kept in solution by their highly aerated state, we can be at no loss, in those days, to attribute their superior agency to the alkaline impregnation, assisted by so high a temperature. Klaproth affirms, that a person, who drinks these waters, in the usual quantity, for twenty-six days, takes of mild mineral alkali 3913 grains, or 8 ounces, 1 drachm, and 13 grains; which amounts to two and a half drachms per day, besides the other saline ingredients.

Doctors Rutty and Smyth, who gave us a valuable extract from this publication, in the Memoirs of the Medical and Philosophical Society of this city, (now in the library of the Royal Irish Academy, but which, we have sincerely to regret, were never published, and are now discontinued,) conclude their account by the following query. "May not some alkaline lixivium be contrived by art, "that would possess similar effects with these waters?" And has not this partly taken place, in the instance of our soda waters? But may we not make a nearer approximation, by a solution of the above specified proportion of mineral alkali, in the relative quantity of water, with the addition or omission of the carbonic acid, and the other saline ingredients, as may be thought proper; afterwards heating, however, each separate dose to 160 degrees?

We find, then, the alkaline carbonates, in the great laboratory of nature, as well as in our experiments, exerting considerable

considerable solvent powers upon these animal concretions, contrary to what has been hitherto supposed.

EXPERIMENT XIV.

Into a filtered solution of ten grains of salt of tartar, in four ounces of distilled water, were introduced two fragments of calculi, weighing seventy-four grains and a quarter. The mixture was set aside for forty-eight hours in a cool room; temperature varying, from 47 degrees at night, to 55 degrees in the day. After twelve hours it began to be coloured, and continued to be more so, until the temperature fell to 51 degrees, when a precipitation took place, and continued during the night; so that it appeared to deposit, at the temperature of 47 degrees, what was taken up at degrees somewhat exceeding 51°. These fragments, on being taken out, dried, and weighed, were found to have lost three grains and three quarters; the laminæ disposed to crack, and the strata to separate and crumble. This weak lixivium, then, exerted much energy, even in a very low temperature.

EXPERIMENT XV.

A fragment of calculus, weighing seventeen grains three quarters, was immersed in a lixivium of similar strength; but now exposed to a temperature, varying, from 51 degrees at night, to about 95 degrees in the day. After forty-eight hours, it was found to lose five grains and a half: a prodigious quantity, when we consider the small surface presented by this fragment, weighing only seventeen grains three quarters. The solution, upon cooling, became turbid, as before, and precipitated a large proportion of the dissolved uric acid.

EXPERIMENT XVI.

A fragment of calculus, weighing forty grains three quarters, was immersed in four ounces of soda water for forty-eight hours, and exposed to a temperature, varying from 55 to about 100 degrees. Its loss amounted to one grain. A repetition of this experiment afforded nearly the same result; and demonstrates, that though the soda, in this super-carbonated state, still exerts some energy, on concretions of the uric acid kind, yet it is but feeble; and that these waters appear more capable of preventing their formation, than effecting their solution, when they once acquire the aggregate state. The same fragment, in a similar quantity of soda water, in the temperature of from 50 to 55 degrees only, sustained no loss, after forty-eight hours. And here we have another proof of the necessity of seriously attending to the degree of temperature, in all researches of this kind.

But it may be observed, as to the internal use of alkaline substances in particular, that their effects must be considerably weakened, upon their immediate admixture

with

with the urine: as the small quantity, that can be conveyed there, must, in the first place, neutralize the uncombined phosphoric acid, in all urine; the benzoic, in children's; and decompose the ammoniacal and magnesian phosphats, in that of every period of life. It must be acknowledged, its efficacy is partly counteracted by these circumstances, which should never be overlooked, and always taken into account, in practical application. Referring to Fourcroy's instructive essay on this subject, Memoires of the National Institute, and Connoissances Chimiques, let us here once more appeal to the test of experiment.

EXPERIMENT XVII.

A fragment of calculus, weighing eighteen grains one quarter, of the uric acid kind, was suspended, for forty-eight hours, in an alkaline lixivium, consisting of four ounces and a half of recent urine, and twenty drops of a very weak, and partly aerated, caustic lixivium: medium temperature about 74 degrees. On being taken out, and dried, it was found to have lost one grain three quarters: a considerable quantity, from so small a specimen. To the filtered solution, were added a few drops of dilute marine acid; which, after a few minutes, precipitated a reddish crystalline matter, in a triple proportion of what generally occurs in the natural state of urine.

From the above experiments, therefore, it appears no longer doubtful: First; that pure lime, even in the small proportion

proportion contained in lime-water; and the pure alkalies, in an extreme state of dilution, in temperatures even somewhat inferior to those of the human system; exert an active solvent power on calculi of the uric acid kind. Secondly; that the alkaline carbonates, under similar circumstances, are possessed of similar powers, though in an inferior degree. And Thirdly; that, by our having ascertained this point, we have removed a long established error, substituted a discovery highly interesting to animal chemistry, and likely to be productive of a more enlightened and successful practice, in the treatment of these diseases.

In these expectations we will appear to be the better founded, when it is considered, that, for want of entire specimens, (preserved here like the oriental bezoars of old,) we were obliged to operate upon fragments, presenting small surfaces only to our solvents: that these last were never renewed during the course of the experiments, which would not have occurred in their application in the form of injections; as they should, in that case, be so often repeated, and act, of course, with renewed energy: that, either taken internally, or used in form of injection, the smallest proportion of alkaline matter, in a great state of dilution, assisted by the human temperature, answers our purpose: and that the temperature, in our experiments, was never permanent, and might be rated at the medium one of 74 degrees.

Having now fulfilled the second object of this essay, I would no longer presume to trespass on the indulgence

of

of the Academy, if I were not actuated by the sanguine hope, of turning the attention of my surgical friends, to the humane consideration of obviating, as much as possible, the most dangerous of operations, by the prudent application of a few safe solvents, injected into the bladder. How far they may succeed, with calculi of the uric acid kind, may be already conjectured, from the preceding experiments: but with those of the next most frequent occurrence, there is much less difficulty to encounter, and every reason to hope for a speedy and safe result. The ammoniaco-magnesian phosphat is partly soluble in water; highly so, in the carbonic acid, (as we have already seen;) and, consequently, more so, in the weakest possible acid impregnations that can be devised: nothing more being necessary, than the addition of as many drops only of weak muriatic acid, as will scarce impart an acid taste. But as precept should, in every instance, be as much as possible assisted by experiment, I shall, for the encouragement of the young practitioner, exhibit a few, on this very soluble species, the more willingly, as he has no assistance to expect from his professional books: these subjects being only treated of in Philosophical Transactions, Memoires of the National Institute, and a few other foreign chemical publications, if we except Whyte's Treatise on Lime-water, to which we would willingly refer him.

EXPERIMENT XVIII.

An entire calculus, of a reddish, gritty appearance, externally, proved to consist of ammoniaco-magnesian phosphat, weighing forty-six grains one quarter, was suspended, for forty-eight hours, in a mixture, consisting of four ounces of distilled water, and ten drops of weak marine acid. After being taken out, and dried, it was found to have lost six grains three quarters. The mixture was whitish, lost its acid taste, and precipitated, on the addition of a few drops of fixed alkali, the ammoniaco-magnesian phosphat, under that beautiful crystalline form, so accurately described by Doctor Wollaston.

We will readily conceive, how much more the loss would have amounted to, in this case, in the short space of forty-eight hours, if the menstruum had been frequently repeated, under the regular influence of human temperature.

EXPERIMENT XIX.

A fragment of the same species with the above, weighing twelve grains, was immersed, for forty-eight hours, in three ounces of distilled water, without addition: temperature from 60 to near 100 degrees. After being taken out, and dried, it was found to have lost one grain three quarters, became so friable as to crumble, and the solution to precipitate with a few drops of pure ammonia. This species

cies of calculus, therefore, is soluble in water, at temperatures even inferior to that of the human. It is unnecessary I should enter into a further detail of experiments, made upon calculi of the mixed kind, having the uric acid, phosphat of ammonia, and, sometimes, though rarely, phosphat of lime, intermixed in their strata. Suffice it to say, that the very dilute marine acid speedily takes up the earthy phosphats, leaves the laminæ of the uric acid bare and distinct, ready to crumble, and of easy solution, in the weakest alkaline lixivia; and still more so in lime-water. A most important consideration, in a practical point of view.

It would be trespassing too much, on the already tried indulgence of the Academy, to go further into the detail of the circumstances necessary to be attended to, and acquainted with, to insure success in the application of these principles. These are already tolerably well detailed, in the Connoissances Chimiques. To the gentlemen, professors in the school of surgery, it more particularly belongs; and, from the zeal and talents now in full activity there, what may not be expected? Created only the other day, by a Cleghorn, (a name as deservedly as universally revered;) fostered, afterwards, by the anxious care and talents of Mr. Dease; we find it already arrived at a state of perfect maturity, and holding out, to the student, advantages, no where to be rivalled, if indeed equalled: and, that nothing may be wanting, to a complete medical, as well as surgical education, establishing a chair of botany,

supported

supported by the acknowledged abilities of Doctor Wade, both as a botanist and teacher. From the above experiments and observations, we may presume to draw the following conclusions.

That acids, and acescent drinks of all kinds, give rise to gravelly and calculous affections, by causing a separation, and precipitation, of the native uric acid of urine within the body. That all acids, vegetable or mineral, nay, the native phosphoric acid of urine, in excess, are equally productive of this effect; the tartaric, perhaps, somewhat more so. That, on the other hand, we find lime, both the fixed alkalies, pure as well as aerated, (even in the smallest proportions,) serviceable in these disorders, by uniting with, and keeping in solution, this acid substance. That they, also, in the smallest proportions, and diluted state, exert strong solvent powers on this acid, in its aggregate form of calculus; provided their action be favoured by degrees of temperature approaching to the human. That, under the same circumstance, contrary to what was generally supposed, the carbonated, sub-carbonated, nay, the super-carbonated, exert similar influence, though in an inferior degree. That lime, even in the small proportion it presents itself to us in lime-water, is a most active and safe solvent of calculi, of the uric acid kind, and its various combinations; as has been long since ascertained by Whyte. That, weight for weight, it exceeds even the caustic alkali, in any state of dilution that the latter can be applied to the living body. That, finding

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four ounces of lime-water, containing only two grains three quarters, take up, or detach, seven grains three quarters, from a very compact calculus, we may be led to suppose this may arise from its action on the agglutinating medium; its affinity to, and energy on animal matter, being so well known: and, if so, may we not expect something, from its power on the mulberry calculus, our most formidable enemy? For, though it cannot touch the oxalt of lime, it may the cementing medium, with which it peculiarly abounds.

For the application of these established facts to useful purposes, I must refer to my surgical friends, being all now possessed of the necessary degree of chemical acquirement; and I am happy to find this career already entered on, by my friend Mr. Crampton, who has favoured us with an analysis of a pulmonary calculus, in the Philosophical Transactions; and from whose professional, as well as scientific talents, we have every thing to expect, in fulfilling (even on this occasion) his duties as a teacher.

Having now endeavoured to accomplish the chief object of this Essay, which was, to establish experimentally a more clear and comprehensive view, of the nature of these maladies, and the remedies employed to combat them, than we hitherto possessed; I should not have trespassed further on the time of the Academy, were it not properly suggested, by my friend, Dr. Clarke, that it would be of importance to ascertain, how far the facts and notions, brought forward in it, may stand confirmed or contradicted, by the result of our practical application of them, in Simpson's Hospital: an establishment affording the best and most extensive field of observation, of this kind, of any in Europe, that of Luneville, perhaps, excepted.

The benefit of this charity extends equally to the blind and gouty. In the year 1795, I found it to contain thirty-two of the latter: and, since that period, thirty-four have been admitted; in all sixty-six gouty patients. Of these, the greater number have either complained of gravel, or passed it, without any previous or concomitant inconvenience: a circumstance which I had, every day, occasion to observe, whilst attending to the state of gouty urine. Among the blind and gouty, however, we may count about twenty-two, as specifically more afflicted: having occasionally complained of marked and distinct symptoms of this disorder. Of these, we find sixteen among the gouty, and six, only, among the blind. Now, as the severity of gout is uniformly diminished, nay, in many instances, the disease entirely removed, by a residence of a few years only, in the house; we must expect to find the same take place, with respect to gravel, to which it is so strongly and nearly connected. And this singular alleviation of both diseases we can only attribute to the influence of temperance, and a manner of living, very opposite to that of their former habits. The diet, in our house, consists of bread and milk, for breakfast and supper; beef or mutton, with table beer, for dinner; all of the best quality, and administered with the greatest propriety and regularity;

rity; whilst the introduction of ardent spirits is prohibited, and sobriety enforced, by the strict discipline of the house. On the other hand, we find that, previous to their admission, they were either addicted to intemperance, or in the habit, at least, of muddling in public houses; where, after a libation with porter, they indulged in the free use of acidulated punch, (the constant nocturnal practice of our middling tradesmen and shop-keepers, who furnish the greatest proportion of our patients). The keeper of a porter-house, of considerable resort, informs me, that, to please the generality of his customers, he finds it necessary to add the juice of an entire lemon to about two quarts of punch; and that, from this circumstance, he would have experienced a considerable diminution of his profits, if he did not occasionally substitute cream of tartar, or the dilute sulphuric acid: an innocent and safe practice, in his opinion. Now, so satisfied are our patients, of the pernicious effects of acids of all kinds, that we find many of them refuse to make use of our table beer, during the summer months; through the apprehension of its acescent quality, (as was before observed;) and which continued to be the practice of Hewson, Khensk, Clapham, and others, for years back: nor do our present two greatest sufferers, Sing and Cox, venture on it, at any season, but with the greatest caution.

To a removal, then, from the former occasional causes, we may attribute no small share of the alleviation of those

those diseases which takes place with us: a practical observation, that cannot be too generally known. But to return to my subject. On the slightest appearance of gravelly symptoms, unconnected with fever, or inflammatory tendency of the urinary system, our patients have recourse to an alkaline medicine, the gravelly pills, (as they term them;) which consist of desiccated soda, in the most convenient form for hospital practice, as well as most suited to gouty stomachs. Of this, (as first advised by Beddoes,) one drachm, with the addition of a few grains of capsicum, or drops of essential oil, and the necessary quantity of hard soap, or extract, is made into twenty pills. Of these, from three to six, or more, are taken in the twenty-four hours; and are found sufficient, not only to alleviate or remove these complaints, but even to render the interference of the physician but seldom necessary. We have had also occasion to remark, that several of our patients, induced by their marked beneficial effects, carried these pills about them, so as to have occasional recourse to them, without much attention to either dose or number.

To this practice, then, we would be disposed to attribute, the very pleasing and interesting consideration, that, among so many gravelly patients, there has not occurred, in the course of ten years, a single operation of lithotomy; nor has the catheter, even in the hands of our expert and able surgeon, Mr. Macklin, been able to discover the smallest occasion for it. We could therefore, have no opportunity

opportunity of ascertaining the efficacy of injections into the bladder, as recommended by Whyte, Fourcroy, and myself.

I shall conclude by observing, that it would be interesting, to have it in our power to extend these researches, to the urine of those, who live habitually on different aliment and drinks, particularly of the acescent kind; as well as to that of those, who drink waters, with mineral alkaline impregnations. But this desirable object can be only obtained, by the concurrent exertions and attention of gentlemen of the Faculty, in different countries and situations. In private practice it is not to be expected: for here, wherever experiment is surmised to be the object, mistrust and suspicion take place of professional confidence. The use of the nitric acid, in our venereal hospital, I hoped, would afford some useful facts, as to its effects, upon the saline contents of urine; the uric acid in particular. But I had not, as yet, sufficient leisure for that enquiry; nor could I, hitherto, obtain the urine of those using it, with all the circumstances, necessary to enable me, at this moment, to draw any direct conclusions, from my examination of it. In many instances, a morbid state of the urinary system (the urethra in particular) took place. In others, the combined effects of mercury interfered: and in all, no certainty of its not being blended with the urine of others, not using this acid. I could not, however, help observing, that the few specimens, sent to me, agreed in one particular, viz. their exceeding very

little,

little, if at all, the usual healthy standard ofacidity. This circumstance must excite our attention the more forcibly, when we consider, that two drachms of nitrous acid, nay, sometimes three, diluted in the proportion of one pint of water to each drachm of acid, were taken daily; whilst, on the other hand, a few drops of the acid elixir of vitriol, or tincturæ martis in sp. salis, nay, the weak vegetable acids, and cream of tartar, persevered in for a few days, impart an additional degree of acidity to the urine. Would not this observation, (if founded), conjoined with the easy decomposable nature of the acid itself, and its action on animal matter, induce us to lean to the opinion of those, who have already asserted, that this acid is partly decomposed in the system, imparts its oxygene to it; and that, perhaps, to a degree, capable of annulling or destroying its properties as an acid?

And it may be here further remarked, in confirmation of such notion, that those gentlemen, most conversant with it here, as well as most capable of judging, entertain strong doubts of its supposed diuretic effects; allowance being made, for the necessary quantity of its watery vehicle. If it be, then, truly deoxyginated in the system, why be deterred by its failure, as a radical cure of syphylis, from extending our trials with it here, to other chronic diseases, as they have already done, in India?

I have, in the former pages, expressed a wish, that physicians should attend to the influence of acescent aliments and drink, upon the state of urine of those who habitually used them; as well as of alkaline matters, upon that of such as occasionally must have recourse to these substances. For it is obvious, that observations and experiments, of this kind, must be more decisive, and less subject to lead us into error, than the most accurate that could be devised, upon this, or any other of the human fluids, when once excreted out of the system, and no longer acted on, by the powerful agency of the principle of life itself.

This desirable object, I now find, has been, in part, already fulfilled, by the industry and ability of Mr. Alexander Philip Wilson, who, in a publication on the *Remote Causes of Gravel*, published in Edinburgh, so far back as 1792, and dedicated to Doctors Black and Monro, (but which I have to regret, only latterly fell into my hands,) details a number of interesting experiments, made upon himself and others. The result of a few of these, as not only highly important in themselves, but as naturally connected with mine, instituted out of the body, I must request the indulgence of the Academy briefly to relate.

From his first experiment, upon himself, it appears, that the natural deposit of uric acid, from a given quantity of his urine, whilst living, as usual, on a diet of vegetable and animal matter, amounted to one grain and a half;

 but

but was increased to three grains and a half, upon eating four lemons in the twenty-four hours.

From the second experiment, upon a healthy boy, æt. 15, living upon an acescent diet, of bread, milk, sugar, sour cream, and honey; that the natural deposit, varying from three quarters of a grain, to one grain and a half, totally disappeared, upon the use of a diet chiefly animal; and was only observable, where indigestion of the acid kind supervened upon so unusual and unnatural a regimen.

The third experiment, we find merely corroborative of the former. But, from the fourth, as well as some others, we learn, that even acid ingesta, or lemon juice, where the action of the skin is vigorous, and assisted by exercise, contribute very little to the increase of the uric acid deposits of urine; and from this and other experiments, instituted upon himself, as well as others, while under the influence of sudorific medicines, he concludes, that the uric acid passes off, (in part at least,) by the skin, under the circumstances already mentioned.

From the fifth, on the same boy, that, whilst living for twenty-four hours, chiefly on beef and salt fish, (though with an allowance of small beer and potatoes,) no deposit of uric acid took place; but, upon turning over, for the same interval of time, to bread, milk, apple-dumplings and sugar, it amounted to one grain.

From the sixth experiment, upon a healthy boy, æt. 20, that, living entirely on vegetable matters and milk, and eating

eating three lemons in the day, a deposit of two grains of uric acid took place; which entirely disappeared, upon his omitting the lemons, and living chiefly on animal food.

From the seventh experiment, on the same person, that a diet of animal food, for forty-eight hours, was productive of no deposit; but amounted to half a grain, upon living, during the same interval, upon a diet, chiefly vegetable, with the addition of three lemons.

I shall finally conclude with the result of his tenth experiment, upon a young man, æt. 19, in good health. Here the natural deposit, of one grain, was increased to two, by eating one pound and a half of apples only. In confirmation of the result of this experiment, I beg leave to add, that, in the course of my attendance upon children, I had often occasion to observe, that this acid excretion was considerably increased, by the use of grapes, persevered in for a day or two only.

We may now, therefore, presume to assert, from the medical history of this disease, as delivered in the first part of this essay, as well as from experiments, instituted in, and out of, the body; that acids, and acescent ingesta, may be considered, as remote causes of gravelly complaints.

ERRATA.

Page 229, line 4, from the top, *for* CALCULUS *read* CALCULOUS.
—— 232, — 3, from the bottom, *for* Insipidity *read* Insipid.
—— 235, — 6, ——————, *for* ammonico *read* ammoniaco.
—— 236, — 9, ——————, *for* ammonico *read* ammoniaco.
—— 242, — 3, from the top, *for* calculus *read* calculous.
—— 247, — 7, from the bottom, *for* Beverovie *read* Beverovic.
—— 253, — 14, ——————, *for* carabonates *read* carbonates.
—— 255, — 3, ——————, *for* excreated *read* excreted.
—— 280, — 10, ——————, *for* lithic *read* uric.
—— 308, — 3, from the top, *for* nitrous *read* nitric.
—— 308, — 4, from the bottom, *for* deoxyginated *read* deoxygenated.

POLITE LITERATURE.

ESSAY ON THE QUESTION

"ARE THE ORIGIN AND PROGRESS OF THE POLITE "ARTS, IN ANY COUNTRY, CONNECTED WITH, "AND DEPENDING ON, THE POLITICAL STATE OF "THAT COUNTRY?"

Illustrious acts high raptures do infuse,
And every conqueror creates a muse.

WALLER.

BY WILLIAM PRESTON, ESQ. M.R.I.A.

READ, MARCH 4th, 1805.

THE present question, proposed by the Royal Irish Academy, is grand and comprehensive; and includes various discussions, bearing on, and influencing some of the most important interests of society, and most interesting topics of polite literature. At the same time it is very difficult of solution, from the multitude of enquiries, to which it leads, and the extent of literary research, which it demands. I state these difficulties, not by way of enhancing the merit of this Essay, but to bespeak the indulgence of the reader, to its defects.

It is not easy to return a precise answer to the present question; because the theoretical tendency, and natural

 influence

influence of governments are controlled, and counteracted, by collateral causes; in such a degree, that reasonings, from general principles, are opposed by facts; and no rule can be drawn from abstract reasoning, to which history does not instantly suggest some striking and remarkable objection. These collateral controlling causes are climate, religious and moral institutions, the temper, genius, and characters of particular individuals.

Thus it may happen, that a despotic government, unfavourable in itself (as we shall see, in the sequel of this Essay) to every species of cultivation, and liberal improvement, may be adorned, in the most eminent degree, with the fine arts, and become the residence of opulence, elegance, and commerce. But this effect must be ascribed to the influence, and peculiar character of individuals; as, for instance, of Augustus Cæsar; of some dynasties of the Egyptian, Persian, and Moorish princes; of Pope Leo X., and of Lewis XIV. While the inductions, which might be drawn from history, may be, sometimes, at variance with the conclusions of general theory, and the conclusions of general theory may be opposed by objections, drawn from history: yet, when the subject comes to be duly examined, this seeming contrariety will demonstrate a perfect uniformity of principle; and the theory will be confirmed by the very circumstances, which, at first sight, seem to be exceptions.

I shall endeavour to maintain the affirmative of the question, by considering what is meant by the expressions,

sions, *political state;* and, afterwards, by shewing the necessary influence of certain forms of government, and other political circumstances, on the fine arts. I shall next consider, how certain great historical events, by changing the political relations of countries, and influencing the state of society, have, at the same time, influenced the state of these arts. Lastly, I shall adduce a few striking facts, from the history of the arts themselves.

The expression, *political state of a country*, is exceedingly comprehensive. It extends, not only to the particular form of government, in any given country, and to the degree of civil liberty, which its inhabitants enjoy; but, also, to other circumstances, influencing the well-being, the feelings, and character of a nation; as extent of territory, commerce, foreign relations. If this is a fair explanation of the phrase, *political state*, it may be seen, what a vast field of discussion is opened, by the question proposed.

But, I trust, the narrow limits, by which an Essay of this nature is necessarily circumscribed, will concur, with the scanty information, and humble talents of the writer, to plead his excuse, for the imperfect execution of the task, proposed by the Academy.

Among the political circumstances of a country, the form of government has the greatest influence on the character and temper of the nation, and the destiny of the arts. But there are collateral circumstances, which may imperiously control the genius and tendency of government,

ment, or even dictate what form the government shall assume. Some of these are natural and permanent; others are accidental and transitory. The former are, soil, climate, and position, with respect to other nations and countries: the situation, whether continental or insular, maritime or inland. The latter are, prevalence of religion, talents of a ruler, character of neighbouring nations.

In the early stages of society, where the mind of man is little cultivated, or varied, by institutions; his desires are simple, and easily satisfied: he is not many degrees removed from the mere animal: his gratifications are mostly of the sensual kind: his artificial wants are few and trifling; and the arts, which minister to them, are proportionably rude, and, comparatively speaking, insignificant. Such is human nature, in the stages of the *warrior* and *hunter*. The rude decorations of their armour, the trophy of victory; the song, that rouses the *warrior* to battle, celebrates his atchievements in fight, or attends him to the tomb, when his breath has fled; the hymn, that accompanies seed-time and harvest, that praises the Gods for their bounties, or deprecates their wrath by prayer; these, it should seem, are the only tribute, that the sturdy and rough children of the heroic ages deign to levy, from the *fine arts*. The pastoral age may require somewhat more. Ease and quiet, and a state between labour and rest, producing a relaxation of mind, with a sufficient degree of bodily health and strength, dispose men, more powerfully, in this state, than in the heroic, to the union of the

sexes.

sexes. Hence arise the passion of love, the solicitude to appear amiable,* the desire of pleasing, and being pleased. To satisfy this desire, the *fine arts* are called in aid. The dance is led; the song, the strains of the shepherd's pipe, are heard in every grove. The hand of the lover, guided by passion, attempts to pourtray the features, that have captivated his soul, and remain imprinted in his heart. Hence results a more diligent cultivation, a more extended use, and a more exquisite relish of the *fine arts*. The heroic, hunter, and pastoral states, gradually settle, into the elaborate and complex forms of civil government; which, in time, supersede that sort of family rule, that patriarchal, or despotic form of government, which universally obtains, among the primæval races of men; a form of government naturally growing out of their original state, and well suited to the simplicity of their early conceptions.

What are called the *fine arts*, arise, from the exertions of the human talents, to multiply the enjoyments or comforts of life. They are the objects of those appetencies, which prevail, in a more perfect state of society, and a more cultivated period of the human intellect; and are the consequence of a satiety of the enjoyments, which are merely necessary to the preservation of the human race. It is this constant endeavour of man, to encrease his comforts, and enjoyments, that gives activity to his existence, and furnishes employment, to his various faculties, of memory,

* See Essay on Amatory Poetry, in the preceding volume.

mory, invention, combination, reasoning; to the physical powers, which are momentarily put in action, at their requisition; and to his feelings, also, of love, hate, joy, and gratitude. Various moral causes, therefore, will concur, to render these *arts* more or less necessary to the happiness of men; and to produce a more or less successful exercise of them. The one is not always so much the necessary concomitant of the other, as we might expect. It does not follow, that, because men pursue with eagerness the *fine arts*, and find them necessary to their happiness, they should excel in them. We find inveterate scribblers, in poetry: execrable performers, in music: and miserable daubers, in painting; who delight themselves, as much as they annoy the rest of the world. The villas and improvements of many a citizen, and many another person, with a vulgar taste, may shew us, that an ardent love for the *arts*, may not always be joined with a true taste for exercising or employing them.

The successful cultivation of the *fine arts*, requires many combined particulars, as a foundation; a happy disposition of the human mind, a desire to be pleased, a cultivation of the human intellect, and a full possession of all its powers—memory—taste—fancy—judgment—reason; and the attainment of knowledge, to profit by the discoveries of past times, to perform certain works, whether mental or physical, with certainty and precision, and with the least possible labour, delay, and expence. In this chiefly consists the difference, between the efforts of polished

lished and learned nations, and those of people in a more early stage of society. The productions of the latter may, perhaps, shew more genius, but excellence in them is more rare; and they seldom exhibit accuracy and correctness. In reducing excellence to principle, consists the utility of criticism, and systems of rules, for exercising the *fine arts.* In some stages of society, certain feelings will peculiarly predominate: these will call for some displays of the *fine arts,* in preference to others; and will also enable men to exercise those *arts* more successfully. Thus, poetry and music may be more cultivated, and with greater success, in one stage of society than in another. Heroic poetry, and the graver lyric, may be the favourites and the ornaments of one stage of society; love-poetry, the drama, and satire, of another. But, in a general view, and abstracting from particular and local circumstances, all the *fine arts* will be most valued, most cultivated, and carried to the greatest perfection, where human society is in the most advanced and perfect state: that is to say, where man is in the fullest and freest enjoyment of the exercise of all his faculties; and where those faculties are improved and cultivated, in the highest degree, by a course of education. Man will not apply much to the gratification of artificial wants, while he is besieged by those which are natural and real. He will not pursue, or even understand, the refined luxuries and gratifications of the mind, while he is sunk, and engrossed by those which are merely sensual. He cannot cultivate the *fine arts* to the best effect, unless, previously, his faculties are fully cultivated. They cannot be cultivated, but by a good education, of precept and example; therefore they cannot be duly cultivated, unless the form of government is good: that is to say, free. Or, supposing these faculties fully cultivated, man cannot exercise them, with the greatest advantage and proficiency, if this exercise of them is interrupted by fear, and restrained and fettered by the constant influence of a tyrannical and jealous government. Thus it will be seen, that, of necessity, the progress and relative prosperity, or decline of the *fine arts*, must be very much connected with the prevalence of particular forms of government.

Nations, as well as individuals, have particular characters, dispositions, and temperaments; as appears, by what the ancients have told us, of the Thracians, the Bœotians, the Æolians, the Spartans, and the Asiatics. These peculiar characters and temperaments are to be ascribed, partly, to forms of government, and education: partly, to the influence of religion: (if we are not rather to consider that as a part of education:) partly, to the force of climate; to which, though I would not allow such a wonder-working predominance, as is done by Montesquieu, I would still attribute great force. It is evident, that the preference of particular branches of the *fine arts*, and the happy cultivation of them, will result much from the national character and temperament. For instance, among a people, mild, amorous, gay, and fond of pleasure, such

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as were the people of Ionia, much time will be devoted to amusement; and men will cultivate the lighter strains of poetry, particularly erotic poetry, and the softest and most luxurious modes and measures of music. The acute and subtle character of the Arabians, inflamed and subtilized by the influence of a burning sun, under which they lived, led them to intricate metaphysical disquisitions; platonic conceits and refinements, in poetry; florid figures, in eloquence; and elaborate conceits, and far-fetched ornaments, in architecture. Here, then, is another aspect, under which the political circumstances of countries are to be considered, with respect to the growth and prosperity of the *fine arts.*

We are not to consider those wonderful phenomena, the poems of Homer, as forming an exception to the general principles, which may be laid down, respecting the state of the *fine arts*, in a particular stage of society. They are standing miracles, in the history of the human mind; since they contain notices and views, poetic beauties, and various traits of refinement and knowledge, which should seem to belong to a stage of society, much more advanced and perfect, than that in which we know they were produced. Another aspect, under which the political circumstances of a country may be considered, is its influence, with respect to morals. It is obvious, that certain forms of government are most favourable to morals. For example; the republican, the principle of which is virtue, inculcates strictness of morals, and a love of justice, with a

 spirit

spirit of equality. It is equally obvious, that there is an intimate connexion between purity of morals, and a true and refined taste, which must be accompanied by purity of mind, dignity, and elevation of sentiment, a love of decorum, symmetry, grace, beauty, and good order. It is evident, that such a spirit is an admirable preparative for great exertions, not only in active life, but in the *fine arts:* that it tends to treasure up the stores of exalted conceptions, of great and magnificent ideas, from whence the poet, the painter, and the sculptor, derive the wonders of their respective *arts.* An imitation of the Divinity will impress the mind with divine thoughts and notions: and a refined taste in conduct, an abhorrence of the low, the base, and the little, will lead to a refined taste in composition; a feeling of the good, the great, and the fair. The characteristic of this will be, a noble and divine simplicity, a true and unaffected grandeur, not of tumid words, but of noble sentiments; a rejection of sordid and puerile conceits, of florid and affected ornaments. On the other hand, where corruption and vice predominate; where the lust of gain, and the rage of pleasure, bear sway; in proportion as the mind is corrupted and depraved, the taste is vitiated. All the forms and appearances of things, then, are distorted into error, by the gross and pestiferous atmosphere, in which virtue cannot breathe. All our views of life and conduct are inverted: all our notions are confounded: false measures of estimation and dishonour are introduced: the basest and most unworthy pursuits are

followed

followed with the greatest avidity; while the most dignified and truly interesting objects are neglected and contemned, or even reprobated and vilified. Where luxury and corruption of morals universally prevail, frivolous and contemptible amusements, and base and sensual gratifications, will take place of refined pursuits, and elegant pleasures. Horace complains, that, even in his time, in the Augustan age, this began to be the case among the Roman knights, the most fashionable part of a Roman audience: **migravit jam ab aure voluptas, ad incertos oculos et gaudia vana.* Thus, impure pleasures, and frivolous amusements, particulaly gaming, will supersede the refined, the intellectual enjoyments, which the *fine arts* afford. They will do more: by depraving the general mind, and vitiating the public taste, they will introduce a corrupt and despicable style, into all the productions of the *fine arts.* If these arts are still called for, by the vanity, the luxury, and prodigality of the age, they will become venal and sordid; they will endeavour to conform to the miserable taste of the ignorant, and the profligate individuals, who pay and patronize them. Nauseous flattery, trivial conceits, false wit, tumid and inflated eloquence, extravagant and ridiculous attitudes, will become their characteristic marks. The poet, the painter, the sculptor, and the musician, will be bribed, to prostitute their arts; to stoop to the most degrading tasks; to be-

come

* Epist. I. Lib. II. ad Augustum.

come the panders of vice, and corrupt the rising generation, by perpetuating the monstrous images of the excesses and enormities of their shameless and brutal patrons. Propertius inveighs, with a truly poetical spirit, invigorated by honest indignation, against the licentiousness of his time: and yet the Romans had then travelled but half way in the road of depravity.

We must not think, that it was merely through the baleful effects of despotism, (though that had undoubtedly a great share,) that poetry and eloquence declined, as they did, at Rome, after the downfal of republican government. We are to attribute this base and melancholy change, as much, at least, to the corruption of morals, and the depravity of the Roman people, as to the oppression of the government. The satires of Juvenal, (making every allowance for poetical exaggeration, and the rage of a man, who seems to have been spited at the world, by neglect and misfortunes,) give a dreadful picture of the general and unbounded profligacy, which pervaded all classes of people, in his time. The prevalence of corrupt and dissolute manners, the reign of luxury, avarice, and prodigality, conjoined, will depend much on the political circumstances of the country, the commercial relations, the extent of empire, the riches, the possession of foreign colonies. Hence we find it is, that the true poetical spirit has declined, in these modern times. Hence I should not be much disposed, notwithstanding the great professions of the French government, and its literati, to

augur

augur any great proficiency towards excellence in the *fine arts*, while the morals of the people remain so profligate as they are at present. It is with concern and pain, that a friend to literature observes the paucity of ideas and multitude of words, the trite and flimsy productions, which occupy too much space, in the volumes of the National Institute. This, however, cannot justly be imputed, either to the French nation, who are endowed, by nature, with talents, and activity in employing them, beyond most people; or to the present government of France; or yet to the revolution: nor does it tend to contradict the assertion, that a republican form of government is peculiarly favourable to the *fine arts*, and the exertion of genius. It is owing to the want of education in the present generation, to the poison of unparalleled frivolity, and corruption* of manners. When a state sinks into luxury and degeneracy; though the artificial wants encrease, and, of course, the greater sums are employed to feed them; less expenditure is allowed to the encouragement of the *fine arts*. The passion of gaming frequently swallows up every other expensive pursuit. Juvenal mentions the rage for gaming, which prevailed in his time: "*positâ sed luditur arcâ.*" This horrid passion, which seems to prevail chiefly among the most savage and barbarous nations, (such were the Gauls, in the times of Cæsar, and the Germans, as described by Tacitus,) and the

most

* See a late entertaining work—*Paris as it was and is.*

most effeminate and corrupted: from the same cause, a mind vacant of ideas, incapable of good, devoid of elegance and refinement, wholly engrosses the mind, to the exclusion of other objects: or, if room is spared for other enjoyments, they are the pleasures of the table, idle expense, fantastic extravagance, and tasteless magnificence. Dress, toys, baubles, gluttony, now consume the sums, which were formerly expended, by a national opulence, under the control of taste, on the valuable productions of painting, sculpture, and architecture. Even the governments of countries take a lead in these frivolities; and, by following and flattering the miserable and childish folly of the times, render the evil progressive. Thus, in ancient ages, a statue, a bust, a superb sepulchral monument, used to be the reward of heroic acts and superior merit; which at once perpetuated an emulation in moral excellence, and a taste in the *fine arts*. Now, the reward of virtue or heroism, is a red or a blue string, fit for a child's whistle; a festino, or a fire-work, which evaporates in smoke, and leaves no trace behind.

It is equally obvious, that peculiar forms of government must have very different, and distinguishable effects, on the human mind, from another consideration: that, in various forms of government, there are peculiar passions, which they tend to call forth; peculiar talents and exertions, which they demand, and put in action. There are in peculiar forms of government, appropriate and peculiar forms of conduct, suited to each; and each has a tendency

dency to form and establish a peculiar national character; while they seem to demand, and promote, exclusively, certain forms of intercourse, and states of society, proper to each. This will produce, not only a difference in the national character, but will, also, greatly affect the character of individuals, the pursuits and arts of the people. Hence will arise forms of industry, pleasures, and enjoyments; to which men will be disposed and guided, by the insensible and necessary operation of the forms of government under which they live. The characters and the habits of life and society, the artificial wants, the luxury, the pleasures and amusements of men, must all have a most powerful influence, on the prosperity and prevalence of the *fine arts*. Thus these arts must have a necessary connexion with certain forms of civil government; inasmuch as the latter necessarily influence the characters, both of the nation and the individual. We shall find this opinion fully supported, by a reference to history. If we turn to trace the progress of the *fine arts*, we shall see, that they have uniformly attended in the train of liberty: and that, although they may have flourished, for a time, under the shade of despotism, by extraordinary care, and as exotic plants; yet, under free governments, they have sprung, and flourished indigenous, and found a kindred soil and congenial sky. In Egypt, the dynasty of the Ptolemies were a family of learned princes, in uninterrupted succession; who, however different from each other in many particulars, all agreed in their admiration and liberal encouragement of the *fine arts;* and raised them to a pitch of excellence, which has not been surpassed, either by the former, or succeeding ages. If the court of Augustus was the residence of all that was excellent in the *fine arts;* the taste and patronage of the sovereign, and some remains of the spirit of freedom concurred, and produced a constellation of admirable men, that will render the Augustan age proverbial, and the wonder of latest time. The genius of the heroic Odenatus, and, still more, of the accomplished and philosophical Zenobia, raised, in the midst of deserts, a stupendous monument of industry, arts, and magnificence, where the classical genius seemed to be revived, in works that rivalled the sublime conceptions of ancient Greece. The race of enlightened sovereigns of Persia loved the Muses, and encouraged the bards of their country, by their munificence, to such admirable exertions, as place the poetry of the East nearly on an equal footing with that of ancient Greece. These, and some other similar instances, of which we shall speak more at large hereafter, are bright examples. But they are only exceptions, arising from the peculiar personal character of the individuals, ruling at the time; or from the influence of antecedent freedom, not yet worn out, but continuing to operate still on the general mind; which do not invalidate the abstract position, that arbitrary governments are alike unfriendly to all arts and sciences; and that the *fine arts* have a necessary connexion with particular forms of government, are dependent

dent on them; and, in consequence, have flourished most, where freedom has prevailed.

I proceed, meantime, to examine the cause of the tendency of different forms of government. In this enquiry, the precedence is due to that form of government which is most ancient, and has been held most venerable; the patriarchal or despotic form of government: not as being most favourable to the *fine arts*, but merely as being most ancient among men.

The despotic government destroys every thing, and repairs nothing. In a despotic government, the sovereign is every thing; the people nothing. "The savages of Louisiana," (says Montesquieu,) "when they are desirous of eating the fruit, cut down the tree. This is an emblem of an arbitrary government." "Every thing in a despotism ought to depend on two or three ideas: hence there is no necessity that any new ideas should be added." "When we want to break a horse, we take care not to let him change his master, his lesson, or his pace. Such is the conduct of despotism, to its subjects." The spirit of despotism is anxious, and tremblingly jealous. It is afraid of talents, of assemblages of the people, of mirth, and of all the enjoyments of life. It is superstitiously attached to all old forms and customs; because it knows that despotism is among the number, and exists, not by its own strength, but by the prejudices and weakness of others.

——Quamvis primo nutet casura sub Euro,
Pondere fixa suo est.*

Every attempt at improvement is reprobated, as the first step to innovation, the parent of revolution. It is apprehended, that if one stone should be taken away, from the structure of ancient abuse and prejudice, the whole would fall to the ground. "Conscious † that it will not bear "examination, the government of the Divan wraps itself "up in impenetrable mystery. The prince, enclosed in "his seraglio, cannot leave his luxurious abode, without "alarm to those who keep him confined." We know what an opposition and alarm have been created ‡ in Turkey, by some attempts of the present emperor to introduce certain modern improvements. All enquiry creates alarm; as it might produce an examination, which would lead to resistance, and end in the overthrow of the government. Philosophy and science, must, therefore, be proscribed, as dangerous. And though, in general, a despotism may require, more than other governments, the practical exertions of philosophy, it is not favourable to philosophical discussions or writings. The despot fears them; because they lead to a doubt of his rights, and an examination of the foundation of his authority. The inquisitive spirit of philosophy is precisely what is calculated to excite the strongest

* Lucan. † Montesquieu. ‡ By the Ulemas.

strongest alarm in the breast of a tyrant. Enquiry is, with him, a state offence. Even under Alexander the Great, who had the advantage of a learned education, and was formed by the lessons of a most excellent preceptor, the freedom of a philosopher was fatal to Callisthenes. To shew the condition of science and philosophy under a despotism, it is related, that the prince of philosophers had the meanness, or the policy, (call it which you will,) to write many of his most useful and admired works in a stile of studied obscurity, that they might be inaccessible to the multitude; fearful, as he was, of wounding the vanity of his royal pupil, by rendering that too common, which he was willing to value himself on understanding exclusively. Thus philosophy must be proscribed as dangerous, or obliged to prostitute herself. As to elegance, and the *fine arts*, the gloomy depressed spirits of the people dispose them to a stupified indolence, a melancholy chearless course of sensuality, and of luxury; not unlike the stupified state of the patient *ox*, in a fat pasture, insensible of the weight of servitude, insensible of the uncertainty of his existence. All their few enjoyments are merely those of sense; a sense, blunted and imbruted by the torpid state of the mind. The fumes of opium and tobacco, the laziness and languor of a haram, bound the gratifications of the most splendid slaves. Poetry, music, sculpture, architecture, painting, receive no encouragement; at least, no judicious encouragement, tending to

their

their perfection, from the uncultivated minds, and degraded natures, of a race deprest by tyranny.

We see this plainly, in the accounts which travellers give us, from Busbequius and Rycaut, down to Eton, Olivier, and Wittman, of the government, manners, private life, amusements and pleasures of the Turks: all repeat the assertion, " *that the Turks destroy every thing, and repair nothing.*" Their buildings are semi-barbarous: so are their manners. All their pleasures are insipid; all their magnificence is tasteless and tawdry. There is something uncouth in all their notions and productions. Wittman relates an anecdote, that strongly evinces the present unenlightened condition of the Turks, without the exception even of their principal and most distinguished personages. " General Koehler was requested by the Grand Vizier, to " have a map of the world sketched out for him. This " being performed, a conversation ensued, in which the " General, having the map before him, told his Highness, " among other particulars, that the earth was round. This " information caused no small degree of surprise to the " Turkish minister; and he shewed, by his reply, that he " was disposed to doubt the truth of the assertion. *If* (he " observed) *the earth is round, how can the people, and " other detached objects, on the half beneath, be prevented " from falling off?* When he was told, that the earth re-" volved round the sun, he displayed an equal degree " of scepticism; observing, that if that was the case, *the*

" *ships*

"*ships bound from Jaffa to Constantinople, instead of pro-*
"*ceeding to that capital, would be carried to London, or*
"*elsewhere.*"* It is easy to be seen, how much the prosperity of the *fine arts* is connected with the prosperous state of the individual in society; with the general opulence of the community, the prevalence of commerce, the free intercourse of man with man, and the security of persons and property.†

The various accounts of the state of the Turkish empire, of the government, or rather of the methodized anarchy, of the Beys in Egypt, and of the other states, where despotism prevails, shew what the *fine arts* may hope, from arbitrary government. Despotism is highly unfavourable to commerce, from the insecurity of persons and property, in general; the jealousy with which strangers are regarded; the constant drains to which trading people are peculiarly subject, both from regular and systematic extortion of the government; and from occasional acts of violence and rapacity, by the great men and officers of court. Hence results a prevalent spirit of dishonesty, fraud, circumvention, and usurious dealing, on the part of the traders and monied men. For they are led to extort exorbitant gains, to counterbalance the dangers of their situation, and the periodical losses, to which they are inevitably subject. In such countries, the accumulation of wealth

* See Wittman's Travels, p. 133.

† See the Accounts of the neglect of Agriculture, on the Barbary Coast.

wealth rests in itself, and is its own reward, or rather its own punishment. It does not bring increase of gratification, but increase of uneasiness. Wealth does not produce an exhibition of magnificence, or an appearance of opulence; since, under arbitrary governments, the reputation of wealth is too frequently a state crime. In the East, the possession of riches is concealed, with the same care, that, in other countries, which enjoy a free government, it is displayed. There perpetual instances occur, of people burying their riches, while they live in apparent poverty. Riches, under such governments, do not confer power; on the contrary, they make the miserable owner a mark for oppression; they give him the fatal privilege of being in hourly apprehensions of torture and death.* This involuntary sumptuary law of fear, in states, where the safety of the individual requires the affectation of poverty, is manifestly inauspicious to the arts of elegance and refinement. In such a state, also, the maxims, both of political and private œconomy, are little known; the science of government is at the lowest ebb; there is no such thing as the patronage of arts, or the encouragement of commerce, by the state. We find, that a number of travellers all concur, in an extraordinary manner, in their description of the degraded state of the arts, in countries where they

once

* Under the old government of France, the farmers were driven to go bare-foot, and to affect the appearance of poverty, to avoid certain taxes, in the nature of tithes.

once had their birth, and grew to maturity, under happier forms of government. Far from being friendly to commerce with the rest of the world, "such a state is happiest, (says Montesquieu,*) when it can look upon itself "as the only one in the world: when it is environed "with deserts, and separated from those people, which it "calls barbarians." Thus, the Turks affect to call other nations *swine* and *dogs;* and treat them with contempt, as profane and unhallowed.†

Despotic governments fear the approach of strangers, who may espy the nakedness of the land; who may contribute to open the eyes of the miserable people to the abuses of government, and awaken them to a sense of their true condition; who may introduce foreign notions, and a spirit of innovation; all which would be dangerous to the repose of government. We perceive what anxious care and jealousy the people of China and Japan display, on this subject; under what close restrictions the intercourse with strangers is laid. Fear is the principle of a despotism; the end, tranquillity. Under such governments there arises a neglect of agriculture, because there is no secure property in the land, and the prince is general proprietor and heir of his subjects.‡ If the prince intermeddles in trade,

all

* Spirit of Laws, Liv. V. cap. xiv.

† See Sonnini, Denon, Olivier, Walsh, Wittman, Baron Stolberg, &c. See also Eton's Account of the Turkish Empire.

‡ See the writers quoted above, and Rycaut's State of the Ottoman Empire; Maillet, Volney, and Reynier, in their accounts of Egypt.

all industry is ruined. The *fine arts* can be little progressive, where nothing is repaired, nothing improved: where houses are built, merely for the necessity of habitation, without any great regard to duration, elegance, or convenience. There is no digging of ditches, planting of trees, or agricultural improvements: every thing is drawn from the ground, and nothing restored to it: no care is taken to provide against the deficiency of unpropitious seasons; or to guard the country from the ravaging inroads of seas, rivers, or shifting sands, by mounds, embankments, canals, or plantations. Thus famine is a frequent visitant,* and the land becomes a desert.† The *fine arts* are yet further retarded by another principle of despotism. It is a decided foe to all innovation. The manners, pursuits, arts, and usages, even indifferent things, of the earliest times, are preserved inviolate, as if they were something sacred. Thus we find the arts, the manners, and state of society, exhibited to us in the Scriptures, and in the poems of Homer, still remain unaltered in the East. Though this may be partly owing to climate, yet much must be ascribed to political causes, included in the government.

Though agriculture is in a low condition in despotic states, yet the people are rather agricultural than manufacturing:

* We find, in the early periods of English history, when the government was nearly arbitrary, that famines were frequent.

† The shifting sands daily spread, in Egypt: the ancient canals are suffered to fall to decay. It is apprehended by many, that the most fertile country in the world will, in time, become a desert.

facturing: again, they are rather more manufacturing than commercial. The reason, why agriculture prevails over manufactures, is manifest: the safety and comfort of the subject, in despotic states, depend much on his being unknown. If we except the ministers of the government, who exercise the oppressions of the tyrant, individuals are only observed by the sovereign to their cost. Men wish, therefore, to withdraw themselves from sight; they fly the populous city; they seek the quiet and retirement of the distant plain: "see, from their mother earth, not God's "blessings spring, but mere subsistence; and eat their "bread in peace and privacy."* Under a despotism, simple unambitious professions are most eligible: such is agriculture. Mechanics are led to associate in greater numbers; their callings are usually exercised in a gregarious manner: this exposes them to the notice of government; their number makes them objects of its jealousy, or its avarice: collected in herds, as they are, it is easy to pounce down upon them, and, at one grasp, to oppress and fleece them. Artisans are naturally led, also, to resort to cities; where they are more readily supplied with the raw materials of their respective manufactures, and find a more certain and advantageous market for their productions. There they are under the superintendance, and heavy hand, of a severe and terrible police; their elaborate and costly manufactures are collected in shops and warehouses, and serve

* Mason.

to allure the eyes, and excite the malignity of the despot, and his voracious and unfeeling creatures. We find the Beys in Egypt perpetually squeezing the manufacturers and merchants. In the same manner, the arbitrary kings of England, in the ruder ages, used to oppress and plunder the Jews. Thus, in Asia, domestic slavery, and despotic rule, walk hand in hand. In a government like this, whose* principle requires, that a particular regard be paid to its tranquillity, and which, by the extreme of subordination, calls for peace, it is necessary, above all things, that the women should be confined, lest their intrigues should prove fatal to their husbands. The effects of this seclusion of the women, on the intercourse of society, and, in consequence, on the *fine arts*, on manufactures, and commerce, are very apparent. A government, which has not time to examine minutely into the conduct of its subjects, views them with a suspicious eye; merely because they appear, and suffer themselves to be known. It will readily be conceived, what influence the peculiarly servile condition of women must have, on music, poetry, and painting: arts, which are adapted to please the fair sex; and derive much of their powerful incentives and encouragement from their favour.

Such an arbitrary prince, as has been described, has so many vices and imperfections, that he is afraid to expose his natural stupidity to public view. He is concealed in his palace,

* See Montesquieu's Spirit of Laws, Vol. I.

palace, and the people are ignorant of his situation. Whatever does not directly menace the palace and the capital, makes no impression on proud, ignorant, and prejudiced minds. As to the concatenation of events, the members of his cabinet, or divan, are unable to trace, to foresee, or even to conceive it. The science called politics, with its several springs and laws, must here be very limited; the whole is reduced to the reconciling of the political and civil government of the country, to the domestic; the officers of state to those of the seraglio. Augustus and Tiberius subjected satyrical writers to the punishment of treason, as having violated the law of majesty. Cremutius Cordus was accused of having called Cassius, "*the last of the Romans.*" We have, in the history of Henry I., an instance of the situation of genius and talent, under despotic power, in the fate of an unfortunate minstrel,* who had satyrized that monarch. A similar instance occurs, in the treatment which the author of a pasquinade experienced, from Sixtus Quintus.

We see something of the genius of arbitrary government, in the various accounts of travels into China. There we find, that the rulers do not encourage the approach of strangers, and that they restrain the egress of their own

subjects,

* His name was Luke de Baras. He was sentenced to have his eyes pulled out; and though the Earl of Flanders warmly interceded for him, the cruel sentence was executed, and the unhappy satyrist died of wounds received in struggling with the executioner.

subjects, though the country has immense inland navigation on its rivers and canals, and a coasting trade, for the communications of the natives with each other, and is overburthened with its population: and, although it has commodities and manufactures, which foreigners are most desirous of obtaining, the Chinese do not send out their fleets, or engage in distant expeditions. The Japanese government is still more circumspect, subject to alarm, and repulsive of strangers. Woe to the *fine arts,* and the professors of them, if the sovereign should take a fancy to cultivate them! His affection and attachment will be as fatal to them, as the love of Jupiter was to Semele, in fable. All the *fine arts* declined in Rome, under Nero and his successors; although that strange inconstant monster not only admired, but cultivated them with so much ardour, that he produced epic poems and tragedies, and sung and played, for nights together, on the public stage; and although his sensibility to poetic fame was such, that his jealousy and envy of the rising talents of Lucan, are supposed to have occasioned the death of that admirable poet.

The *fine arts* were at a still lower ebb, under that miserable race of tyrants, the later Greek emperors. The drama, if it produced any thing, was probably detestable. Yet these sovereigns mixed, with an extraordinary degree of anxiety, in all the petty disputes and disturbances of the theatre; as distinguished and marshalled, with the various colours of the different factions. Why, then, was

Egypt

Egypt remarkable for learning, the cradle of all the sciences? Why, in that famous land, was the fountain, to which all mankind resorted, to drink the streams of knowledge? The history of this people will confirm the observations I have hazarded.

The Egyptians are said to have been the first, who found out the rules of government, and the arts of making a people happy, the true end of government. Their first kings did not live after the manner of other monarchs, or govern by their own arbitrary will and pleasure, in the management of public affairs, or even in their private way of life. No slave, bought with money, or servant, born in the house, was admitted into their service: they were attended by the sons of the priests; who, after having received a suitable education, were, at the age of twenty, placed near the royal person; that, being attended, both night and day, by men of superior birth and extraordinary merit, the king might learn nothing unworthy of his station, and incur less danger of falling into vicious excess.

There were stated hours, both of night and day, when the king was obliged to give attention to business, and serious employments. When he first arose in the morning, he perused the letters and dispatches from various parts of his dominions: then, after bathing, he put on splendid robes, and proceeded to sacrifice in the temple. The victims being brought to the altar, the chief priest, in the presence of the king and the assistants, prayed, in a loud voice, for the health and prosperity of the king, who governed

verned according to justice, and the laws of the kingdom. On this occasion, he enlarged on his royal virtues; observing that he was pious towards the *gods*, tender towards his people; moderate, just, magnanimous, of strict veracity, liberal, master of himself, punishing below the magnitude of the offence, and rewarding above the measure of the service. He then spoke with execration of the faults, which the king might have committed, through surprise or ignorance; at the same time absolving him, and laying the blame* on his ministers and council. Thus they strove to win the king to virtue; not by sharp admonitions, but by the praises due to good actions. After the sacrifice, a priest read, out of the sacred records, such actions of famous men as might be of use in life, and fit for imitation; that the king might be instructed, and govern his state, according to their maxims and examples. Even in the economy of the king, all his actions were defined and regulated, as to time and place, by laws and customs: by them even his food and drink were prescribed. It is said, that in a certain temple, in Thebes, was a pillar, on which were imprecations against a king, who had first introduced luxury into Egypt. It was not in the power of the king to wrong or oppress the subject: he could not punish any person

* It is remarkable to see the conformity between this practice, and the constitutional doctrine of a limited monarchy, as received in England. *The king can do no wrong;* his faults are those of his ministers; but these ministers may be impeached and punished.

person out of passion or caprice; or give judgment, in any case, otherwise than as the law ordained. This admirable constitution, and most of the privileges of the people, remained under the Grecian race of monarchs; many of whom were wise and beneficent kings, and consulted the happiness of their subjects, in every particular; and especially in the encouragement of knowledge, commerce, and the arts. Even the worst and weakest princes of this dynasty, were munificent and liberal to learned men and artists; and invited men of talents, from all parts, by the most splendid rewards; formed magnificent collections of books, paintings, and sculptures; and themselves excelled in learning, and many of the arts they patronized.* Thus

* Athenæus relates of Ptolemy, who was nick-named Physcon, from his corpulence, and Cacergetes, from his cruelty, that every species of art and science was cherished and taught, in Egypt, in his time. This prince, having put to death a great number of the citizens of Alexandria, and banished others, who were attached to his brother, from whom he had usurped the crown, filled his dominions with grammarians, philosophers, geometricians, musicians, schoolmasters, and other persons, capable of perfecting the arts; who, having no other subsistence than the fruits of their labour and diligence, contributed greatly to the propagation of knowledge, and refinements, and the love of the arts. The father of Cleopatra, and last of the Ptolemies, derived the name of Auletes, or the Flute-player, from his excessive attachment to that instrument. Strabo says of him, that, besides his debaucheries, he applied himself, in a particular manner, to playing on the flute. He had such an opinion of his abilities, that he instituted musical contests at his palace, where he disputed the prize with the first musicians of his time. And as the dress of players on the flute, among the ancients, was something peculiar to the profession, he submitted to wear the buskins, and even the bandage

we see the history of Egypt formed an exception to the general conclusion, respecting the state of men in society, in the East; but none to the general conclusions, as to the tendency of arbitrary governments, with respect to the *fine arts.* We shall, perhaps, see hereafter, why Egypt formed an exception, in the first respect, till she was overwhelmed, with the rest of the world, by the policy and military genius of Rome.

It is equally easy to account for the flourishing state of the *fine arts,* in the Augustan age; and when the phenomenon comes to be explained, it supports the general theory. Though the reign of Augustus was arbitrary in fact, it was not so in appearance. The forms of a republic subsisted; the senate met, and even preserved the appearance of free debate. Consuls, and other magistrates, such as were in use while Rome was free, continued to be elected, or rather nominated; and possessed the ensigns and pageantry, without the reality of power. The people were still unbroken to the yoke. The memory of the fate of the first Cæsar was yet recent. The politic Augustus was unwilling to irritate his subjects, by employing a galling curb, which

bandage and veil of the tibicen: as may be seen, says Dr. Burney, by a beautiful amethyst, in the possession of the King of France; which is supposed to have been engraved by command of Aulētes, and worn by him, to gratify his vanity, on account of his musical excellence. The name of Auletes is seriously given to this prince, both by Cicero and Strabo, who was his cotemporary. The former could not have meant any contempt, for he had an esteem for him. See Burney's History of Music, Vol. I. p. 229.

which might rouse them to a sense of their degraded condition. He affected to mix with the people. He professed the manners and sentiments, and affected the garb of a private citizen; as was, in after times, practised by Cosmo de Medici. He invited familiarity: he made a parade of urbanity, and seemed to feel the charms, and delight in the intercourse of private friendship. He let the reins of government flow loose, on the necks of the governed; and wished to form the Roman people to the oblivion of past liberty, and the habitude of servile obedience, by luxury, sensual indulgences, and the comforts and blandishments of peace. In such a scheme, the *fine arts* were not forgotten or excluded; they were part of his plan; they were ancillary to his purpose. Notwithstanding all the care and policy of Augustus, the seeds of liberty were not wholly stifled: there was a latent effort, an unconquerable tendency to vigour and vegetation. Through all the super-incumbent oppression, there was a lively, though afflicting memory of the past, which no arts of blandishment, no influence of terror, could wholly eradicate. This spirit led Virgil, though a court poet, to place Cato, as a lawgiver, among the good and just in the Elysian shades. This spirit emboldened Horace, though the favourite of the usurper,* and a man of worldly prudence, to allude, without fear, to his having borne arms, in the ranks of those who fought for freedom. This spirit taught an annalist to

* He used to call him, "lepidissimum homuncionem."

call Cassius, who had stained his hands in the blood of an usurper, the last of the Romans. This spirit dictated the lofty declamation of Lucan, and the indignant and high-minded invectives of Persius and Juvenal. And, finally, this spirit produced repeated struggles for freedom; and those conspiracies, under which some of the Roman oppressors of the groaning world sunk. The mind, therefore, as yet, retained its energy unimpaired: but the deterioration of genius, and declension of the arts, under the baleful influence of tyranny, was very rapid.

Let us proceed to the splendid age of Lewis XIV., when "*pensioned Boileau lashed, in honest strain, flatterers* "*and bigots;*" and

"Late Corneille, with Lucan's spirit fir'd,
"Breath'd the free strain, as Rome and he inspir'd."

The ruling passion of this king was vanity. His vanity, however, was connected with a generous and exalted nature, and a good understanding; which directed him to place its gratification in noble and sublime objects, and works of magnificence. He signalized his reign, not only by military trophies and conquests, but also by the splendor of genius, and the embellishments of those liberal arts, which adorn an age and country with their monuments, and are able to make luxury appear a virtue. He gave the utmost encouragement to manufactures, arts, poetry, painting, philosophy, architecture, sculpture and music. The

The views of the sovereign were powerfully seconded, by the talents of an able and magnanimous minister,* of a spirit and temper congenial to those of his master. Thus his reign produced a number of immortal names; in architecture and painting, Le Brun, Le Sucur, the Poussins; in sculpture, Bernini; in music, Rameau, B. Lully; in philosophy, Des Cartes, Gassendi, Cassini, Malbranche, Leibnitz; in poetry, Boileau, the Corneilles, Racine, Quinault, La Fontaine, J. B. Rousseau, &c.; in eloquence, Massillon, Bourdaloue, Flechier, Fenelon, Pere Bossuet, &c., a splendid catalogue! Besides this, France must not be considered as an absolute despotism: Montesquieu affects to treat it as a limited monarchy: and even then began to dawn the spirit of philosophical enquiry, and free discussion, the power of ridicule, (that touchstone of imposition and ancient abuses,) and satire. These, under Lewis XIV., notwithstanding the imposing grandeur of that monarch's person and measures, opened the career of animadversion and innovation, to the bold spirits which succeeded. First, to the president, Montesquieu, whose works contain many severe and direct attacks on the abuses of government, and the baneful influence of despotism; then, to Rousseau, Voltaire, and d'Alembert, who attacked ancient abuses still more, with all the powers of genius and eloquence, in their writings. We even find the pious and mild Fenelon, in his Telemaque, uttering lessons of clemency, justice, the love

* Louvois.

love of peace, and the duty of a prince to respect and preserve the persons and properties of his subjects and neighbours; which convey the most pointed and energetic censure, on the vain-glorious and relentless Lewis XIV., and his schemes of ambition. But, if we consider France as a despotism, such free exertions of genius were contrary to the despotic spirit; and the event corroborates the general position, "that arbitrary power, by its principle, "must counteract and hate the progress of the *fine arts*:" since, if we consider the government, then existing in France, as arbitrary, we must own, that, by departing from its principles and maxims of policy, and not only tolerating, but encouraging the *fine arts*, it prepared the way for its own downfal. The free unfettered exercise of the faculties of man, being, in some degree, permitted, they expanded themselves; and acquiring force, with a geometrical progression, scorned to be restrained within any bounds but what themselves prescribed. There was, indeed, in France, a constant and unconquerable tendency to freedom, even under the most violent and convulsive exertions of tyranny. All this ended in the subversion of monarchy, and the establishment of the wildest and most licentious forms and principles of democracy.

In a well regulated republic, the condition of citizens is moderate, equal, easy, and agreeable: every thing partakes of the benefit of public liberty;* even the condition of the women.

* Montesquieu.

women. The general conversations are more and more instructive: there is less sensuality, but more true pleasures, and rational enjoyments. This leads to a more judicious cultivation of the *fine arts;* yet not alike of every branch. There are some, as we shall see hereafter, which do not thrive much on democracies. It must be owned, that, in republics, there is often a pragmatic spirit, a certain hardness and unbending nature; perhaps, too, a certain sameness of character. In free governments, the people are the best and most munificent patrons of all the liberal and pleasing arts. It is remarkable, that, in England, the *fine arts* have flourished, and yet have experienced very little patronage from the sovereigns. Simplicity of manners, moderation, frugality, regard to decorum, are the virtues of a republic. Every man is interested in the exercise of these virtues, because it is necessary to the well-being of the state. Every man, therefore, is an inspector of the conduct of his fellow citizens, a censor of manners, and a restraint on what is wrong. In a republic, by this means, the moral sense will be particularly cultivated and refined; and the perfection of this sense is intimately connected with a correct taste and judgment. Purity of mind, and unadulterated taste, are essentially requisite to success, in the higher walks of poetry; and to that correctness and rectitude of spirit, which alone are able to relish the sublime graces of poetry, and become the parents of sound criticism: while the forms of the good and fair, the excellent and decorous, are thus presented to the mind. Look on the small state of Athens, scarce larger than a single county of England, and consider what admirable things she performed, in architecture, painting, sculpture, eloquence, poetry, and philosophy. Many of her wonders have survived the wreck of time, and are still inimitable by modern art. We are astonished at the mighty exertions, the superb monuments, of a small state like Athens. But the wonder is explained, when we consider, that the love of glory, joined with frugality, may affect as much as vanity, combined with wealth and luxury. Democracy encourages the spirit of frugality in the individual, as much as monarchy does the love of splendor.

The eloquence of Greece surpassed that of Rome; because, in democracies, eloquence chiefly flourishes. It is there a great engine of government: all things are transacted openly, and on debate: it is the key to the affections of the people: it becomes the means of rising to the first honours of the state. Thus Greece anciently became the great school and theatre of eloquence. In a democracy, and in a despotism, there is an equality; but these equalities are of different kinds. In the democracy, it is equality of rule: under a despotism, it is equality of servitude and submission. In the democracy, it is equality of rights and privileges: in the despotism, it is equality of weakness and degradation. In a democracy, the people are identified with the government: in a despotism, the government

government is wholly distinct and separate from the people, and seems to have different feelings. In a democracy the people are all in all: we are perpetually told of the majesty of the people. In a despotism the people are nothing. A democratic government is ever studious of public magnificence: her rewards are, generally, the productions of the *fine arts*, orations, elegies, pictures, statues, triumphal arches, and monuments. It is unnecessary to mention, how favourable this must have been to poetry, oratory, sculpture and architecture: indeed it is obvious, that the popular assemblies were the nursing parents of poetry and eloquence. The effect of a general participation in the administration of government, must be, to form a refined and well-informed population, to educate the public mind, and call forth the mass of talents and good sense, which exists in a nation. It will produce a greater attention to correctness and propriety, in speaking and writing the language of the country; because every individual will feel, that he may, at some time or other, be called upon, to discuss important subjects, and to deliver his sentiments in public. The citizens will, therefore, study their native tongue, and understand it in perfection: they will comprehend all its force and beauty, and be masters of all the delicacies and refinements of speaking. All this must be highly favourable to every species of composition; since it must incite and lead men to cultivate the vernacular language of their country. This is the first and true foundation of the studies of poetry and

and eloquence. In Athens, the perfection and graces of the language were generally understood, and highly appreciated. If a public speaker happened to misplace a word, or employ a faulty or inelegant expression or phrase, it was immediately perceived by the audience, and followed by general marks of disapprobation. Thus the *Attic* style of writing and speaking, became the model of elegance, refinement, purity and grace. When we wish, even at this day, to describe a peculiar delicacy and happiness of wit, and a correct neatness, and classical beauty of style, we call them *Attic*. Something similar was produced, by the influence of a free government, at Florence.* The *lingua volgare* was there refined and polished, to an extraordinary degree; and was written and spoken by the Florentines, with so much purity, that "*lingua Toscana in bocca Romana*," "the Tuscan tongue, the Roman accent," is a well known proverb.

The frugality, resulting from simplicity of manners, and the spirit of equality, which prevails in a republic, is highly favourable to commerce; which, while it ministers to the luxury of others, is sparing and severe in itself. It is true, that the state of society, in the ancient world, was

* The government of Florence underwent various changes, from time to time; but still the spirit of democracy predominated. By the ancient government, twelve citizens, with the name of *Anziane*, were elected to preside over the government. Their office was annual, and two foreigners were appointed judges: one was stiled *Capitano del Popolo*.

was not so favourable to the advancement and perfection of manufactures, as it seems to be, in these times. Manufactures were then, in general, carried on by slaves, who worked for the emolument of their proprietors.* Such an enforced exercise of trades could not have exhibited that energy of industry, that unremitting and eager application, that chearful activity and display of talent, that extraordinary fertility of invention, followed up by an adequate degree of labour, ready to execute, which characterize the works of freemen. Yet most of the republics of ancient times were commercial. Athens, Corinth, Rhodes, Tyre, Heraclea, Byzantium, Marseilles, and, above all, the state of Carthage, possessed many ships, and carried on an extensive commerce, which brought them in great riches. In later times, the flourishing states of Venice, Genoa, Florence, Pisa and Lucca, Holland, the towns of the Hanseatic League, Geneva; and, in our own days, the new republic of the United States of America: all concur, to shew the intimate connexion between republican freedom and the commercial spirit; and the tendency of the for-

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* Demosthenes, the orator, was proprietor of a number of slaves, who were employed in the business of armourers. Cornelius Nepos describes the family of Atticus, (v. Att.) "usus est familiâ, si utilitate judicandum est, "optimâ; si formâ, vix mediocri: namque in eâ erant pueri literatissimi ana-"gnosti optimi, et plurimi librarii ut ne pene pedissequus quidem quisquam "esset qui non utrumque horum pulchre facere posset. Pari modo artifices "ceteri, quos cultus domesticus desiderat, apprime boni." The elder Pliny tells us, that, till the year U. C. 580, there was no profest public baker at Rome.

mer, to produce agriculture, manufactures, and general industry. There are particular causes, had we time to dwell on them, which, at present, render the American republic backward, in the fine and elegant arts.

While monarchies patronize arts, and manufactures, by luxury, expense, and a large consumption; republics support them, by parsimony, the spirit of equality, and habits of sobriety and industry. A love of the democracy is, likewise, that of frugality: this must limit the artificial wants, the importation of foreign luxuries, and the extension of those arts, that minister to mere sensual pleasures. As equality of fortune supports frugality, so the latter maintains the former; and both concur in the preservation of freedom. " True it is," (says Montesquieu,)* " that " when a democracy is founded in commerce, private " people may acquire vast fortunes, without a corruption of morals: this is, because the spirit of commerce " is naturally attended by that of frugality, economy and " moderation, of prudence, tranquillity, order and rule. " So long as this spirit subsists, the riches it produces " have no ill effects." As luxury and gross sensual indulgences are incompatible with the true republican spirit, the sublime mental gratifications, which result from an expansion of the powers of the mind, a communication of exalted sentiments, a consciousness of the dignity of human nature, and a contemplation and enjoyment of the

* Spirit of Laws, B. V. c. 6.

the sublime productions of genius and intellect, are prized and cultivated. We see how favourable all this must prove, to the cultivation and perfection of the *fine arts*, especially in their most elevated departments.

The popular assemblies, the theatre, the academy, the Lyceum at Athens, even the private society of the principal citizens, were schools of eloquence, poetry, music, and philosophy. Thus the very drinking songs, or scholia,* which delighted an Athenian company, in the moments of festivity, were sublime moral odes, written by their most eminent sages. The dialogues of the Athenian writers, on the deepest subjects of politics and philosophy, are in the form of convivial meetings, *symposia* or banquets. This is nothing fanciful or imaginary, but a true picture of the manners of the country, and the time. When there was perfect personal freedom; including, as one of its most valuable branches, the uncontrolled intercourse of man with man, and the free communication of thought, through liberty of speaking and writing; conversations were both frequent and delightful, and usually turned on the most interesting and important subjects; and were equally marked, by elevation of sentiment, and purity of expression. Hence it was by no means surprizing, that the most grave and important subjects should be discussed, in the table-talk of their banquets.

This tendency and influence of the republican spirit did not operate so much, it is true, in the military republics of

* One of these scholia is written by Aristotle, Ἀρετη πολυμοχθε, &c. &c.

of Greece, which do not appear to have excelled in the *fine arts.* The reason of this was, that these governments enjoined such a strictness of discipline, and severity of manners, that all relaxation and amusement, music and dancing excepted, were proscribed; as either tending to waste time, or to enervate the mind and body. Besides, these republics banished wealth, and prohibited the citizens from commerce, and the exercise of gainful professions; and obliged them, by law, to remain idle. In the commercial republics, on the contrary, the government endeavoured to inspire the love and habits of industry. A law of Solon made idleness a crime; and insisted, that each citizen should give an account of his manner of living. Such a law must have produced an activity of mind, a due cultivation of all its powers, and an economical distribution of time.

The republican form of government produced an elated spirit, a dignity of mind, favourable to the higher kinds of poetry; as the epic, dramatic and lyric, and the sublime pursuits of philosophy. Every man was led to the study of public affairs: every man was in the habit of conferring freely on the most important subjects. This introduced the peculiar study of moral philosophy, and political economy. This produced a correct and noble way of thinking, and contributed much to the excellence of oratory. This general elevation, and nobleness of sentiment, must have contributed greatly, to form the admirable tragic poets, who flourished at Athens. It is a most extraordinary

extraordinary circumstance, in the history of literature, that a state so small, and a population so confined, as those of Athens, should, within a very small space of time, have produced three such dramatic poets, as Æschylus, Sophocles, and Euripides. The temper of the people is marked, particularly, by the purity, the gravity and dignity of sentiment, which appear in these authors; and the number of important maxims and reflexions, in morals and politics, which are introduced in their writings.

Though simplicity of manners, and frugality, are required, by the republican spirit, in the individual, republics exult in their riches, and acts of magnificence: they contrast the great works, and splendid expenditure of the community; their vast monuments, their sumptuous public buildings, their pompous shows, and magnificent scenic representation, with the humble dwellings, and simple lives, of the private citizens. It is here, in this noble republican pride, ever grasping futurity in its elated ideas, we see the lofty character, the generous disinterested genius of the free state, in all its productions. This was the case, in an eminent degree, with respect to the Athenian republic. She expended, on the most solid and magnificent public structures, on the theatrical exhibitions, on unrivalled productions of the poetic art, on pictures and statues, immense sums. This she was enabled to do, by the rich treasures which flowed into her from various quarters; the vast wealth, which had been brought from the

treasury

treasury of Delos; the trade with the colonies; the produce of the gold mines on the Thracian Chersonesus.

Under Tiberius, the ædiles proposed, in the senate, to re-establish the sumptuary laws. The emperor opposed it; well knowing that such regulations were connected with the republican spirit. He did not, however, express his motive. " We were frugal, (said the emperor,) while we " were masters only of one city: now, we consume the " riches of the whole globe, and employ both the masters " and their slaves, in our service." When a proposal was made, under the same emperor, to prohibit the governors of provinces from carrying their wives with them, on account of the dissoluteness and irregularity, which followed those ladies, the proposal was rejected. " It was said, " that the examples of ancient austerity were changed " into a more agreeable manner of living."

" The spirit of moderation, (says Montesquieu,) is what " we call virtue in an aristocracy. It supplies the place " of the love of equality in a popular state. Modesty, " and simplicity of manners, constitute the strength of an " aristocratic nobility. When they affect no distinction, " when they mix with the people, dress like them, and " share their pleasures, the multitude begin to forget their " subjection. The laws (adds he) should forbid all kind " of commerce to the nobles; otherwise they would monopolize the whole to themselves. Commerce should be " the employment of the people. The golden chain, which

was

"was displayed at Venice, on stated days, was calculated "to flatter the feelings of the people, to reconcile them "to the government, and persuade them, that every thing "was managed for their advantage. The riches, which "were thus exhibited, were understood to be the riches "of the state."

This spirit of moderation, in an aristocracy, has the same effect, to many purposes, as the spirit of equality in a democracy. It gives the mass of the people some idea of their own importance; and thus contributes to produce that elevation of mind, and grandeur of sentiments, which are the parents of excellence in all the nobler branches of art. It tends to generate a love of country, which disposes men of talents to continue and reside on the parent spot, even under some disadvantages, rather than to emigrate in search of better fortunes; and engages them to exert their talents, to embellish the place which gave them birth, with the monuments of genius. The spirit of moderation, like the spirit of equality, requires a spirit of frugality, and sumptuary restraints, which preclude gross and sensual indulgences; and, as a resource and substitute, lead men to more elegant and refined gratifications, such as the *fine arts* bestow. The spirit of frugality, by retrenching expense, in the sensual enjoyments, hoards the means and funds, not only of the state, but the individual; and reserves a greater mass of wealth, to be employed in the encouragement of those arts, and the completion of works of magnificence. In support of this opinion, let us recur to history, and see the progress of the *fine arts*, the surprising monuments of art, genius, and magnificence, which have adorned the modern aristocratic republics of Italy; as Venice, Genoa, Florence, and Pisa: not to speak of ancient Rome, which, in its best and purest times, was aristocratic. How vast and noble were they! what elevation of talent do they exhibit! how much do they seem, at this day, to surpass the strength and revenues of states so very limited in extent! The pomp and splendor of their palaces and public buildings; their excellent poetical productions; the share they bore, in the revival of letters; must be ascribed to the influence of freedom. Criticism was honoured and respected: a multitude of learned editors, as Vellutello, Landino, Victorius, Aldus, arose: translations of most of the ancient classics were made; which are now known by the name of Collana, from the complete series they form: the ancients were examined, as models of sublimity and beauty: the modern Italian language sprung out of barbarism: rhetoric, philosophy, and poetry flourished: Petrarch gave to Italian poetry, an elegance, and softness, a grace, which is inimitable; to this he added the charms of modesty and virtue.

We proceed to consider the influence of a limited monarchy on the *fine arts* Monarchy is favourable to many of them, and to the manufactures connected with them; to those, especially, which are subservient to luxury and pleasure. Monarchs maintain a splendid establishment, state and magnificence. They are led, both by inclination

and

and policy, to diffuse a love of expense and parade, a taste for luxury, festivity and pleasurable indulgence, among their nobles and courtiers. By this means, they endeavour to increase the influence of the crown, by rendering its favours of more value. While they involve their nobles in debt, to render them dependent; they try to exhilarate their minds, to make them forget their complaints and grievances, and forego their rights and claims. By engaging them in frivolous amusements, and attaching them to pleasures, they banish the thoughts of ambition, and all care of rising in the state, except through the favour of the court and the sovereign. The spirit of dissipation, gallantry and amusement, diverts the attention of the powerful subjects, dispels gloomy and malign thoughts, and dissipates ambitious projects, which might threaten the repose of government. The court, and seat of power, being rendered agreeable, by the various pleasures they afford, and the splendor they exhibit: a race of powerful and haughty nobles are allured to a distance, from their strong and ancient castles; where, surrounded by numerous bands of their warlike and faithful retainers and dependants, they were used to resist the will, and despise the resentment of their sovereign: they are led to commit their persons into the hands of the monarch, in a state like that of hostages. It is said, that the court of Vienna* practises this policy at present, to ensure the dependency

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* See Townson's Travels in Hungary.

of Hungary, of whose inhabitants it is extremely jealous; because the people anciently had formidable and extensive rights, and a great liberty; and still have retained a fond remembrance of them, and shewed a disposition to claim and assert them. The nobles have vast possessions; and a power, which, if they acted in unison, might prove fatal to their connexion with Austria. It, therefore, has studiously endeavoured at accomplishing the ruin and subjection of the Hungarian nobility; by attracting them to court, and implicating them in heavy expenses. * Henry the Third endeavoured to practise the same artifice, with respect to the French nobility of his time; and to engage them, by his example, in frivolous pursuits, and inordinate pleasures. He fell the victim of his own artifice. His vigour was relaxed, his understanding clouded; he sunk into a premature debility, and impotence of mind and body; while, at last, he pursued that from inclination, which, at first, he practised from policy.

The spirit, which thus originates in the sovereign, and those immediately about him, is diffused through the nation; affects every individual with the poison of luxury, and disposes the people to expense in clothes, equipages, furniture, the pleasures of the table and amusements. Hence, an universal patronage will be afforded to all the arts, which minister to luxury and amusement; to various manufactures, which produce elegant superfluities, and flatter

* See Hume's History of England, and Davila, Guerre Civili di Francia.

flatter the artificial wants. The love of pleasure will demand, the disposition to expense will remunerate exertions, in various branches of the *fine arts*, as subservient to manufactures, as contributing to the accommodation and gratifications of luxurious men, as furnishing or improving the means and modes of amusement. Such are painting, sculpture, architecture, music, and certain branches of poetry, particularly the drama. Love and gallantry will prevail, and supply subjects, while they afford encouragement to other branches of poetry. The poet will thrive, and be at ease, under the patronage of a splendid and opulent court. The free and pleasurable intercourse of the sexes will continually furnish new occasions of resorting to the muse, and new incitements to excellence. "As riches, (says "Montesquieu,*) by the very constitution of monarchy, "are unequally divided, there is an absolute necessity for "luxury: were the rich not to be lavish, the poor would "starve. It is even necessary here, that the expenses of "the opulent should be in proportion to the inequality of "fortune; and that luxury should encrease in proportion, "and grow more and more extensive, as it arises from "the labourer to the artisan, the merchant, the magistrate, "the nobility, to the great officers of the state, to the "very prince: otherwise, the nation is undone." The republic and monarchy both encourage the *fine arts:* the republic, in the spirit of parsimony; the monarchy, in the spirit

* Spirit of Laws, Book VII. chap. iv. Eng. Trans.

spirit of luxury: the republic, in the spirit of public magnificence; the monarchy, in that of private expense: the republic, by the elevation of mind, and the correctness of taste, to which it gives birth; the monarchy, by the love of pleasure, which it encourages: the republic uses the *fine arts* as means of ambition, and engines of government; the monarchy, as ministers of those indulgences, and pleasurable enjoyments, which it is its policy to promote. The *fine arts*, which are respectively cultivated, in a republic and monarchy, have always differed, in conformity with the different character and principle of the two governments. The first are more noble, severe, and exalted; the others more light, graceful, and pleasurable: the first, connected with action, serious occupation, and the administration of public affairs; the other, resting in mere amusement, and much connected with the gratification of the senses.*

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* The kingly government of the Jews may be considered as a limited monarchy; being governed, partly by the code of the Mosaic law, and partly by the great power and credit of the hierarchy. The reign of Solomon, which was long and glorious, may be regarded as the Augustan age of the Hebrews: and what we know of it may serve to shew the connexion between the political state of the country, and the progress of the *fine arts*. The prosperity of the Jewish nation, at this period, not only enabled them to cultivate the arts and sciences, but induced foreigners to visit and assist them. Instances of this we find, in what is related respecting the Queen of Sheba, and Hiram, King of Tyre. As the Romans, in the time of Augustus, and his successors, were indebted to the Greeks, for a great part of their knowledge in the polite arts; so the Hebrews, under Solomon, had assistance from Egypt, and from Tyre. As to music and poetry, which seem to have been put on so respectable a footing, in the former reign, they appear to have

had

It is under the mild atmosphere of limited monarchs, where a variety of arts and professions exists, and, at the same time, there is a great number of idle and dissipated people; where the free sallies of humour and ridicule are not only tolerated, but favoured, as sources of amusement; where luxury, idleness, and the desire of pleasure, dispose men to intrigue, and to an indulgence of all their whims and propensities; that the comic muse fixes her abode. The free and sportive character of society and conversation, the intercourse of the sexes, the volatile and frivolous character and pursuits, which courts and their retainers produce, and the free display of all the vanities and humours of men, furnish abundant materials for comedy; while a splendid and well-frequented theatre, which is always among the pleasurable establishments of a free monarchy, encourages and rewards the display of her powers.

It seems, then, that, if all other circumstances are equal, a mixed monarchy should be favourable to more branches of the *fine arts*, and produce greater perfection in them, than

had their share of attraction in that of Solomon. In Ecclesiastes, he speaks of music among the vain luxuries, and vexations of spirit, with which he found himself satiated: "I got men singers, and women singers, and the delights "of the sons of men, and musical instruments of all sorts." The poetical parts of the Old Testament are sufficient to convince us, that poetry was carried to a very high pitch of perfection, among the ancient Hebrews. The description of the magnificence of Solomon, particularly of the structure of the temple, and its embellishments and furniture, may convince us, that they had carried architecture to an equal pitch of excellence.

than any other form of government; since it will unite the elevation of mind of the republic, with the pleasurable disposition, the varied characters, and free expense of the monarchy. We have seen, that a monarchy is favourable to the comic and satyric poet. Eloquence also flourishes in mixed monarchies, where deliberation is admitted: and assemblies, discussing the political interests of the state, though not absolutely popular, are sufficiently large to give the popular form, to afford a theatre for the display of oratory, and incitements to excel, that may call out exertion, by a numerous audience, and the idea of a public exhibition. There was no eloquence in the Roman senate, after the accession of the emperor. Yet, even in the parliament of Paris, bold and sublime strains of energetic elocution were not unusual; as, when a member fell on his knees, and invoked the spirit of St. Lewis. The English senate is a great school of oratory, a grand theatre for the exhibition of eloquence: the subjects of debate are so important: the persons, who engage in them, are selected from such various classes of society; the deliberations are so free and public!

The English government, being a mixture of various forms, it should be most favourable to the progress of the *fine arts;* as comprizing, in itself, all that is most favourable in each, to their advancement. It has popular assemblies, to promote, nay, to render necessary, the study and advancement of eloquence. There is so much of the de-

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mocratic form, and the people, on the principle of representation, have such a share in the government, such an importance in the state, and are impressed with such a sense of their own dignity, that it produces an independent spirit, and an elevation of mind; while the splendor of an imperial court diffuses the love of pleasure, and the opulence of the merchant joins with the pomp and expense of a wealthy nobility, to supply an ample encouragement to all the arts, that minister to luxury, pleasure and magnificence.

When the great duke of Florence, Cosmo, prevailed in his schemes of ambition, and, under the affected simplicity of manners, and affectation of a love of equality, rendered himself master of his country; we are not to argue with respect to a monarchy, nor yet with respect to a republic, from what then took place at Florence. Though, nominally, there was a republic; yet, in reality, a monarchy was established: and, though single domination was established, a strong free spirit remained. Hence we shall find, in the admirable works of art and literature, which Florence produced, something mixed, something that savours of the expense and magnificence of a monarchy, and, at the same time, breathes the free and elated spirit, and shews the noble and independent sentiments, peculiar to a republic.

I shall conclude this part of my Essay by observing, that, as in various departments of nature and art, extremes are found to meet; so it is, with respect to the influence

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of the political circumstances of countries, on the progress and prosperity of the *fine arts*. The extremes of despotism and anarchy operate alike: the one, by a jealous gloomy control, uniformly acting; the other, by occasional licentiousness, and bursts of popular fury, more sensibly violent and tremendous. These aggressions on personal safety, property, freedom of speech, and superiority of talent, so cruelly inimical to the *fine arts*, proceed, in both cases, from the same cause; from a sense of weakness, from an apprehension of hostility, arising out of the consciousness of deserving to have foes. Both governments, (if they deserve the name,) endeavour by the same means, (namely, by terror) to obtain the same end, self-preservation: both are equally prodigal of blood, equally destructive of human nature and human happiness; of all that contributes to embellish the former, and promote the latter.

I proceed to consider the difference of climate. The varieties of climate affect the *fine arts:* directly, by their influencing the temperament, disposition, national character, and intercourse of society; and indirectly, by their predisposing men, to concur or acquiesce in the establishment of certain forms of government.

As climates are distinguished* by degrees of latitude, so are they, also, by those of sensibility. The different effects of the same pieces and performances, on an English and Italian audience, are surprising. This difference of sensibility must have a striking effect on the growth and progress of the *fine arts*. Of course, the varieties of climate

* Montesquieu.

mate must be more or less favourable to them. Where there is most sensibility, the *fine arts*, if the operation of that sensibility is not controlled, by the operation of other causes, which are unfavourable, must be most prevalent and prosperous. It is true, that political institutions may, and often do, control and counteract the softening effects of climate. Thus the severe and uniform manners and discipline of the Spartan republic, inculcating an inflexible sternness of nature, and proscribing pleasure, relaxation and soft indulgences, must have been unfavourable to the *fine arts*. In the North are people, who have few vices, many virtues. In northern climates, scarce has the animal part of love a power of making itself felt (says Montesquieu).* " In temperate climates, love is attended by a thousand circumstances, and endeavours to please, by things that have the appearance, though not the reality of this passion. In warmer climates, love is liked for its own sake: it is the only cause of happiness; it is life itself." In southern climates, the machine, of a delicate frame, but strong sensibility, resigns itself to love. In the northern regions, a machine robust and heavy, finds pleasure in whatever is apt to throw the spirits into motion; as hunting, and other athletic exercises. The general love of music in Italy, the unrivalled excellence in painting, the extraordinary faculty of the *Improvisatori*, are proofs of the superior sensibility of

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* See Spirit of Laws, B. XIV. c. ii. Nugent's Translation, V. I. p. 327, et sequentes.

the Italians. In fact, the rapid and unstudied effusions of the *Improvisatori*, are proofs, rather of superior sensibility, than of poetical talent. It appears that haste, an absence of thought, and exclusion of preparation, seem necessary to the exercise of this faculty. It seems to have an intimate and inseparable connexion with music. The extemporaneous effusion is usually some address to the company, or allusion to some local or occasional circumstance; or a descant on a string of similies, suggested at the moment. It is not merely recited, but sung out to some tune, with much vehemence; and the musical air always seems to suggest the lines.* As their climate is yet more genial, the sensibility of the Greeks surpasses even that of the Italians. It formerly produced pre-eminence in all the *fine arts:* a pre-eminence which the Greeks might still maintain, if the influence of a most happy climate, and the capabilities of their natural endowments and talents, were seconded by the enjoyment of freedom, and the influence of a rational and patriotic government. Modern travellers speak in high terms,† of the amiable manners, the gay temper, and lively genius of the Greeks, at this day, sunk as they are in deplorable ignorance, and prostrated under the iron rod of a barbarous and unrelenting despotism.

The penances of the Indians, so full of barbarity, the heroism of the women of Malabar, who burn themselves

* Such was the character of the recitations of Signor Negri.

† See Guy's Sentimental Journey in Greece, Abbe Mariti, Sonnini, Olivier, &c.

selves with their husbands, form no objection to what has been said, about the great sensibility of the natives of warm climates. This sensibility, though it makes them fear death; makes them fear other things even worse than death. This degree of sensibility made them early arrive at a proficiency in the arts of music and poetry, which the delicacy of their organs enabled them to practise in the greatest perfection. This refinement of their organs made them receive strong impressions from surrounding objects: hence they excelled in music, of which they have a vast number of modes or measures; and sublime strains of descriptive and figurative poetry. It disposed them to the love of pleasure, and made all their passions violent in the extreme:* hence the platonism of their love poetry; the ardour, the delirium, with which they describe the intoxicating sentiments of love; and the strange mysticism of their religious poetry.†

The influence of climate, on the arts and pursuits of a people, may be seen, in what ancient writers tell us of the music, the poetry, and other literary compositions of the ancient Greeks of Asia Minor. Nothing could be more relaxing and seductive than the climate: the very air seemed to diffuse the spirit of sensuality, pleasurable indulgence, and libertinism. The Lydian mode of music was remarkable, for its effeminacy and fascinating power:

love

* Even their religious poems adopt the tone of love.

† Sir William Jones's Works, Vol. I. "On the Mystical Poetry of the "Persians and Hindus."

love and poetry were the progeny of this soft climate. The Milesian fables, the prototype of the modern novel, were the productions of Ionia, celebrated for its opulence, its commerce, the number of its colonies on the borders of the Propontis, the Tanais, and the Nile; and not less celebrated for the effeminacy of its inhabitants. In this province, where the Meander winds through a most delicious country; where groves of myrtle, the almond, sweet willow, and the orange, perfume the air; all nature inspires the most voluptuous sensations. Here the Milesian tales originated; and Aristides, who distinguished himself in these compositions, according to Plutarch, must have written before the time of Crassus: for, after his defeat, a copy of these fables was found in the baggage of a Roman officer, and brought to Surena. The warlike Parthians despised a nation, which, in the midst of its military pursuits, could give itself up to such amusements.

The influence of climate, and the love of pleasure, may have encouraged the various branches of the *fine arts*, that are connected with the pleasures of sense, and minister to luxury. This, in some degree, served to counteract the tendency of arbitrary power to discourage arts and sciences. Thus we find, that the delightful regions of Asia Minor were ever the favourite seats of love and poetry; where the son of Bacchus and Venus was peculiarly worshipped; and the voluptuous spirit of the climate breathed through its poetry. While the political state of the country precluded the sublimer efforts of poetry, the epos, and the drama,

drama, and the rousing and animated strains of a masculine eloquence, it relaxed the mind into indolence and soft indulgence: it produced the Lydian measure of music, effeminate and voluptuous in the extreme: it produced a race of amorous poets, who celebrated love, the prevailing sentiment of the country, with all the truth of nature, and all the embellishments of fancy. Thus were the chains of the people so entwined in myrtle and flowers, that they were concealed from view, and scarcely prest on the limbs that bore them.

Climate may influence the *fine arts*, in a less direct manner, by predisposing men to receive certain forms of government; and contributing, in other respects, to their establishment. The East, the original seat of patriarchal authority, seems to have been, at all times, the chosen residence, and head quarters, of arbitrary power. Montesquieu endeavours, with much ingenuity, to explain the cause. "In Asia, countries, which are very cold, border "on others, which are very hot; as Turkey, Persia, India, "and Japan.* In Europe, on the contrary, the temperate "zone is very extensive, though situated in limits very "different from each other; there being no affinity between "the climates of Spain and Italy, and those of Denmark "and Sweden. But, as the climate grows insensibly colder, "on our proceeding from south to north, according to the "latitude of each country, it follows, that each resembles, "in point of climate, the country adjoining; that there is "no

* See Spirit of Laws, B. XVII. c. iii. Nugent's Translation, Vol. I. p. 393.

" no very extraordinary difference between them; and that, " as I have just said, the temperate zone is very extensive. " Hence it comes, that, in Asia, the strong nations are op- " posed to the weak. The warlike, brave, and active peo- " ple, touch immediately on the indolent and timorous: the " one, therefore, must conquer; the other, be conquered. " In Europe, on the contrary, strong nations are opposed " to strong; and those, who join each other, have nearly " the same courage. This is the grand reason of the " weakness of Asia, and the strength of Europe; of the " liberty of Europe, and the slavery of Asia. That liberty " in Asia never increases: in Europe, it is enlarged or di- " minished, according to circumstances.* The nations, in " the north of Europe, conquered as freemen: the nations, " of the north of Asia, conquered as slaves, to satisfy the " ambition of a master: such are the Moguls, the Afghans, " and the people of China and Tartary. The genius of " the Getic or Tartarian nation, has ever resembled that " of Asia; the whip is every thing. The Tartars diffuse " slavery; the Goths freedom. Asia has much larger plains: " it is cut into much more extensive divisions, by moun- " tains and seas; and, as it lies more to the south, its " springs are more easily dried up. The mountains are " less covered with snow; and the rivers, not being so " large, form less powerful barriers. Power, in Asia, must " be despotic; else there would be a division, inconsis- " tent with the nature of the country. In Europe, the " natural

* Spirit of Laws, B. XVII. c. v. Nugent's Translation, V. I. p. 395, et seq.

“ natural division forms many nations of a moderate ex-
“ tent. The North of Europe has been called, the forge
“ of the human race. In Asia, they have always had great
“ empires: in Europe, they could never be established.
“ Here observe (by the way) the effect of a country being
“ divided into a number of small states; as ancient Greece
“ for instance, ancient Italy, modern Italy, Germany, and
“ the rest of Europe, at this day; with respect to the en-
“ couragement of commerce, letters, and arts. In Europe,
“ the ruling by laws is not incompatible with the main-
“ tenance of the state, but favourable to its continuance.
“ It is this, which has formed a genius for liberty; which
“ has rendered every part difficult to be subdued by fo-
“ reign powers. On the contrary, in Asia, a servile spirit
“ has uniformly reigned.”

“ On the very principle on which slavery prevailed, ge-
“ nerally, in Asia, it will be seen, why Egypt, if we
“ are to call it part of Asia, Egypt long formed an ex-
“ ception to all that has been said, respecting the loca-
“ lity of Asia. It is difficult of access almost on every
“ part; affording great impediments to an invasion, and
“ powerful means of defence against a foreign enemy. On
“ the side of the Mediterranean sea is a very small line
“ of coast, in proportion to the general extent and impor-
“ tance of the country, and this is very difficult of ap-
“ proach. At each mouth of the Nile are formidable whirl-
“ pools and quicksands; on each flank of Egypt, it is de-
“ fended by a dreadful desert of vast extent, where the

" shifting sands threaten to overwhelm whole armies at " once. Such are the effects of climate and geographical position."*

The prevalence of religion may be considered as another political circumstance, which has a powerful share in promoting, or resisting the progress of *fine arts*. The influence of false religion, and the superstitious worship of images, in the time of ancient paganism, manifestly tended to bring the arts of sculpture and painting to perfection. The utmost magnificence of expense, and encouragement were employed, to render these symbols of the Deity, and the edifices in which they were placed, truly worthy of a divinity.† Thus artists were stimulated to display their abilities, in exhibiting the forms of the ancient heathen divinities in the sublimest manner; and in adorning their temples with pictures, sculptures, and other decorations. Poetry and music, in all ages, and all states of society, seem to have supplied a part of religious worship; and the natural enthusiasm of the bard received new inspirations from the feelings of religious fervor. Poetry, thus animated and exalted, supplied the pagan ritual with hymns, in honour of the Deity. Most of these devotional poems of the ancient heathens have perished, perhaps through the zeal of the first Christians: but (if we may judge from poetical history, or from the

remains

* The author begs to be excused, for having extracted so largely from Montesquieu.

† Such were the temple and statue of the Olympian Jupiter, at Athens.

remains of Greek and Roman devotional poetry, which have happened to reach us) the compositions of classical times, on sacred subjects, were not inferior in merit, to the other ancient productions of the *fine arts*. The dithyrambics of Pindar are said to have been the noblest effusions of his genius; they were devotional hymns in honour of Bacchus. The hymns ascribed to Homer and Orpheus, and those of Callimachus, are preserved; and shew how much the spirit of devotion may elevate and adorn poetry. The same may be said of the *carmen seculare* and other odes of Horace. The ancient pagan mythology was singularly adapted to warm and captivate the imagination, by the wildness and variety of its fictions. The traditions and fables of paganism were, many of them, highly ingenious and beautiful: susceptible, at once, of an allegorical morality, and of all the charms and graces of poetic management. The descriptions of divinities and their attributes, and the rites by which they were adored, and the solemn addresses to them, which occur in the ancient epic, tragic and lyric poets, are among the noblest and most striking passages in their works. Among the wonderful remains of ancient art and magnificence, which are yet to be seen, in Egypt,* Greece,† Italy,‡ Palmyra,§ Persia, and even in India,‖ and astonish the traveller; some, by

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* For the monuments of Egypt, see Bruce's Travels, Denon, and a work of great merit, Mayer's Views in Egypt.

† See Chandler's Travels, Stuart's Athens, &c.

‡ See Ruins of Pæstum, Piranesi, Overbeke, Stolberg's Travels.

§ See Ruins of Palmyra, by Wood.

‖ See Chardin, &c. &c.

their sublime greatness, and stupendous dimensions; some, by their exquisite grace and beauty, their just proportions, the harmony of their parts, and the elaborate perfection with which they are finished; and others, again, by a combination of all these different attributes: many of the principal were edifices, erected for religious purposes. Indeed, in every period, and through every stage of society, religious enthusiasm has, occasionally, and often without directly intending it, been a promoter of the *fine arts*, (with the solitary exception of the Christian religion, at some particular periods, and in some particular sects.) Even the rudest ages had their idols: and the darkest and most savage rituals, even those, which streamed with the blood of human sacrifices, were not without their choral hymns and religious melodies.*

The first introduction of Christianity was, certainly, unfavourable to the *fine arts*.† The course of life, and education of many of the primitive teachers of the new doctrine, rendered them unfriendly to every species of elegance, pomp and refinement. Their religious notions, particularly their abhorrence of the idolatrous worship of the heathens, accompanied by an active zeal, led them to consider, as a most meritorious sacrifice to the true God, the destruction of heathen temples, and the graven images with which they were decorated. By this spirit, many of the

* See, in Asiatic Researches, and other books, an account of eastern monuments.

† The reader will find the influence of various forms of religion, on the manners and tastes of men, considered much at large, in an Essay on the Effects of the Reformation, by Villers.

the finest monuments of antiquity were destroyed; while the rage against images was carried even to a pitch of extravagance. When the new religion had extended its sway, and the Christian church grew wealthy, the hierarchy suffered political considerations to mingle with the concerns of faith. The ministers and votaries of religion began to feel the effects of pomp and decoration. Modern Christianity, like ancient paganism, sought to captivate the imagination, and excite superstitious veneration, by a powerful appeal to the senses. Thus the religion, which had gloried in the naked simplicity of its worship, and set itself in decided hostility to the splendid superstitions, and pompous ceremonial of paganism, adopted an imitation of all that it before decried. The idols of the heathens yielded to the crucifix, and images of the Virgin and saints: the walls of churches were covered with paintings and sculptures: the choirs resounded with vocal and instrumental music. Christianity, in her turn, became the patroness of the arts; and invoked their aid, to trick her out, in all the beauty of holiness, with gorgeous vestments, stately temples, statues, pictures, sculptures, solemn processions.* It is well known to every traveller,

* " The Saxons, from the first introduction of Christianity among them, " had made use of images: and perhaps Christianity, without some of those " exterior ornaments, had not made so quick a progress among idolaters; but " they had not paid any kind of worship or address to images; and this abuse " never prevailed, among Christians, till it received the sanction of the se- " cond council of Nice." Hume, Vol. I. end of chap. ii.

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veller, how much of the labours of modern artists, since the revival of letters and the *fine arts*, in Europe, have been dedicated to religious structures and sacred subjects. But I shall find occasion to resume this topic. Let us now proceed, to consider the operation of certain grand historical events, on the *fine arts*.

It is observed, by the philosophical historian,* "The rise, "progress, perfection and decline of the arts and sciences, "are curious objects of contemplation, and intimately con-"nected with the narration of civil transactions. The events "of no particular period can be accounted for, but by "considering the degree of advancement men have made "in these particulars. Those, who cast their eyes on the "general relations of society, will find, that all the im-"provements of the human mind had reached nearly to "their state of perfection, about the age of Augustus. "There was a sensible decline from that period; and men, "thenceforth, relapsed gradually into ignorance and bar-"barism. The unlimited extent of the Roman empire, "the consequent despotism of the monarchs, extinguished "all emulation, debased the generous spirits of men, and depressed

"The more to facilitate the reception of Christianity, Pope Gregory (sur-"named the Great) enjoined Augustine to remove the idols from the heathen "altars, but not to destroy the altars themselves; because the people (he "said) would be allured to frequent Christian worship, when they found it "celebrated in a place which they were accustomed to revere as sacred. "He also exhorted these missionaries to imitate the pagan festivals." See Hume, Vol. I. chap. i.

* Hume, Hist. England, Vol. III. page 247, et seq.

"depressed that noble flame, by which all the refined "arts must be cherished and cultivated. The military "government, which soon succeeded, rendered even the "lives of men insecure and precarious, and proved de- "structive to those vulgar and more necessary arts of "agriculture, manufacture, and commerce; and, in the "end, to the military art and genius itself; by which "alone the immense fabric of the empire could be sup- "ported. The irruption of the barbarous nations, which "soon followed, overwhelmed all human knowledge, which "was already far on its decline; and men sunk every age "deeper into ignorance, stupidity, and superstition, till "the light of ancient sciences and history had nearly suf- "fered a total extinction in all the European nations."

One of the most stupendous and dreadful historical events, with which we are acquainted, is the deplorable destruction of the Roman empire, by fierce barbarians. The confusion of all the orders of society, the erasure of all the arts of peace and elegance, all the institutions of civilized humanity, all the fairest inventions of human intellect and genius, from the face of the ravaged earth, was the consequence. To renovate the vigour of our degraded nature, it perhaps became necessary, that the arts of effeminate and slothful luxury, together with the beings, who exercised and enjoyed them, should be swept away; and that the milder and more finished tribes of men, who were fated to disappear, to vanish, like a vapour or a dream, together with their inventions, their monuments, their arts,

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their habitations, and their sciences, should be replaced by a race of gloomy, joyless, and furious demons of extermination, ministers of human chastisement, whose only virtue was an unreflecting, ungoverned, and headlong valour; whose only joy was the calamity of their fellow-creatures, whose science was destruction. All the ingredients of human happiness and comfort were dashed to the ground. All the elements of civil society were confounded, in discord and anarchy, by swarms scarcely human; whose manners were as rude and barbarous as their language and their names. The world was immersed in a general chaos; and the *fine arts* were not only unknown, but forgotten.

> Sic erat instabilis tellus, innabilis unda,
> Lucis egens aer, nulli sua forma manebat,
> Obstabatque aliis aliud.——Ovid.

Such is the picture, which historians are fond of giving us, of the destruction of the Roman empire. However, it must be confest, that the irruptions of the Goths, the Vandals, and other barbarous swarms, which overspread the Roman provinces, did not destroy as much, as, at first glance, might have appeared. They found the people sinking fast into the barbarism of ignorance and depravity, through the effects of luxury and evil government: a barbarism more fatal, in spirit and essence, though less disgusting and terrific, in form, than that of their fierce and uncultivated conquerors. All love of fame, all true taste for the *fine arts*, all sense of right and wrong, were fled. It

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is true, that, in the miserable devastation which ensued, many noble cities were overthrown; many admirable works and monuments of antiquity were destroyed: but, on the whole, perhaps, society and the arts did not lose so much as is generally imagined; nor was the human race so much changed, for the worse, as we are too ready to allow. Let any person impartially read over the history of the latter ages of the Greek empire, and he will be obliged to confess, that the total extermination of such a degenerate and unworthy race, could not have been a subject of much just regret, or any great loss to the civilization and virtue of mankind. That vast and hateful capital, Constantinople, then was, and so it remains, a sink of abomination. The bloody intrigues, the relentless vengeance, the cruel punishments, the all-powerful sway of women and eunuchs, the unbridled domination of ignorance, fear, folly, avarice, lust, incapacity, and blindness, were just as great then, as they are at the present hour. Had not the human race, whose enormities were fully ripe for such a tremendous chastisement, been then overwhelmed by warlike barbarians, it is probable, that their own unmanly vices and degeneracy would ultimately have exterminated them, and depopulated the country; or, at least, plunged them in a degree of ignorance and blindness, equal to that which prevailed among their conquerors in the dark middle ages. Let the reader consult Gibbon, an historian worthy of the period he has chosen for his theme, with respect to the astonishing depravity and turpitude of the times. Any person, who looks into the miserable productions* of those ages, may perceive, that taste and literature were then so debased, that they could not well fall lower; and that there is no real cause of regret for the loss of such false knowledge and base refinement. At this fatal period, from the east, and from the north, countless swarms of gloomy and ferocious barbarians, ignorant of every art, but that of desolation, poured over the Roman provinces: they swept away the monuments of former science and magnificence, the institutions and enjoyments of peaceful times.

In conformity with this political state of society, was the state of the arts; which seemed to be extinct, and swallowed up, in the vast abyss of general ruin. The memorial rhymes and incantations of the Druids; the bardic songs of the ancient Gauls and Britons; the hymns of the northern Scalders, often the harbingers of battles, sometimes the prelude to human sacrifices, and fraught with all the horrors of a gloomy and sanguinary mythology; cannot be considered as forming an exception to what has been said, respecting the absence of the *fine arts*, at this period. It is further to be observed, that whatever might be the science or talents of the Druids and bards, they seem

* See the mob of Augustan historians; Ammianus Marcellinus, respectable in point of historic fidelity, detestable in point of stile; Ausonius, Prudentius, Juvencus, Sedulius, Nonnus, Quintus Calaber, Serenus, Sammonicus, Martianus Capella, &c. &c. &c. Claudian is a prodigy for his time: Dion Cassius, and Anna Comnena, are splendid exceptions: *rari nantes in gurgite vasto.*

seem to have been confined exclusively to these classes of people, who endeavoured to secure their ascendancy over the minds of men, by preserving to themselves a monopoly of the small portion of knowledge and accomplishments, which then existed.

"There is an ultimate point of depression," (says Hume,) "as well as of exaltation, from which human affairs naturally return, in a contrary progress; and beyond which "they seldom pass, either in their advancement or de"cline." There is, in fact, in nature a constant and universal effort, and tendency to rectification. The tree, which is planted in a crooked position, endeavours to make itself upright. Out of the very obliquities, errors and vices of man, springs the endeavour to correct them. What happened, after the destruction of the Roman empire, illustrates fully this wise order of guiding providence. Out of the state of chaos we have described, arose, not a cure, but a palliative, the feudal system; the existence of which is a most signal fact in history. The feudal system, which began in the ninth century, continued in full vigour, to the middle of the twelfth. This system was perfectly military; out of it sprung the institution of chivalry, which is referred, by the best writers, to the eleventh century.* Romance was the offspring of chivalry. These three causes had a powerful influence, to generate the character and

* See St. Palaye, Memoires de Chevalerie, Memoirs of the Academy of Inscriptions, the preface to Fabliaux e Contes.

manners of the twelfth and thirteenth centuries, and the spirit of love and adventure, so favourable, in many respects, to poetry, music, and even to other arts.*

The period in which the people of Christendom were the lowest sunk in ignorance, and, consequently, in disorders of every kind, may be fixed at the eleventh century, about the reign of William the Conqueror. From that æra, the sun of science beginning to re-ascend, threw out many gleams of light, which preceded the full morning, when letters were revived, in the fifteenth century. The Danes and other northern people, who had so long infested all the coasts, and even the inland parts of Europe, by their depredations, being settled in fertile regions, under milder climates, had now learned the arts of agriculture, found a settled subsistence at home, and were no longer tempted to desert their industry, in order to seek a precarious livelihood by the plunder of their neighbours. The feudal governments, also, among the southern nations, were reduced to a kind of system. And though that strange species of civil polity was ill fitted to ensure either liberty or tranquillity, it was preferable to the universal licence and disorder, which had every where preceded it.

In the course of the century or two, next from Charlemagne, almost the whole allodial property of Europe changed into feudal. Why and how this change took place,

* The first romances were the production of the twelfth century.

place, is particularly explained by Montesquieu.* In the barbarism of those times, there was no magistrate who possessed the power to bring criminals before him, or enforce his decisions. Luxury, greedy and expensive, though rude; and artificial wants, importunate and wasteful, in proportion as they were few in number; required and produced great inequality of property. Each petty chief regarded himself as the equal of his prince. In time of war, the power of the sovereign was considerable; in time of peace, it was nothing. As property became vested in few hands, the evil became enormous. The great feudal barons of Europe, despising the feeble authority of the sovereign, carried on private wars against each other. Such a state of society was not favourable to the progress of arts and refinements: and the existing arts, such as they were, all accorded with the state of society, and were subservient to the taste and pursuits of these turbulent and ferocious times. In the period, after the Norman conquest, architecture† was most diligently cultivated: but its style and destination were influenced by the political circumstances of the country. Partly, through the warlike spirit and insecurity of social life in general; partly, through the wealth

* See Spirit of Laws, B. XXXI. Chap. viii.; the title of which is, "in what manner allodial estates were changed into fiefs."

† From the estimation in which architecture began to be held, arose that extraordinary institution of free-masonry; at least, it gave name to the secret regulations, which were adopted, for the correspondence and mutual aid of strangers and pilgrims, in these times.

wealth of the church; architecture produced either fortresses, or churches and monasteries; but scarcely any other edifices, for public use or private accommodation. Thus we find, that the arts, under the feudal system, were in a rude and uncultivated state; and that all their productions were uncouth and barbarous, like the people for whose use and gratification they were intended. Architecture was of a rude and massy character; chiefly employed, as I have said, in the construction of castles, gloomy and inconvenient, but strong, and not ill calculated for purposes of defence, according to the imperfect military science of the times, where the baron revelled with his numerous retainers, or from whence he sallied forth, to spoil the surrounding country; or of churches, vast, dreary, disproportionate, damp and dark, affording a type and image of the chearless and oppressive darkness, the gross fabrications, and dismal superstitions, which then prevailed over the world. Sculpture was little known; and as imperfect, in its conceptions and execution, as the architecture of the age. Poetry, if it deserved the name, had received as little improvement as the two former arts. The exercise of it was confined, almost exclusively, to the minstrels; and its object was merely the amusement of a race of rude uncultivated and savage warriors, in their hours of festivity. In conformity with the bigotry, ignorance and credulity of the times, the metrical productions of these rude ages were, either uncouth dramatic pieces, founded on stories taken from scripture, and called *mysteries;* or romances,

mances, which were originally sung at festivals, accompanied by musical instruments, and recounted the exploits of preceding warriors; or fabulous legends of giants, enchanters, spectres and fairies. From this state of chaos, into which the feudal system had degenerated, a new light seemed to expand itself, and illuminate all Europe. Among other monsters, to which the feudal system gave birth, was the universal prevalence of the judicial combats; when the appeal to the sword superseded all expedients, and the person accused for treason, rape or murder, threw down his gauntlet, and defied his accuser to mortal combat. In those days, when wickedness and impiety had arrived at the highest pitch, it was proposed, that the valour and generosity of individuals should form a supplement to the weakness of law. Combinations were then formed, to protect ecclesiastics, virgins, widows and orphans, and for redress of injuries in general. All the young men of family entered into these societies: hence, when it came to be patronized by the sovereigns of Europe, as well as the church, the order of chivalry arose. Towards the close of the eleventh century, Gregory VII. formed the idea of uniting all Christians against Mahometanism. It was then the wild and romantic enterprises of the Crusaders arose from chivalry. The early romances were the records of the adventures, arts, education, habits and manners of thinking, appropriate to chivalry. The *troubadours* and minstrels flourished in the ages of chivalry. In that age, admired poetical productions, or brilliant warlike exploits, were the

only

only means, which could raise men of low birth* to the highest ranks in society. The *troubadours* and minstrels were almost as numerous as the castles of the great; and they were welcome guests, at the courts of every prince and baron. At this time, as an appendage of the system of chivalry, arose courts and parliaments of *love.* They were composed of a number of persons of both sexes, with a preference to the fair-sex. They decided questions of gallantry and love. Alice, third wife of Lewis the Young, held a court of love at Troyes, in the latter end of the twelfth century, on a question, already determined by the Countess of Champagne, daughter of the same Lewis, by a former wife, which was referred to her, by way of appeal.

The French have a claim to priority, over all the nations of Europe, in the gallant institutions of chivalry, in the invention of romances, and in the production of all the various species and denominations of works of imagination. The Paladines, or peers of France, the puissant knights of Charlemagne, filled all Europe with their fame, and found a legendary historian of their fabulous exploits, in the supposed archbishop Turpin, whose work is a copious treasury of romantic subjects, and the parent source of romantic writings. From the peers of France, originated the

* Peter Vidal, a famous minstrel, was the son of an obscure tradesman. His fame, as a troubadour, gained him the favour of the highest characters, such as Richard I.

the Table Ronde, and the *British and Armoric knights of Arthur; which made such an early impression on the imagination of Milton, that he determined to make their atchievements the subject of an epic poem, as he himself intimates.

——Arturumque, etiam sub Tevris bella moventem.

The French applied themselves, with incredible ardour, to the study of arms; to the attainment of perfection in the profession of chivalry; and to the laws and refinements of love and honour. Tilts, justs, and tournaments,† became their favourite amusement. They were passionately addicted to them; and celebrated them, with great splendour, pomp, and solemnity. Then arose all the train of *fancies chaste and noble;* all the heroic extravagances, imposing and magnificent follies, that grew out of the spirit of chivalry, and characterize the modern heroic ages. This spirit of chivalry was favourable, in a certain degree, to the arts. Painting and sculpture were encouraged, by the magnificence in dress and ornaments, which began to be studied and generally displayed; and by the devices, and other ornaments, which the knights now used on their armour. Music, too, was more prized and cultivated. It was employed in the military pageants, which were so

 much

* Begirt with British and Armoric knights.—Milton.
† These were distinct and different from each other.

much in fashion: it was employed by the minstrel, to enliven the feast and revel, which succeeded to the military pageants: it was employed by the gallant and enamoured knights, in the masques and serenades, with which they paid homage to their mistresses. The females, too, began to be sensible of their own value; to perceive, and be proud of the admiration which they excited; and to think themselves bound to deserve the adoration and attachment of their admirers, by suitable qualifications. They endeavoured, therefore, to secure the continuance of their empire, over the hearts of their lovers, by the embellishments of the mind, and the attainment of a variety of pleasing and elegant accomplishments. Among these, music and singing were not forgotten. We find, accordingly, in the early descriptions of charming and elegant females, that singing, and playing on the lute, are always mentioned. As to poetry, it evidently must have followed in the train of chivalry. That institution produced an elevation of sentiment, an ardent and generous love of fame, which led the great and powerful, who had the means of encouraging poetry, to prize and appreciate the exertions of the bard. The courteous and valiant knights loaded the poets of the time with favours: they made them the companions of their amusements and pleasures; the chroniclers of their loves and triumphs. They even endeavoured to imitate them, and join the bay to the myrtle and the laurel. Thus we find even Richard Cœur de Lion had cultivated the muses; and we have poetical remains of his composition.

The times of chivalry furnished the poet, in a pre-eminent degree, with two of the most copious and popular subjects of song, love and arms. Thus we see, in the influence which the institutions of chivalry had, on the progress of the *fine arts*, another instance, to shew how much these arts are dependent on the political state of the country.

The progress and prosperity of the *fine arts* are connected with a vigour of intellect, and elevation of sentiment: and we see that such events or institutions, as have contributed to produce an energetic frame of mind, contributed, in an equal degree, to the advancement of the *fine arts*. The corresponding energies of the mind dispose men to simultaneous exertions, in arts and arms; as if the elated spirit sought to extend its empire over every walk of excellence, and acquire sovereign mastery, and undisputed possession, in every apartment of the house of fame. Eschylus distinguished himself in the battle of Salamis; and, in his noble play of the Persæ, he has given a glorious description of that memorable engagement, in which his own valour shone conspicuous. Nor was this union of energies peculiar to an individual. The Athenian people displayed supreme excellence, in the *fine arts*, in all the most sublime productions of human genius, at the same time that they demonstrated superior energy of mind, and the unconquerable love of freedom, by leading the van of the Grecian host, that withstood the despotism of Persia. It was then, that Phidias conceived adequate ideas of the majesty of the gods, and expressed them faithfully in sculpture: and the painting of Panænus, in the portico, was accounted a full reward for the heroic exertions of Miltiades and his illustrious companions in arms!*

When the Romans had established the fame of their military prowess beyond dispute, and asserted their dominion over the world by the conquest of the Carthaginians and the Greeks, they saw that a province yet remained unconquered; and it was then that they aimed at an equal pre-eminence and dominion in the *fine arts.* When Greece yielded in arms, she made an ample reprisal in arts, and enslaved her fierce conqueror; and Rome fixed her mind and attention on a picture. In the succession of people who appeared, from the destruction of the Roman empire in

* In a country, not larger than some shires in England and Ireland, and within the compass of a short period, it is surprising what a number of illustrious men arose, in the various provinces of the *fine arts.* In dramatic poetry, Eschylus, Sophocles, and Euripides, with many more, whose works have perished, were nearly cotemporaries: then succeeded the comic writers, Aristophanes, Menander, Philomen, and a cloud of others; of whom the reader may find some account, in the entertaining papers on the subject, in Cumberland's Observer: in history, eloquence, and philosophy, came Thucydides, Pericles, Demosthenes, Eschines, Lysias, Plato, and Xenophon: in sculpture, Phidias, Praxiteles, Thymilus: in painting, Panconus, Polygnotus, Micon, Pamphilus, Zeuxis, and Parrhasius. Nor are we left to conjecture, or the relations of ancient writers, for a sense of the excellence of this admirable people in architecture: the noble remains of ancient Athens, which have triumphed over the rage of time and barbarism, bear testimony to their superiority; and we must recollect that, at the same time, the Athenians carried on great and expensive wars, and contended, by sea and land, for the supreme dominion of Greece.

in the west, we may trace a perceptible difference, a gradual advance, in the merits of the succeeding race, over that which went before, both in energy of character, and in the arts: of the Danes over the Saxons; of the Normans over the Danes. The Danes passed through a long probation of hardy expedients and stern necessity, in their native woods: they brooded over the gloomy and gigantic conceptions, which elevated the savage mind: they formed their spirits in unison with the sublime and rugged scenery around them; which gave birth and nutriment to wild and lofty ideas, and served to ennoble and render interesting savage independence: they worshipped deities, which their own free and heroic imaginations created. The Normans command respect and admiration, more than the Danes and Saxons: they were a band of soldiers, who never fled before an enemy: they spread their warlike hosts through Italy, Sicily and England: they were every where feared, and looked upon as a superior race of men: their friendship was coveted, their enmity was deprecated. As there was a gradation in prowess, personal gallantry, warlike exploits and military fame, from the Saxons to the Danes, from the Danes to the Normans; there was a similar and proportionable difference and gradation, in their mental attainments, in the refinements of sentiment, in the knowledge of all the arts of life, and a relish for elegance and magnificence. We are told, by the historians of the dark ages, that the Saxons produced the most horrible desolations, wherever they came. This was, partly, owing

to

to their natural ferocity; partly, to the obstinate resistance of the Britons.* Thus the beautiful country, which the one struggled to conquer, the other to defend, was stripped of all its ornaments. When the Saxons obtained quiet possession of the finest provinces of Britain, by the extirpation of their ancient inhabitants, they were really a barbarous and miserable people, destitute of the most desirable accommodations, and of the arts by which they are procured; without models to imitate, or masters to teach them these arts. Thus were the arts, both useful and ornamental, in a very rude imperfect state. We find architecture† at the lowest ebb. Painting, for a reason which will be mentioned hereafter, seems to have been brought to a greater perfection, at this period, than many of the other arts. Poetry and poets were much admired, and treated with an high degree of respect.

The

* Gildas, who was an eye-witness of these scenes of devastation, paints them thus: "A fire was kindled, by the sacrilegious hand of the Saxons, "which spread from city to city, and never ceased, till it had burned up "the whole surface of the island, from sea to sea. The walls of all the colonies were beaten down, and their inhabitants were slain with the point "of the sword. Nothing was to be seen, in the streets, but fragments of "ruined walls, towers, and temples, fallen from their lofty seats, besprinkled "with blood, and mixed with mangled carcases."

† See Henry's History of England. There does not seem to have been one church of stone, nor any artist who could build one, in all Scotland, at the beginning of the eighth century. And, in England, stone buildings were very rare, during the eighth and ninth centuries; and, where such buildings were erected, they were the objects of much admiration.

The Danes, who, for some time, were the predominant people of England, were of as bold and intrepid a spirit as the Saxons had ever been, and rather more fierce and warlike. By their numerous fleets, they rode triumphant in all the European seas, and carried terror and desolation to the coasts of Germany, France, Spain, Italy, Scotland and Ireland. They were pagans: and those divinities, who were the objects of their worship, had been famous heroes; whose favour, they imagined, could only be obtained, by brave exploits in war. Their admission into the hall of Odin, the father of slaughter, the god of fire and desolation, and all their future happiness, (they were taught,) depended on the violence of their own death,* and the number of enemies they had slain in battle. This belief inspired them with a contempt of life and thirst for blood.

> Inde ruendi in ferrum mens prona viris, animæque capaces
> Mortis, et ignavum redituræ parcere vitæ.——LUCAN.

Nor was their education less warlike than their religion. Born in fleets and camps, the first objects they beheld were arms, storms, battles and slaughter. Thus all that was terrible, by degrees, became familiar, and even delightful to them. Their childhood and dawn of youth were spent in running, leaping, climbing, swimming, wrestling,

* See the Song of Regner, Lobtrog, and the Accounts of the Poetry of Egil Skallagrim, a famous northern poet of those times.

ling, fighting, and such like exercises, as hardened both their souls and bodies, and disposed and fitted them for the toils of war. As soon as they began to lisp, they were taught to sing the exploits of their ancestors; and their memories were stored with tales of warlike expeditions. Their valour was boastful and audacious, attended with much presumption and self-confidence, and stimulated by the fondness for a violent death. They were cruel in war, but of a social and convivial disposition among themselves. The Danish soldiers, who were quartered upon the inhabitants, in the reigns of Edgar the Peaceable, and Ethelred, were the beaux of those times. They were particularly attentive to the dressing of their hair, which they combed, at least, once every day, and thereby captivated the affections of the English ladies.* The mountains of Germany, Sweden and Denmark, and even Iceland, were not unvisited by the muses. The chronicles of events among the natives were in rhime;† and they advanced to battle with war-songs. The poems of the ancient bards of the North are said to have produced amazing effects on their hearers. ‡ Legends of the power of music are found, in the historians of those periods, similar and equal to what is related of the harps of Orpheus and Arion. Many of their metaphors were exceedingly bold and sublime.

* See Henry's History of England.

† Canute the Great and Alfred were poets and musicians.

‡ Venerable Bede (See Henry's History of England) gives a wonderful account of Cædmon, an ancient Saxon poet.

lime. Their language and expressions were glowing, and not unlike those of the Orientals or American savages. It appears they had great singularity, prodigious artifice, and almost endless variety, in the kinds and measures of their verses. Music was equally admired and cultivated: the halls of kings, princes and nobles, rung with the united melody of the voice and harp. Some skill in vocal and instrumental music seems to have been necessary to every man, who wished to mix in polite society; and the want of it was disgraceful.

The Normans surpassed the Saxons, and their own progenitors, the Danes, not in arms alone, but in policy, arts of life, and cultivation of all that was then held refined and beautiful. They gave the tone to the rest of Europe. They excelled in generosity of sentiment, in heroism, and in poetry. The first and favourite themes of romantic song, were produced by their story, by the deeds of Charlemagne and Roland.*

We also see how much the state of the *fine arts* is influenced by the political circumstances of a country, from the greater advancement which some of them make, the

 degree

* Jullifer, a soldier in the army of William the Conqueror, who first broke the ranks of the English at the battle of Hastings, is said to have advanced, on that occasion, singing the song of Roland.

About the year 1100, a grand prose narrative, compiled in Latin, from the songs of Roland and Olivier, two of the principal peers of Charlemagne, was published, in the name of Turpin, archbishop of Rheims. He was followed, by Geoffry of Monmouth, and by Robert Wace, who wrote Brut d'Angleterre.

degree of interest and attention which they excite, and the favour and encouragement which they attract to themselves, in preference to others, more conducive, perhaps, to the real comfort of life. It is thus that poetry and music came to be cultivated with enthusiasm, and some degree of success, among martial and rude people, while the other *fine arts* were little known or regarded. The reason was, these arts contributed to record their military exploits, and concurred to complete the entertainment of their moments of festivity. To shew the continued and harmonized correspondence, between the energy of character, and a proficiency in the *fine arts*, it is observed, that the productions of Chaucer, the great parent of English poetry, began to appear, at the time that the English arms triumphed in France: his Court of Love, it seems, being written in the year of the battle of Crecy.* At that time the spirit of chivalry was at the height, in England and France. The institution of the order of the Garter took place early in Chaucer's time. This spirit had incalculable effects on the general mind. It is to be ascribed to the spirit of chivalry, which then prevailed, and filled all Europe with exalted sentiments of love and honour, that the sentiments of Chaucer's lovers are so fine and delicate. The spirit of chivalry influenced the general state of society and manners. Chaucer was the chosen friend and companion of John of Gaunt, king of Castile.

Another

* It was in the year 1329, when the plague was raging in London.

Another great event was, the general establishment of the Christian religion, and the superstitions which were engrafted on it. At first, the spirit of superstition and bigotry contributed to keep the world in darkness, and deplorable ignorance; but, in process of time, the very institutions, which had most powerfully produced this effect, began to produce the very reverse of the picture. Such were monastic institutions, pilgrimages, the worship of images; all of which (though a contrary effect might have been expected) appear, to a certain degree, to have contributed to the revival and advancement of the *fine arts*, and even (unfriendly as they might be supposed to be to such an effect) to the advancement of solid learning. The erection of churches and monasteries was a great cause and incentive of the improvement of architecture. Painting and sculpture were, also, prized and cultivated; for the ornaments of these religious structures; for the images, shrines and sepulchres, and the furniture and utensils employed in them. Music was, likewise, studied and improved, as a solemn and grateful accessary, indeed, an indispensable requisite, in religious service. The first attempts at dramatic poetry, appeared in the miracle plays and mysteries. Monastic institutions also, (though in after times they became receptacles of sloth and ignorance,) yet, in the dark ages, contributed greatly to the improvement and instruction of mankind, and the cultivation of arts and sciences. The leisure, which the monks and other religious persons enjoyed, was dedicated to the pursuits of

 painting,

painting, sculpture and enamelling, and to music and poetry. Most of the persons, who excelled in those ages, in the *fine arts*, or became famous, by their writings, in history and poetry, were religious. It is the peculiar characteristic of the Roman Catholic religion, and some other sects of Christianity, that they address themselves much to the senses. The authors or improvers of these religious forms, were fully aware of the influence and force, which the senses possess over the hearts and characters of men. The buildings, which they constructed for public worship, were highly venerable. Their stained and painted windows, their massy pillars, the extensive aisles, the magnificence of the fabric, its concave roof, the splendid choir, were all calculated to inspire the mind with religious solemnity. To this were added the carvings, the painted images, and other decorations, the accompaniments of music, the uniform garb of the priests and nuns, their decent gestures, their slow and pompous processions, the solemn chaunt of the sublime anthem, the splendor of the altar, the brilliancy of the tapers, the smoke and fragrance of the incense. There was, in these early ages, an extreme scarcity of books; so that, in those times, seven hundred volumes were esteemed a foundation for a national library. The library of monasteries, however, in a great degree, supplied the disadvantage arising from the small collections of individuals; and many of the monks were constantly employed,

* Godwin's Life of Chaucer.

employed, in transcribing and multiplying copies of books. Many of these manuscripts they illuminated and embellished in a most beautiful manner, with miniature paintings and gilding.* By this means, the ecclesiastics disseminated an acquaintance with the classics and other books;† and also promoted arts and manufactures. Yet the degree of classical learning, thus circulated, bore the stamp of the barbarism of the times, and of the want of true taste. Rhyming Latin verses, and a puerile style in composition, with a fondness for trifling conceits, prevailed in poetry, such as it was; and the prose of those days was jejune and inflated, bombastic and barbarous.

The priests reflected deeply, in a spirit of cordial cooperation, on the best methods of swaying and governing the mind. Considering man, as the creature of sense, they addressed themselves most elaborately to his eye and his ear: they engrossed to themselves every thing that was most magnificent and awful, as far as they were able: and, not content with that, they even desired to become a source of amusement,‡ a sort of masters of the revels to the people. To this object they directed their shows, processions, and festivals. It appears, also, that they were jealous of the minstrels, whom they considered as rivals in their profession.

* See, in Coke upon Littleton, the extreme value which was set upon a book called the Grail.

† It must be confessed, however, they were chiefly employed in multiplying psalters and missals.

‡ See Warton's History of English Poetry, Godwin's Life of Chaucer.

sion. These views, of the different ecclesiastical bodies, were opposed and counteracted, (but in vain,) both by the hierarchy and the civil government, with a becoming zeal for religion, and a just sense of decorum. In the year 1258, an injunction was given by the Barons of England, that secular plays should not be permitted to be performed before the abbot and his monks; and Ludi Theatrales are forbidden to be performed in churches and church-yards: which shews, that the practice must have been pretty general.* It is not improbable, that mysteries and miracle plays were adopted, or at least brought into more general use, for the purpose of evading provisions and ordinances of this nature; by mixing something with the dramatic form, that was religious and scriptural. The monks, and other ecclesiastics, flattered themselves that they should be able, by this device, to elude the ordinances and decrees against profane stage plays and interludes; and, at the same time, to allure the populace. Nor should we ascribe it merely to policy and deep design, that the monks, and other ecclesiastics, insinuated themselves into all scenes of revelry which were going forward; and affected to take such a lead in the sports and amusements of the people. We are too fond of assigning abstruse

* We have various instances of dramatic performances, exhibited by religious bodies, of which the reader may find some enumeration, in Godwin's Life of Chaucer, Warton's History of Poetry, and other books of that kind. We are told, that the fourth general council of Lateran made a decree, prohibiting the clergy from attending secular plays.

struse political motives, for actions that are natural. It is not wonderful, that people, who were bred up in idleness, and had few means of filling the void of time, should eagerly catch at every species of amusement, which lay within their reach. In fact, there was no amusement, however puerile, coarse, and indecorous, which the monks thought they could enjoy without detection, to which they did not recur. The ancient sculptures, the works of monks for the most part, which are yet to be seen, in various places, shew the temper and character of the monks of this period. Instances of this may be seen, in the chapter-house of York, and in the halls of some of the chapels of Oxford. It appears, that, though the spirit and institutions of religion gave a certain degree of encouragement to the arts; the benefit, which they derived from thence, was but imperfect and limited. The monkish arbiters of elegance were gross in their tastes, and easily satisfied. Under their superintendence, the arts stopt half way in their progress to perfection. The spirit of ecclesiastical decoration produced works, vastly inferior to those which proceeded, at the same time, from rising taste, and rational magnificence, in the free states of Italy. Liberty was at least equally munificent with bigotry; but she proved a much more efficient and useful patroness. She enlarged the understanding, and refined the taste, both of the workman and the critic; while she extended rewards, to stimulate the exertions of the former. We are enabled to institute some comparison on this subject. The paint-

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ings in *fresco*, on the walls of St. Stephen's* chapel, lately discovered, are quite fresh, though executed in the year 1348. They display a gross ignorance of anatomy, proportion, and perspective; and are very inferior to the paintings, which had appeared almost a century before in Italy.† Yet we must suppose them the work of the best artists England then afforded, stimulated to exertion by royal bounty,‡ and the spirit of religion. The patronage, which superstition afforded to refinement, and the imitative arts, was entirely relative, and the advantages derived from it local and temporary. The spirit of false religion, and priestly craft, produced advantages in a period of extreme grossness and barbarism. Thus, good grew out of evil; while the arts and policy, of the priests and monks, contributed to awaken and disseminate some little knowledge, and love of literature, and the *fine arts*, where they had been hitherto unknown. The effect of pilgrimages, to sacred places and shrines of saints, though they originated in gross superstition, was the civilization of mankind, and the advancement of arts. Men were thus led to a more extensive commerce with each other; and what began in bigotry ended in knowledge and politeness. They were forcibly

* Sacred plays are mentioned, by Mathew Paris, to have been acted in the year 1110, in the abbey of Dunstable: the author was Galfrid, a Norman, who was afterwards abbot of St. Albans.

† In the year 1276.

‡ They were executed by the orders of Edward III.: they represent the catastrophe of Job's family.

forcibly impelled to the acquisition of that knowledge, which is insensibly obtained, not only in human nature, but in the arts, by an observation of various countries, and of the manners and customs of various nations.

The grand source of improvement of Europe, in those early ages, was found in the Crusades, which brought the natives of the northern and western parts of Europe acquainted with the arts and civilization of the Grecian empire, and of the Saracen's, with the luxury and enjoyments of the people; and enabled them to refine the manners, the arts, and pleasures of their own countrymen, on their return. The Crusades too, by exciting a romantic spirit of adventure, and a generous readiness to sacrifice all other objects to the pursuits of honest fame, gave rise to a number of gallant acts and atchievements, which furnished matter for heroic song; and also produced a certain high and romantic mood, an elevation of sentiment, extremely favourable to the cultivation of poetry and music, which are generally the pleasures of refined spirits. Though the Greek empire was much on the decline, these military adventurers had still an opportunity of observing a degree of splendor, a perfection and skill in commerce and agriculture, a display of politeness and of the *fine arts*, of architecture, sculpture, painting, poetry and music, such as they had never before witnessed, nor could possibly have conceived. And at that time, also, the Saracens were highly cultivated, and very forward in arts and politeness.

 About

About the time that chivalry arose, or soon after, the mendicant orders arose also. St. Dominic and St. Francis of Assise were the founders, at the very same time, of the two great monastic orders of mendicant friars. The dignitaries of the universities were the chief opponents of these orders. The mendicants endeavoured to support their consequence, and gain adherents, by a superior degree of industry, learning and eloquence. Here was another political circumstance, which contributed to enlighten the public mind, and produced a rivalship and emulous exertion of talent. These two parties attacked each other with great animosity, and much ability was displayed on each side. The earliest opponents of the mendicant orders were, William de St. Amour, Joachim,* Abbot of Flora, in Calabria. John de Meun,† also, attacks the mendicants in verse, and gives a summary of the invectives of William de St. Amour. John of Parma was the great champion of these orders.

The kind of civilization and advancement in the arts, which flowed from a source remote, and appearing so little calculated to produce any good or ornamental effect, and rather adapted to cramp the energies of the human mind, to degrade its taste and feelings, and confine its pursuits, was still worthy of the source whence it sprung. It

* Who added to the usual monastic vows.

† John de Meun principally attacks them, on two grounds: their insinuating themselves into private houses, and seducing young persons and women; and their idleness.

It was a sluggish, a slovenly and half-begotten amphibious civilization, savouring much of the gross and vicious. It did not push forward, as might be expected, but remained stationary, or even became retrograde. The knowledge of the ancients was introduced, it is true; and the learned languages, particularly Latin, were in general use. But the classics then best known, and in the highest repute, were not of the purest style. Such a preference argued the rude and inferior taste of the times. The classics in greatest vogue, while the best authors were neglected, were, in poetry, Ovid, Lucan, Statius, Prudentius. The most admired prose writers were Seneca, Boethius, Macrobius and Valerius Maximus. Dictys and Dares: the Gesta Romanorum also of Guido de Colonna, the Bellum Trojanum of Josephus Iscanus, the Philippeid of Guillaume le Breton, and the Alexandreid of Gaultier de Chatillon, were favourite works. The amusements of the times bore the stamp of grossness: rude rhymers, minstrels and mummers, jugglers, tumblers and posture-masters, were the delight of a rude people. Joinville (as quoted by Godwin) talks of the estimation in which they were held, and of their ingenious gibes and mockeries, and feats of *legerdemain:* Chaucer, also, alludes to their popularity.* The miracle plays or mysteries, of which a vast number are preserved, not only in English, but in other languages, particularly Italian, are monuments of the gross taste infused by the monks, these rude arbiters of elegance. The

* Life of Chaucer, Vol. I. p. 62.

ceremonials and pageants of May-day, where *Robin Hood* was represented as lord of the May, with *Maid Marian*, his faithful mistress, as lady of the May; the feast of fools, and other similar pageants, were suited to the taste of the times, and seem to have had a sort of monastic quaintness, which plainly marked out their derivation from the convent. A lord of misrule was elected,* and a prelate of fools: all this was accompanied by a multitude of burlesque ceremonies. There was, also, the feast of *innocents*, and that of the *ass*. In the latter a wooden ass was exhibited, with a person enclosed, and attended by a crowd of mummers, representing six Jews, six Gentiles, of whom the poet Virgil was one, and some other personages. There was an oration in praise of the ass; and the whole assembly brayed like asses, as loud as they could. The utmost coarseness of manners, broad humour, and vulgar ribaldry, prevailed on these occasions.

What contributed, at first, to enlighten the world, and advance the progress of the *fine arts*, in a certain degree, and for a certain purpose, became afterwards the cause of

* When Queen Elizabeth was entertained by her favourite Leicester, at Kenelworth castle, the images of the ancient manners and amusements were revived; and mummeries, and the recitations of minstrels, made a large part of the amusement on this occasion. The mock heroic legend of the Tournament of Tottenham, much in the manner of the burlesque poem of the Orlandino, of Teofilo Folengo, a famous Macaronic writer, born in the year 1493, who published, sometimes under the name of Merlino Coccaio, sometimes under that of Limerno Pitocco, was composed and recited by a personated minstrel.

of an effect directly contrary. When superior improvement became general, the gloomy and despotic empire of papal superstition had the most unfavourable effects on the state of society, and the destiny of the *fine arts*. The deplorable bondage in which it held the world, shackled the powers of the human intellect, and disseminated a taste, gross and uncouth, as those who then assumed the government of the consciences and understandings of men. By them some of the finest remains of antiquity were mutilated and defaced, in the pious rage of mistaken sanctity. Many of the invaluable treasures of Greek and Roman literature are supposed to have been obliterated, to make room for the disgusting legends of some miserable fanatic or maniac, dignified with the name of saint; or for the barbarous and despicable effusions of some monastic rhymer.* It is a certain fact, which appears from the writings of Petrarch and some other early authors, that many classical works, which had survived the irruption of the northern barbarians, were then in existence, and have since perished, through the want of taste and the ignorance of the subsequent ages; when monkish† indolence

* See the Life of Francis D'Assise.

† Every one, that has perused the ancient monkish writers, knows, that, however barbarous their own stile, they are full of allusions to the Latin classics, especially the poets. There seem also, in those middle ages, to have remained many ancient books, which are now lost. Malmesbury, who flourished in the reign of Henry I. and Stephen, quotes Livy's description of Cesar's passage over

lence and barbarism plunged the world in a new darkness. False literature is even worse than ignorance, as it is worse to wander out of the way, than to remain still in one place. Then monkish rhymes, quibbles, false eloquence and barbarous conceits, prevailed together with gothic architecture. But, according to the perpetual balance which is kept up in human things, by the tendency which always urges and actuates the race of man to ameliorate their condition, evils always bring with them the source of their own correction. The tyranny of superstition was speedily felt, and men grew impatient under the yoke, and struggled to break their bonds. Here the very ignorance of the times, and the prevalence of superstition, began to furnish a new incentive and theme, to some, at least, of the *fine arts;* namely, poetry and eloquence. The Italian writers, about the thirteenth century, began to descant with freedom, on the corruptions of the church: the study of words gave place to that of things.

The philosophical discoveries of the Bishop of Spalatro began to expand the human mind: philosophy enlightened letters; letters ornamented philosophy; truth arose on

over the Rubicon. Fitzstephen, who lived in the reign of Henry II., alludes to a passage in the larger history of Sallust.§ It appears also, from the writings of Petrarch, that he was acquainted with some of the works of Cicero, which have since perished: it must have been through the ignorance and want of taste of the monks. We have an account, from some late travellers, of the gross ignorance of the monks of Patmos, and their disregard of the remains of antiquity which they possess.

§ See Hume's History of England, Vol. III. p. 249, and Monthly Magazine.

on the ruins of error. Even in England, where science and the arts had not made such advances as in other places, the minds of men began to be opened; they learned to enquire and reason.* The scandalous lives of the monks became the topic of invective, among the popular preachers, and rude satirists of the time. The same subject was mentioned, in that parliament, at the close of the reign of Edward III., which shewed such a disposition for innovation, under the pretext of reforming abuses. The idea was there started, and even discussed, of throwing aside the yoke of Rome. From the Arabians, the Italians imbibed their knowledge of the Aristotelian philosophy, and the spirit of free enquiry. This led, not only to an examination of abuses, and the detection of error, but even to scepticism and infidelity; which early appeared, in the writings of Cecco d'Ascoli, and Brunetto Latini, friends and intimates of Dante.† In England, Wickliff began to preach against the prevailing superstitions. The King, the Princess of Wales, and several of the greatest personages of

* Petrarca, and Richard of Bury, preceptor of Edward III. were the means of preserving some of the choicest remains of antiquity. Petrarca received the crown of laurel at Rome, April 8th, 1341. Two embassies came to him the same day, to offer him the crown; one from the university of Paris, the other from the senate of Rome. Robert, king of Naples, the most learned prince of his time, was appointed to examine the pretensions of Petrarch, who repaired to Naples for the purpose, and was received by the king with the utmost kindness.

† About this time was produced the book of the three impostors, Moses, Mahomet, J. C., ascribed to Petrus de Vincis, mentioned by Dante, Inf. Can. 13.

of the realm, were suspected of favouring the doctrines of Wickliff. John of Gaunt, and many of the ablest and most skilful courtiers, avowed themselves his abettors. Every pen was engaged in the dispute: the satirical and descriptive powers of poetry were called out, in this warfare: the followers of the old and new professions had their respective ballad-makers. Dr. Percy adverts to two ancient polemic dramas, *Every Man*, and *Lusty Juventus*. Many passages, in the Inferno of Dante Alighieri, as the reader will find, breathe the same spirit of bold invective, which prevails in that ancient English satyrical poem, which is entitled The Visions of Piers Plowman, by Langeland.* The genius of free enquiry, which emancipated the mind from papal tyranny, gradually extended itself to the abuses of civil government, and created a general spirit of resistance to tyranny and oppression. This produced a general revolution in favour of freedom, and highly auspicious to the progress of knowledge and the *fine arts.* A more correct taste, a more acute and critical judgment, a more steady and regular march to learning, began to prevail. Eloquence, and the arts of composition, were now rendered necessary, by the frequency of attack and defence, among the polemical writers; and this, in time, produced a classical taste, and love of learning,† which became

* See Inferno, Canto XV. sta. xix. and xx.; and particularly the circle of Malebolge and gulf of Simony, Canto XIX. and Canto XXIII.

† Brunetto Latino, a Florentine, the preceptor of Dante, composed a Tesoro or Encyclopedia. There is a passage in it, relative to the magnetic needle,

became general. This was not, perhaps, the golden period of the arts; but it was, at least, the time when they were held in the highest honour. The study of them was prosecuted with the most eager assiduity; and they who excelled in them were received, by all those whom they would naturally desire to please, with an attention nearly bordering on adoration. In France, at this period, flourished the celebrated assemblage of poets, Ronsard, Baif, &c. &c., who gave strength and elegance to their vernacular tongue; and, in fact, made it a language, engrafting into it the beauties of the Greek and Roman speech. These were known by their cotemporaries, under the honourable appellation of the Pleiades; an appellation heretofore applied to the poets of Alexandria. At the same time, the art of painting began to be generally esteemed and patronized. The famous painter, Leonarde da Vinci, was honourably received at the court of France, and died in the arms of the first Francis. A famous event also, the discovery of the art of printing, now took place, and contributed, beyond all power of calculation, to the improvement of the world. The admirable remains of Greece and Rome now became familiar to every body, by the multiplication

needle, which serves to shew, that its virtues, in navigation, were known forty years before 1300, the year to which most modern philosophers refer its discovery. Brunetto seems to speak of it rather as a matter in general use, than as a new discovery. Guglielmo da Pastrengo, in the fourteenth century, composed the first Bibliotheca Literaria in alphabetical order.

plication of copies. A variety of learned men* arose, who employed themselves, with infinite application, to present the text of the classic authors to the world, in the purest form. The splendid court of Leo X., so much celebrated by cotemporary and all succeeding poets, extended its genial influence to the protection and advancement of the *fine arts.* At this time, also, the English taste began to be really refined and reformed, and the English language became regular and classical. The poetical dynasty, which had commenced in Chaucer, Lydgate, and Gower, was continued in splendor, in Sackville, Wiat, and Surry. Many of the first reformers were not only men of great learning and ability, but of a true classical taste, and elegance of mind. Erasmus, who was particularly severe on the corruptions of the monks,† and may, in some measure, be reckoned one of the reformers, excelled in learning, critical refinement, wit, and classical style. The art of painting was, at this time, much encouraged in England. Hans Holbein worked there, as well as other painters of eminence; a proof of the refinement of taste which had then taken place. The regular drama rose on the ruins of the miracle plays and mysteries.‡ The Italians, who excel so much in music at the present, were the earliest improvers of

* The Aldus family, including Paulus Manutius, and Asolas, some of the refugee Greeks, Calliergi, &c. &c.

† Erasmus, on some occasion, makes very free with the monks, whom he calls *cucullators, scortatores turpissimos, nebulones.*

‡ The first model of a regular tragedy was the Gorbeduc of Sackville.

of that divine art. Modern music was rendered a science, reduced to principles, and has thence been furnished with its scale, its counterpoint,* its best melodies, its religious and secular dramas, and with the chief part of its grace and elegance. "Italy, in modern times, (says Burney,†) has "been to the rest of Europe, what Greece was to Rome. "Its inhabitants have helped to civilize and polish their "conquerors, and to enlighten the minds of those, whose "superior prowess had frequently enslaved them." When classical learning had begun to flourish in England, Erasmus visited that country; and Linacer, Sir John Cheke, and others, applied themselves with ardour to grammatical studies. Sir Thomas More wrote epigrams, and other poems, which have considerable merit; and was distinguished, as much for learning and elegance, as for integrity. Cardinal Wolsey, the powerful favourite of Henry VIII., while he had the confidence of his master, and full command over the treasure of the country, was a munificent and splendid patron of learning and the arts, of which he was an excellent judge. Erasmus graduated at Cambridge, and was professor of Greek at Oxford, in which station he was succeeded by Dr. Crook. The *adagies* of Erasmus are dedicated to Lord Montjoy; the king himself‡ distinguish-

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* Counterpoint is generally supposed to have been invented by Guido, a monk of Arezzo, about the year 1022.

† Hist. of Music, pref.

‡ Henry VIII.

ed him with marks of his particular favour and affection. Bishop Fisher had great zeal to promote literature in others, and to excel in it himself. Warham, Archbishop of Canterbury, was an equal encourager of learning and learned men:* Erasmus calls him a great canonist, an able statesman, and a favourer of learned men. At this time, too, Polydore Virgil was patronized by Henry VIII., who gave him church preferments in England. Reuchlin, one of the early reformers, and the friend of Erasmus, was also one of the great restorers of letters in Germany. The learned Budeus, at this time, flourished in Paris, and was, likewise, the friend of Erasmus. As this last, by his bold and free censures of the monks, led the way to the Reformation, it has been remarked, that "*Erasmus laid the egg, and Luther hatched it.*" Thus the action and re-action of genius and freedom promote each other, and energy of mind is favourable to the arts. It was not merely by the force of dry religious controversy, that the Reformation advanced. It availed itself of the exertions of oratory and the powers of invective, enlivened by wit and ridicule. Luther possessed uncommon genius, a lively imagination, a great share of learning, and, at the same time, sacrificed to the Graces. He composed some poems, both in Latin and German: he was fond of music, in which he was both a composer and performer. He said, "it expelled melancholy, and put the devil to flight, who "mortally

* See Jortin's Life of Erasmus.

"mortally hated music." He even entertained a mean opinion of the capacity and disposition of those, who had no taste for this admirable art. Others of the reformers also, Eobanus Hessus, Ulricus Hutten, and Beatus Rhenanus, were men of distinguished taste and learning. Cardinal Sadolet, one of the first scholars of the age, highly esteemed both Melancthon and Bucer, noted reformers. The unguarded commendations, bestowed by Leo X. on Luther, occasioned great scandal.

The poetical history of the reign of Queen Elizabeth could not be comprised in a moderate volume. Epic, didactic and devotional poems, translations from the ancient and all the modern languages, pastorals, sonnets, madrigals, acrostics, humorous and romantic ballads, were produced, with a profusion, which, perhaps, has never since been equalled. No less than seventy-four poets are assigned to this period, in the new edition of the Theatrum Poetarum.* Many of these have been consigned to oblivion: a few, as Sir John Harrington, Sir Philip Sidney, Drayton, Fairfax, Warner, and Sir Walter Raleigh, continue to be cited, in deference to their ancient reputation. Shakespeare, Fletcher, Johnson, Spencer, and Sir John Davis, are still confessed to be unrivalled in their several styles of composition. After a lapse of nearly two centuries, during which the progress of literature has not been interrupted, the literary splendor of this reign is the boast of

* See Ellis, Spec. ant. Poetry, Vol. II. p. 129—30.

of English literature. This (as Mr. Wharton has justly remarked) may be ascribed to the Reformation. When the corruptions of popery had been abolished, the laity, who had now been taught to assert their natural privileges, became impatient of the old monopoly of knowledge. The general curiosity, heightened by ideas, either real or imaginary, of the treasures contained in the Greek and Roman writers, excited all persons, of leisure and fortune, to study the Classics. The marvellous progress of Queen Elizabeth, in the Greek nouns, is recorded with rapture, by her preceptor, Roger Ascham. He might have found many similar examples, in Anna Boleyn, Lady Jane Grey, the daughters of Sir Thomas More, and other distinguished characters. As the stores of Greek, Roman, and Italian literature, were now laid open, through the medium of translations, the former supplied our language with a variety of beautiful allusions: the latter afforded numberless stories, taken from common life, in which the variety of incident and ingenuity of contrivance were united.

It seems that the English language was, at this time, more copious, and better adapted for the purpose of poetry, than at any prior or subsequent period. Our vocabulary was enriched, during the first half of the sixteenth century, by almost daily adoptions from the Greek, Latin, Italian, French and Spanish languages: not to speak of the oriental tongues, which furnished liberal contributions of words, and still more liberal of figures and phrases; particularly when the scriptures came to be generally studied,

died, and were translated into the vernacular language. Though some of these denizens were admitted without necessity, and only through a blind veneration for the dignity of polysyllables; they added something to the expression, as well as to the harmony and variety of the language. A lively Italian writer* has made a remark, which, though singular, appears to be just; that the translation of the Bible is the test and standard of the language in England, while the standard in Italy is the Decameron of Boccacio. The consequence of this, in England, was important. The vulgar tongue having become the vehicle of religion, was regarded, not only with national partiality, but with pious reverence. Even at this day, amidst the great improvements of our language, the old translation of the Bible is read with pleasure, and strikes us with its energy and beauty. This shews us, in the effects of the Reformation, how much the progress of the arts may depend on the political circumstances of the country.

I find, this historical induction has betrayed me into great prolixity; I shall therefore desist, and adduce, in confirmation of what I have already offered, two or three striking and unquestionable facts, from the general state and history of the *fine arts*, which strongly shew their dependance on the political circumstances of the country. The first fact is, that the English have no peculiar strains of national melody, like the Scotch, the Welsh, the Irish, the

* Algarotti.

the Swiss and the Calabrese. We find none of these airs of traditional music, wildly sweet, and simply pathetic, which speak so forcibly to the heart, and operate like magic on the imagination and affections of the people, with whom they are indigenous, to awaken the love of parent soil, and excite a fond association of ideas.* I can speak from experience: I have felt the powerful and inexpressible effect of the strains of national music; and found myself melted, to a degree of enthusiastic tenderness, by hearing some of our original Irish airs sung and played, even by very middling performers. I have seen many of the Scotch nation, particularly from the Highlands, most forcibly affected, by the strains of their native music. If the fact be, as I have supposed, that the English have no appropriate minstrelsy or indigenous melody, let us endeavour to account for this deficiency. The Scotch, Welsh and Irish, though the countries they inhabit have been much subject both to foreign aggression and intestine wars, yet retain more of the aboriginal inhabitants, and are, at this day, a less mixed race than the English. They have still, in some measure, retained in popular use their peculiar dialects, handed down to them from remote ages. They converse in their own languages with a conscious delight; and have preserved, together with their languages, many of their ancient customs, in-stitutions,

* The powerful effects of the air, called *Ranz de Vache*, on the Swiss, while they were a people, were like enchantment.

stitutions, traditions and pastimes, and also many of their metrical compositions. Spencer* also, in his views of the state of Ireland, says, that the English colonists preferred the language of the natives to their own. Spencer, in speaking of the Irish, even in his time, says, "There is amongst "the Irish, a certain kind of people called *bardis*, which "are to them instead of poets: whose profession it is, to "set forth the praises or dispraises of men, in their poems "or rithmes; the which are had in so high regard and "estimation among them, that none dare displease them, "for fear to run into reproach through their offence, and "to be made infamous in the mouths of all men: for their "verses are taken up with a general applause, and sung "at all feasts and meetings, by certain other persons, "whose proper function that is; who receive for the same "great rewards and reputation amongst them."†

It is easy to account for this difference. The lofty mountains, the woods, defiles and morasses, by which Wales, Scotland and Ireland were defended, afforded natural fortresses, to which the ancient inhabitants retired, from the rage and pursuits of their enemies, and preserved their language and manners pure and unmixed. The progress of invasion was stopped, and some remnant of independence preserved. To this circumstance Ireland superadded a remote insular situation, which originally preserved her

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* He describes, in a striking manner, the pertinacity with which the Scotch, Welsh, and Irish, especially the latter, retain their own customs.

† Spencer's Works, Vol. VI., small Edit. p. 124.

from the visitation of the Romans. England, on the contrary, which was better known, lay more open to invasion, and afforded fewer natural means of defence. It was therefore completely conquered, over and over again, and became, in succession, the prey of different races of invaders, who introduced their own language, manners, and institutions, and, in a great measure, metamorphosed the people whom they thus subjected; leaving them nothing, mental or corporeal, they could properly call their own. These again were, in turns, transformed by new conquerors. When the military science and discipline of the Romans prevailed, and drove the ancient Britons, to preserve an indigent and precarious independence, among the bleak mountains of Wales, Cornwall and Caledonia; the language, the manners, the garb, the habitations, pursuits and ideas of the people, became wholly Roman. Fair cities were erected: commerce flourished: all the arts of peace were understood and practised; and with them the luxury and softness of Rome was introduced, and every trace of Celtic origin disappeared. At the decline of the Roman empire, the extremities of that vast body were left defenceless, and became paralysed. Britain became the prey of the Saxons, who not only conquered but desolated the country; and, in the course of an obstinate and murderous contest, for the possession of the soil, obliterated every trace of Roman civilization, and introduced the Saxon language and Runic mythology. The Saxons, in their turn, began to acquire opulence, and to be softened

tened by the arts of peace. They then became objects of contempt and aggression, to a more fierce and northerly race of barbarians. The Danes prevailed for a season, and three sovereigns of that nation quietly possessed the English throne: this yet further destroyed the nationality of the people. After this, the Norman invaders, having possessed themselves of the country, endeavoured, as much as possible, to complete the subjection of the inhabitants. They changed the tenure by which lands were held; they introduced their own laws and language; and proscribed, with studious and unrelenting severity, the manners and customs of the Saxons. The Normans themselves had not been an aboriginal race; they were the descendants of northern adventurers, who had established themselves in France, in the same manner that the Saxons had settled in England. Thus we see, what a fluctuation of inhabitants, what a perpetual change of masters, took place in England. This will explain the cause of the fact I have stated; that the present inhabitants of England retain no national melody, and fewer national customs and traditions, than, perhaps, any other nation in Europe.

Another remarkable fact occurs in the history of poetry. It is observed by Algarotti, that Moliere (and we might say the same of some of our English comic writers) is as superior to Aristophanes, Terence and Plautus, as all modern tragic writers, Shakespeare excepted, are inferior to Sophocles and Euripides. The fact is undeniable, and the reason is, that the ancients were not provided with schools

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of comic humour: whereas, every country, where good poets are to be found, furnishes a school of tragedy. The object of tragedy being to excite terror and pity, by the representation of great and calamitous events, the tragic muse finds her materials every where. The tragic poet requires no preliminary education: man is every where unhappy, and every where feels his misery. Hence more excellent writers have arisen in tragedy than in comedy.

The task of comedy is difficult: her excellence consists in the natural representation of manners and characters, not of the most perfect kind. The talent, by which the comic writer aims at eminence, in this department, is called humour: the subjects, on which it is employed, are, the foibles, the caprices, the lighter passions of men. It is obvious, that comedy can arrive at perfection, there only, where a plentiful crop of foibles, follies, and caprices arises: where all the various vanities, and eccentricities of human nature, are left free to expand themselves, and blossom without control; and the professions and pursuits of men are infinitely varied. I have already shewn, that, under a strict republic, the ramifications of character, and the display of follies and foibles, are repressed, by morals and virtue, the spirit of equality, and the cultivation of good order. The republican government endeavours to form a perfect character: comedy delights in that which is imperfect. Comedy requires a variety of characters: despotism produces a sameness of character, and stifles and

overwhelms

overwhelms all the caprices and eccentricities of men, by the force of terror.

It has been observed, that the terms, used to express the products and efforts of eloquence, at Athens and Rome, mark the different genius of the people. The Greeks called regular harangues, λογοι, *discourses;* a word that marks operations of the intellect: and the use of this term seems to imply, that their harangues were addressed to the understanding, and sought to attain their end, by the powers of reasoning. The Romans called speeches of a similar kind, *orations;* a term taken from prayer, and including the idea of intercession, supplication, and an address to the passions. This is no fanciful or chimerical distinction. We find this difference of character fully exemplified, in the productions of Demosthenes and Cicero. The reason of this variation, in the style of public speaking, is to be found in the difference of political circumstances and national character. The Greeks were more lively, more ingenious, more spiritualized; their passions were all in arms, and ready at a call. The Romans were more steady, and less impassioned; and it required more application, and display of oratory, to rouse their feelings.

There is a fact, related in the annals of music, which shews the connexion between the arts, and the political state of a country. Many of the ancient writers, who visited Egypt, after it became a Roman province, speak of the inhabitants as the most melancholy and abject race of people in the world. Ammianus Marcellinus says, "The "Egyptians

" Egyptians were not formed for mirth or pleasure: they " worshipped their gods with sorrow and fear: while the " Greeks and Romans made religion an object of joy and " festivity." We are told, by Diodorus Siculus and Plutarch, that the cultivation of music, an art, which the Greeks and Romans thought so necessary, to humanize and soften mankind, was prohibited by their government. Dio Chrysostom informs us, that poetry was interdicted among them, as well as music. Strabo says, that the sound of instruments was not heard in their temples; but, that their sacrifices were made in silence. Under the Ptolemies, on the contrary, music was very much cultivated; and their religious ceremonies were distinguished by pomp, and embellished with all the charms of vocal and instrumental melody. This is a most striking and wonderful phenomenon, in the history of arts and sciences, this total and gloomy change, in the pursuits, the genius, and temper of a whole nation. Licentiousness, gaiety, and mirth, even in excess, prevailed under the dynasty of the Ptolemies; poetry and music were cultivated with an ardent enthusiasm. Whence arose the melancholy transformation? The ingenious and learned Dr. Burney accounts for it, in a manner that does honour to his feelings and liberality. " All this is reconcileable, and consonant to the nature of " things: for, when these writers visited Egypt, its inha- " bitants were in a state of slavery, and had been so for " five hundred years before; and though not like the " Jews, in a strange land, yet, like them, they *had hung*

" *their*

"*their harps upon the willows.*" The Roman government, no doubt, was very grinding and oppressive to the provinces. This fact is very important; and goes far to shew, how much the state of the *fine arts* depends on the political state of the country: since it demonstrates, beyond a possibility of doubt, the baleful influence of despotism, of whatever kind it may be. It shews that, in its principle, and necessary operation, unless its character and natural tendency be counteracted by some collateral cause, it must be the deadly foe of all chearfulness, and cultivation of the human spirit.

I flatter myself, I have now sufficiently supported the affirmative of the proposition before us; by a general consideration of the nature of man and his pursuits; by a reference to history, and by striking examples taken from the course and progress of the *fine arts.* I cannot boast of much deep research, or ingenious novelty, in the structure which I have raised. Most of my materials are obvious, and are taken from the surface; yet, perhaps, the application of them, in some parts, may appear new. I perceive my essay has swelled to a formidable bulk; yet I commenced it with a determination to consult brevity: but, in the course of my researches on the subject, I found such a variety of matter, pertinent to my subject, that it proved a much easier task to reject than to compile. Such as my production is, (for I am fully conscious of its defects,) it is offered to the Royal Irish Academy, with all due respect, and with some degree of diffidence. But

judgment,

judgment, and true science, will ever take an extensive view of a subject: they will perceive all the difficulties with which it is surrounded; and, of course, will be disposed to receive an imperfect attempt, with more indulgence than would be afforded to it by presumptuous ignorance.

ON THE

PRIMEVAL LANGUAGE OF MANKIND.

BY RICHARD KIRWAN, ESQ. L.L.D. P.R.I.A. &c. &c. &c.

READ, NOV. 4th, 1805.

THE origin of vocal language, that combination of sounds, by which the thoughts and sentiments of men are communicated to each other, thus forming the principal link of their social intercourse, has always excited the astonishment of those who have attended to its investigation.

On this subject, two opinions have been proposed. The first was held, or rather suspected, by persons unacquainted with the most ancient and authentic record of the origin of our species. They supposed, that men originally lived in a savage unconnected state, destitute of any language; that their mutual wants and dangers induced them at last to unite; and, that by uttering different sounds, as often as they pointed at different objects, they gradually formed a language. Thus its origin is explained by Diodorus,* and by Lucretius.†

* Lib. I. cap. iii. † Lib. V. v. 1027, &c.

> At varios linguæ sonitus natura subegit
> Mittere, et utilitas expressit nomina rerum.

And again,

> Postremo quid in hoc mirabile tantopere est,
> Si genus humanum, cui vox et lingua vigerit,
> Pro vario sensu, varias res voce notaret.

But we are surprised to see so eminent a critic as P. Simon,* agree with these unenlightened heathens, and abandon, without any necessity, and in opposition to all just rules of interpretation, the literal sense of the second chapter of Genesis; in which, language is expressly mentioned as co-existing with the first pair. Even the celebrated Warburton, though he expressly deduces the origin of language from inspiration, appears to me to have been too liberal in allowing the possibility of any other origin.† Its impossibility has been demonstrated, both theoretically, by the subtle and eloquent Rousseau;‡ and experimentally, in the person of the savage of Aveyron. Among many curious observations, of which he was the object, it was discovered, not only that the organs of speech grow torpid by inaction, and can, with great difficulty, utter any articulate sound; but, what was still more extraordinary, this savage was, with equal difficulty, taught to connect those

* Hist. Crit. du Vieux Testam. Lib. I. chap. xiv. et xv.

† Divine Legation, Book IV. §. iv. p. 106, in 8vo.

‡ Sur l'Inégalité, &c.

those he was enabled to produce, with the objects presented to him, as signs to denote them. The Chinese cannot pronounce the letters B, D, R, X; because, not being in their language, they were not taught, in their infancy, to utter the sounds annexed to them.

The second opinion, therefore, namely, that the gift of speech was originally bestowed on our first parents, by the great Author of their existence, is the only one which can, with any appearance of reason, be entertained; and is confirmed by the Mosaic history of the origin of our species. It fully proves, that the power of communicating their thoughts to each other, was possessed by our first parents, and coeval with their existence.*

That the language, thus imparted to man, possessed, at its origin, that degree of perfection which it afterwards attained, is a supposition neither necessary nor analogous to the usual conduct of Divine Providence. The designs of Providence would be sufficiently answered, by inspiring such sounds, and suggesting the knowledge of their signification, as denoted the objects with which they were necessarily conversant; such as the names of the various animals, which they were instructed to use or to avoid; and the relations which they themselves stood in, with respect to each other. Accordingly we find, that Moses, notwith-

* See the learned notes of Dr. Magee, in his Discourse on the Scriptural Doctrine of Atonement, p. 300, &c.

standing his usual attention to brevity, does not fail to mention both these circumstances. Gen. chap. ii.

On this foundation, further improvements might afterwards have been superstructed, either by the invention of new names for new objects, or by devising such modifications, as should render the expression and discrimination of the relations of objects to each other more precise and accurate, during the long space of time that intervened between the Creation and the Flood.*

The primeval language must have been, at first, monosyllabic, or, at least, dissyllabic; these being the simplest enunciations: but, soon after, it, for the most part, assumed this last form, or became more compound; these forms being the most convenient for expressing the different relations, which objects bear to each other, and to the various modifications of existence, action, passion, and adjacent circumstances; as such relations may be denoted by the variations of the terminating syllables. This mode of signifying relations, is much more natural than that employed in many ancient and modern languages; and, therefore, must have preceded it. For, as a profound philosopher, the celebrated Adam Smith, hath well observed, to express a relation in this "manner, did not require any "effort of abstraction. It was not expressed, as in the "languages

* 2256 years, by Mr. Jackson's chronology, which I adopt. It differs little from the Septuagint.

"languages alluded to, by a peculiar word, denoting
"relation, and nothing but relation, but by a simple variation of the correlative term. It was expressed, as it
"appears in nature; and not as something separate and
"detached, (as by our particles *of*, *to*, *from*, &c.) but as
"mixed and blended with the correlative object."

The relations of verbs, to person, number, and time, whether stated as actual or possible, or under the modifications of interrogation, command, or velleity, are still more complex; and must have been, with less effort of abstraction, denoted by variations or additions to the radical term, than by any words or abstract signs of such relations; such as are employed in languages of posterior origin.

Numbers, while mankind, and all animals, existed only in pairs, would naturally be marked by terminations, which denoted one individual, or both: and, hence, the dual number must have preceded the plural, which was denoted only when more than two were brought into existence.

In the same manner, the sexes, and inanimate objects, must have been originally distinguished by the termination of their appellations; but the latter, being of no sex, and having, in their different classes, a strong resemblance to each other, were naturally considered as an unit, or a single object.

During the life of Adam, various arts were invented; as that of agriculture, that of metallurgy, and also architecture, (as cities were built,) and many more, which these presuppose;

presuppose; consequently, the sphere of language was much enlarged, many new radicals being invented.

The numbers of mankind must have prodigiously increased, long before the death of Adam; for it is ridiculous to think that he had no more than three sons, or that they had not attained the age of puberty, at the same period that men do at present. He must have had many more sons, as well as daughters, though none are mentioned by Moses; as he intended tracing little more than the pedigree of Noah, and the remote and immediate causes of the Flood.

Cain, when sentence of banishment was pronounced against him, apprehending he might be put to death by some of his brethren, retired to a considerable distance from them; and his family, having little or no intercourse with the remaining descendants of Adam, for many ages, it is highly probable, that, in his family, the primitive language was gradually altered: at least, it could not receive the improvements, which that, more favoured by Adam, had received. In this, peace was preserved, at least during the life of Adam; but, in the family of Cain, crimes of every kind appear to have been committed; in so much, that, in the days of Enos, the grandson of Adam, the descendants of Seth, and probably many more, who formed the community in which Adam resided, were distinguished from the family of Cain, by the honorable appellation of *Sons of God.* But, in process of time, when both families had multiplied to a great degree, and the earth had been fully peopled, both unfortunately intermixed with each other; and, as it frequently happens, the wicked seduced the good, contention soon arose, legitimate governments were subverted; war, violence, conquest, or anarchy, every where prevailed; nor was even the presence of God, which was long, at least occasionally, manifested to Adam, and his favoured family, and emphatically called the *Spirit of God*, sufficient to repress these disorders. Hence, the necessity of destroying the whole race, all to one family, namely, that of Noah.

It is not necessary to suppose, that the whole range of the primitive language was known to Noah or his family; but its structure, its idioms, and radical words, might be retained by them; and several books, written in that language, were certainly preserved by them, as will be seen in the sequel.

Thus this language subsisted, as we are informed by Moses, for some generations, (about five hundred years,) among the greater part of the descendants of Noah; not but other languages might have arisen, during that interval, among other families, sprung from banished criminals, as before the Flood. But these, formed without any preconcerted plan, in the intercourse of a turbulent and ignorant multitude, could be nothing more than uncouth jargons, as defective, and ill connected, as those of the lowest ranks of society, in all countries, generally are. The practice of punishing the most atrocious crimes, by banishment,

nishment, was, anciently, the most usual:* and, in those early ages, such crimes were very frequent.† Each new criminal, with his family, resorting to those of a similar description, soon forgot his native language, and adopted that of the tribe with which his family had been incorporated. How soon a language, spoken by comparatively few families, is lost in that of the society to which they are aggregated, appears, in many instances. The Jews lost theirs, at Babylon, in about seventy years; and Barrow, in his highly entertaining and instructive account of China,‡ tells us, the French refugees, at the Cape of Good Hope, lost theirs in less than seventy years: and so it must ever happen, when communication with the parent stock is not frequent and easy. Even at present, the English language has undergone some variation in America.

But the great and sudden transition, from the primeval language to a multitude of heterogeneous languages, happened, as Moses relates, several centuries after the Flood, in the plains of Shinaar. Immediately after that catastrophe, the children of Noah were ordered to people the earth: for this purpose, it was necessary they should separate. But, having antecedently associated the idea of separation with that of exile, they long persisted in re-

maining

* See Le Clerc, in Genes. iv. 2. Diodorus, Lib. III. cap. iv. 2 Goguet, 236. Grotius, in Matth. V. p. 68.

† Thucyd. Lib. I. c. v.

‡ Page 425.

maining together; and, after passing several years in the Eastern regions, they removed, in a body, to the Western. They lived in tents, and led a pastoral life; as appears by the ninth chapter of Genesis: if they had cultivated any tracts, they, most probably, would have been attached to them. The example of Noah, who was an agriculturist, does not seem to have been followed by his posterity. The culture of vines (from the misfortune which their product had occasioned, and the curse, entailed on some of them, originating from it, and, possibly, the recollection, that Cain, the agriculturist, must have been drunk, when he killed his brother,) appears to have been neglected, for several ages; for its discovery, in after times, was highly celebrated: and, to this day, the use of any intoxicating liquor is interdicted to the four casts of the Hindoos;* nor do I find it mentioned in any account of China.

Charmed with the fertility of the Babylonian plains, they seemed to have designed to proceed no farther, but resolved to erect a tower, as high as possible, as a signal, by which their situation, in distant rambles, might, at all times, be determined. It was, however, evident, that, extensive as these plains were, their products would, at last, be insufficient for the maintenance of such multitudes, as they must, in process of time, amount to; whence numberless disorders would have arisen. The gentlest method of forcing them to separate was employed. Their different tribes,

* Indian Recreations, Vol. II. p. 284.

tribes, and their subdivisions, were rendered unintelligible to each other, by obliterating the memory of their ancient language, and substituting, in its stead, new sounds, different in each tribe, and intelligible only to those that composed it; or altering the signification of the primitive sounds. It is not necessary to suppose, that all these tribes lost their original language; the views of Providence would equally be attained, if it subsisted in one tribe only, or one fraction thereof.

To estimate the degree of perfection, which language must have attained before the Flood, it will be proper to examine, what degree of knowledge men must have possessed some ages before that catastrophe.

Among the proofs of antediluvian knowledge still existing, the most incontestible are, the astronomical tables of the Bramins; and particularly those of Tirvalore, discovered by Mr. Gentil, about the middle of the last century. Their epoch coincides with the famous æra of the Calyougham, that is, with the year 3102 before Christ: and this æra must have been ascertained by observation; as Mr. Playfair shews, after a strict and masterly examination, in the second volume of the Edinburgh Transactions. And, if founded on preceding observations, as is most probable, these observations must have commenced 1200 years earlier, that is, 4300 years before Christ.* The Deluge happened

* I am aware, that the conclusions, deduced by Mr. Playfair, have lately been combated, in the sixth volume of the Asiatic Researches; but, in my opinion, ineffectually.

pened 3169 years before the birth of Christ, according to Jackson's chronology, (which I adopt); therefore, the Calyougham commenced sixty-seven years after the Flood; and the observations, on which it was grounded, commenced 1133 years before the Flood: which agrees remarkably well with the tradition of the Jews; for Josephus expressly mentions, that the children of Seth addicted themselves to astronomy before the Flood.*

The learned Professor farther adds, that the construction of these tables implies a great knowledge of geometry, arithmetic, and even of the theoretic parts of astronomy; that those who framed them must have possessed a calculus equivalent to trigonometry; and that, upon the whole, it appears there existed, at that period, a body of science really astonishing.

That such a body of science could exist, and be communicated to subsequent ages, without the art of writing, is incredible: yet these tables afford a sufficient proof, that astronomical science, at least, had so descended, and were, consequently, written. It may also be inferred, that alphabetic writing had been known before the Flood; for the Sanscrit writing, in which these tables exist, is alphabetic; and into this their original language was soon translated. Moses also informs us, that a written account (or rather history) of the descendants of Adam existed; from this he transcribed, in the fifth chapter of Genesis, the names

* Antiq. Lib. I. cap. ii.

names of the ancestors of Noah. But it certainly contained much more, and related the most important transactions of the antediluvian ages; for St. Peter expressly tells us, Noah preached repentance to the antediluvians, 120 years before the Flood; a circumstance unnoticed by Moses.*

While science was thus improved, we may conclude language received similar improvements; as we have always seen its progress to perfection to keep pace with that of knowledge: it certainly did so, among the Romans; and still more obviously, in modern times. Among the Greeks, indeed, a singular exception occurred; as the perfection of their language long preceded their improvements in science; the reason of which will soon be seen. When, therefore, we consider the length of time the primeval language had been spoken, namely, by the lowest computation, 1300 years, and, more probably, 2000; the longevity of those who spoke it, the few generations that succeeded one another, during that period, not more than four, and the consequent stability it must have acquired; it being impossible to suppose it much altered, during so short a transmission; the undisturbed state in which the more favoured descendants of Adam remained, during the greater part of that interval; we have sufficient reason to conclude, that this language attained a far higher degree of perfection, than any subsequent language, that could not

* 1 Peter, iii. 20.

not enjoy the same advantages, was enabled, by any possibility, to acquire.

Three things are indispensably necessary to the perfection of a language: 1st, That it should be capable of expressing, with energy and precision, and, consequently, without any ambiguity, all the various objects, which the senses may present, the understanding define, the imagination depict, and the different shades and modifications of the invisible passions and sentiments which actuate the human breast.

2dly, That melody should exist in the prolation of its sounds, and, under the direction of genius, in the structure of its periods, their cadence, and versification.

3dly, That its construction should be so unfettered, that its designation of relations should not require any particular fixed situation, but be capable, without ambiguity, of all that variety of position, which melody, either in prose or verse, may require.

Having thus ascertained in what the perfection of a language consists, and the probability that it may justly be ascribed to the primitive language; and having also indicated the distinctive characters by which, if it still exists, it may yet be recognized, I now proceed to examine, whether they apply to any, or to which, of the most ancient languages now known to us; being furnished with *criteria*, by which their respective pretensions may be decided.

The principal languages, whose claims have hitherto been severally insisted upon, are, the Hebrew, the Egyptian,

the

the Chinese, and the Greek; though the claim of this last has, as far as I can find, found only one advocate, namely, John Erick, a German professor; whose proofs, being chiefly drawn from distorted etymologies, were, by others, treated with the utmost contempt.*

OF THE HEBREW.

The first distinctive character of the primeval language, namely, the most natural designation of the relations of nouns, is not found in the Hebrew. Mr. Wilson, in his Hebrew Grammar,† (the best and easiest I have seen,) tells us, "that nice attention to the changes of termination, so "requisite in acquiring the knowledge of other ancient "languages, has here no existence; the relations and de-"pendencies of nouns, are not distinguished by termina-"tions or cases, but by particles or prepositions prefixed." These, it is true, are also incorporated with the word, but not only they are general, but they indicate the relation in the most clumsy manner; for it is often difficult to distinguish, whether they form the radical, or only denote its relation, which, Mr. Wilson acknowledges, is very apt to perplex the learner, "as he must strip the noun of these "signs, before the primitive form can appear."‡

The

* See Michaeler, de Origine Linguæ primaria, p. 300.

† P. 108.

‡ P. 116.

The comparison of adjectives is performed in the same awkward manner; and is often so ambiguous, as to be unintelligible.* The superlative is formed, in the most inartificial and infantine manner, by a mere repetition of the positive.

Nouns have but two genders, the masculine and feminine; thus inanimate things are not distinguished from the animate: just so the vulgar, among us, frequently express themselves. Probably this defect was productive of idolatry.

There is no dual in the Hebrew, except when things, which are naturally double, are mentioned; as, the eyes, the ears, the hands, &c. (hence, also, it never occurs in the New Testament). Wilson, indeed, does not make even this exception; but I find it mentioned by Bythner,† and Amama.‡ Here, also, it differs from the primeval language: in many instances, the singular and plural coincide, and can be distinguished only by the sense, or other words in the sentence.‖

Lastly, in verbs, neither persons, moods or tenses, are marked by the changes of their last syllables; but by means of letters of a particular order, which appear, sometimes in the beginning, sometimes in the middle, and sometimes at the end of the original word. Another wide departure from the original language.§

From

* For instance, in Gen. x. 21. † P. 18. ‡ P. 24.
‖ Wilson, 149. § Id. p. 109.

From these, and many other inherent defects, the learned Le Clerc, himself a professor of the Hebrew language, declares, that perhaps no language is fuller of ambiguity and obscurity.* Can such be the language polished and improved for twenty centuries?

To this our late pious and learned Primate, Newcome, answers, that the difficulties, respecting these and other modifications of the Hebrew verb, are considerable, but not invincible; that it is true, that the substitutions of one gender, number or person, for others, are bold and frequent, but not inexplicable.† As much may be said of the jargon, spoken by the English in the days of Henry III.; or in France, during the reign of Lewis IX.

The advocates of the Hebrew found its claim chiefly on the two following grounds.

1st. That many or all the antediluvian names are significant, in the Hebrew language, and derivable from it. But the learned Mr. Lanigan, lately Scriptural Professor in the University of Pavia, in the first volume of his Biblical Institutions, observes, that these names are as easily derivable from the Chaldaic or Syriac, and still more easily from the Arabic. Grotius, Huet, and Le Clerc think, that the real antediluvian names were translated into the Hebrew; and they give many instances of similar translations: thus the translator of Sanchoniatho into Greek, calls Adam, *Protogon.* Mr. Lanigan, indeed, thinks, that many of them cannot

* Preliminary Discourse to the Pentat. §. 6.

† Preface to Ezechiel, p. xxxiv. and xxxv.

cannot be deemed translations; as their derivation from the Hebrew is forced and wiredrawn. It follows, then, that they are not of Hebrew origin. We have no reason to suppose, that Moses was acquainted with the antediluvian language: he found those names in his family-memoirs; and derived them, as he could, from the Hebrew, or from the Arabic, which he well understood. Of such names, our learned Professor mentions four, Cain, Tubal Cain, Noah, and Babel: the true derivation of these, and some others, I shall soon have occasion to mention. Le Clerc thinks, that many of these names were given, not at the time of the births of the Patriarchs, but were rather by-names, derived from some remarkable event, that happened in their time. And, indeed, this is evident, with respect to Phaleg or Peleg; as Moses expressly tells us, he was so called, because, in his time, the earth was divided between the descendants of Noah. Genes. x. 25.

The second ground, on which the advocates for the Hebrew rest its claim, is, that a number of words, of Hebraic origin, are found in many other ancient languages; as the Chaldaic, Syriac, Phœnician, and Persian. These, they think, are remnants of the ancient primeval language; and, since these are also Hebrew, they think that language must also be the Hebrew. But this mixture of Hebrew words, in those languages, is easily accounted for. It is now generally allowed, that the Phœnician, Canaanitish, and Hebrew, were one and the same language. The Phœnicians traded to all nations, and must have left them many

 words;

words; as the French do with us at this day. The Medes, Persians, and other Eastern nations, may have received many more, from the Israelites dispersed among them. So the Greek colony, established at Marseilles, it is well known, communicated many words, which still remain in the French language.

After what has been said of the ambiguity of this language, it is needless to mention its uncouth guttural sounds, its unsusceptibility of the varieties of position, and other marks of imperfection.

THE EGYPTIAN.

This language exhibits the same defects as the Hebrew, and still greater. The Copts neither decline their nouns, nor conjugate their verbs, otherwise than by prefixing particles, sometimes of one or more syllables, and sometimes a single letter, which denote the case, gender, number, and person; several of them being joined together in one word, and the primitive word usually placed last. So that the difficulty of their language consists, in the incredible combination of the words and particles, in the change of the vowels, in transposing the middle parts of the words, and adding superfluous letters, to distinguish which requires great labour and skill.*

THE

* Wilkins, De Lingua Coptica, 1 Univers. Hist. folio, p. 226.

THE CHINESE.

Of the Chinese language, a very satisfactory account has been given, by our late accomplished and intelligent travellers, Sir George Staunton, and Mr. Barrow. The construction of this language, Mr. Barrow* tells us, is extremely simple: it admits of no inflection of termination, either in the verb, or in the noun; each word being the same invariable monosyllable, in number, gender, case, or tense. The cases they distinguish, by general abstract signs, as we do in English; which, alone, as already seen, plainly shews this could not be the original language of mankind; men never beginning by abstractions. Comparison is also made by adventitious particles; and the superlative is marked, in the same awkward manner as in Hebrew, by a repetition of the positive: the tenses of verbs, of which there are only three, are also distinguished by abstract particles. Sir George, indeed, thinks, that this language furnishes a practical proof, that the laborious structure, and intricate machinery, of the Greek and Arabic tongues, are by no means necessary, either to a complete communication on all the business of life, or even to the grace of elocution, or the harmony of verse.

 I am

* P. 264.

I am much disposed to entertain a different opinion, on each of these particulars. There are many shades and discriminations of verbs, which cannot be indicated by particles, suggesting the difference of time merely in the gross. The difference between definite and indefinite time is lost; and thus all pretensions to precision, the principal excellence, and the most necessary of all the qualifications of language, are abandoned. Indeed, of all known languages, spoken by a civilized nation, the Chinese hath the smallest pretension to precision. Every word has, at least, twenty different significations, besides the different aspirations; and these significations are only distinguished, by the difference of tone or accent; to perceive which, Sir George acknowledges, requires a nice ear, and delicate vocal powers, to render them exactly. How the grace of elocution, and the harmony of verse, can subsist, in such a confusion of discordant sounds, I am at a loss to conjecture: yet, even this contrivance is not always sufficient, to express the sense of a word; recourse must be had to the ultimate *criterion*, tracing with the finger, in the air, or otherwise, the form of the written character of the doubtful sound. Such a language is, no doubt, very simple; but so is the *Lingua Franca*, which, in many respects, resembles it, but whose perfection, I suppose, nobody will vaunt. Of this similarity, Mr. Barrow gives some examples, page 281, and Sir G. Staunton, page 418, (in 8vo.). Adam Smith justly remarks, " that the simplification of the rudiments of lan-" guages renders them more imperfect, and less proper,

" for

" for the purposes of language: for, if precision be re-
" quired, (which, indeed, the Chinese does not aim at,)
" such languages become more prolix; several words being
" necessary to express what might have been expressed by
" a single word. Thus, the words *Dei*, and *Deo*, in Latin,
" sufficiently shew, without any addition, what relation the
" object signified is understood to stand in, to the objects
" expressed by the other words in the sentence; whereas,
" in English, and other modern languages, we must em-
" ploy, at least, two words, and say, *of God, to God,*
" and sometimes four; for the single word *amavissem*, we
" must say, *I would have loved.* This prolixity evidently
" enervates the eloquence of most modern languages."
Dr. James Gregory adds, that " the moods of verbs, like
" other inflections of words, express, much better than any
" *succession* of words can do, the intimate connexion and
" relation of various thoughts, which are not successive,
" but simultaneous, or co-existent, and which appear un-
" naturally disjointed, and, in some measure altered, when
" they are expressed by a series of words, denoting each
" of them separately, and in succession."*

2dly. This simplification of the principles of languages, renders them less agreeable to the ear: the variety of termination in the Greek and Latin, occasioned by their declensions and conjugations, gives a sweetness to their language, altogether unknown to any modern language.

3dly. This

* 2 Edinb. Trans. p. 216.

3dly. This simplification not only renders the sounds of our language less agreeable to the ear, but it also restrains us from disposing the sounds in the manner that might be the most agreeable; tying down words to a particular situation, and forbidding almost every kind of inversion or transposition.

THE GREEK.

In this, and this only, most of the characters of the primeval language are found. It is perfectly original, being underived, in the opinion of the most profound antiquarian and ablest linguist of the last century,* from any other Oriental language, with the exception of a few words, borrowed from the Phœnicians, Thracians, and Scythians; and in its structure, it totally differs from all of them.

In this, the relation of nouns to each other, and of verbs to time, person, and number, are denoted in the most natural manner, and with the greatest precision and accuracy, by mere changes of, or additions to, the termination.

It is equally happy, in expressing every modification of perception, passion and emotion, which may arise in, occupy, or agitate the human mind.

The dual number, in all cases, it almost exclusively possesses. Adam Smith, from misinformation, conceived this

* Hemsterhusius; see the French translation of Herodotus, Vol. I. p. 276.

this number to exist in the Sclavonic, and in other Oriental tongues. In the Swedish it certainly exists, and in languages derived from it; as the Anglo-Saxon and Islandic: but the Swedes borrowed it from the Goths, who long resided in Thrace, and derived it from the neighbouring Macedonians, who certainly spoke a Greek dialect, though corrupt. In the Anglo-Saxon, and Islandic, the dual is retained only in the pronouns; as the great Swedish antiquarian, Ihre, assures us. He denies it to be found in the Sclavonic, or any other Oriental dialect, with which he was acquainted.

The plural number of nouns of the neuter gender, being originally considered, from their similarity to each other, as one object, admitted a construction with verbs in the singular number: a mode of construction, which was afterwards unwarrantably abused. Even animated beings, considered merely as *things*, were often expressed by neutral nouns.

Again, if we examine the degree of perfection, which the Greek attained, and still exhibits, we shall find it acknowledged, by the best judges, to exceed that which any other known language has ever reached. In proof of a fact, so well known, it is needless to accumulate authorities; one alone, of perhaps the ablest judge of the delicacies of expression, that has appeared in the last century, will be sufficient. It may easily be perceived I mean the celebrated Voltaire. Of the Greek, he thus speaks:

" The most perfect of all languages must be that, which " is, at once, the most complete, the most sonorous, the " most varied in its modes of expression, and the most " regular in its arrangement; which has most of compound " words, whose prosody best expresses the slow or impe- " tuous emotions of the mind; and whose sounds are most " musical. The Greek possesses all these advantages: it " has not the rudeness of the Latin; of which so many " words end in *um, ur, us.* It has all the pomp of the " Spanish, and all the sweetness of the Italian; and, by " its long and short syllables, it is superior, in musical " expression, to all living languages: so that, even disfi- " gured as it is, at this day, in Greece, it may still be re- " garded as the most beautiful language in the universe."

Now, if we compare the degree of excellence, which this language attained, in the earliest ages after the Flood, with the state of civilization of those who spoke it in those ages, we shall find the utmost disproportion betwixt them; the inverse of what happened in any other age or country. Homer wrote 940 years before the Christian æra, when Greece was far from being thoroughly civilized; yet, in him, it is acknowledged, the Greek language appears, as polished and refined as in Sophocles, Euripides, or even Demosthenes, who wrote in the most civilized periods. And, if we pierce higher into antiquity, we find Linus, who lived 1500 years before Christ, and 300 years before the Trojan war, and his disciple, the first Orpheus, both so much admired, that the former, in subsequent ages,

was

was thought the son of a muse; and the latter, of Apollo. Museus wrote a poem, called The Rape of Proserpine, 1400 years before Christ, according to the Parian Marbles.* Tatian, who flourished in the second century, mentions many other poets, who preceded Homer.† Nor were there barely poets, but also many historians, before Homer; as Corinnus, Dictys Cretensis, &c. who wrote immediately after the Trojan war; and, consequently, nearly 1200 years before Christ.‡ But, if we attend to the state of society, at the times of Linus and Orpheus, we shall find it highly barbarous, by the avowal of the most credible Greek historians themselves; and scarcely improved, in the age that immediately preceded the siege of Troy, and called the Heroic.

Thucydides, who wrote about 410 years before Christ, tells us,‖ that, in the earliest times, Greece enjoyed little or no repose. The various tribes, that inhabited it, had no intercourse with each other: the stronger continually expelled the weaker from the more fertile parts; these sought refuge in the territory of Attica, which, being the most barren, was, at first, thinly inhabited; but, from these new accessions, became very populous. Yet, its inhabitants did not form a political union with each other, nor had any common laws, before the reign of Cecrops, about the

* See the Appendix to Playfair's Chronology.

† Euseb. Prepart. Evang. Lib. X. cap. ii.

‡ Voss. de Hist. Græcis, Lib. IV. cap. i. p. 428.

‖ Lib. I. cap. ii. Apollodor. Lib. III.

the year 1556 before Christ.* In the ages, called Heroic, robbery and piracy were universally practised; the law of the strongest was almost the only one which they acknowledged, and openly avowed.† After the siege of Troy, almost all the cities of Greece were disturbed by seditions; and the return of the Heraclidæ, eighty years after that siege, occasioned new commotions: in so much, that many years elapsed before peace was restored.‡ This universal fermentation forced many to migrate to Asia, and join their countrymen, long established in Ionia, Æolia, and Doris: yet it was in this tempestuous period, that Homer was born and flourished. It does not appear, that any, either in that, or the preceding ages, applied themselves to the improvement of their mother tongue; neither, were it requisite, would their ignorance or circumstances permit them to effect it. When, then, did it attain, or from what source did it derive, the excellence it possessed in the most barbarous ages?

This forms a paradox, which can be solved, only, by supposing, that it originally descended to the Ionic race, from the earliest ages, in the same, or rather in a far superior degree of perfection; for, during that transmission, it, probably, contracted those defects, which may be observed in the earliest compositions that we now possess.‖

To

* 2 Goguet, 16, 17, 18.

† Thucyd. Lib. I. cap. v. Plutarch. *Theseus.*

‡ Thucyd. Lib. I. cap. xii.

‖ Mr. Mitford tells us, " no circumstance, in the history of the Grecian " people, appears more difficult to account for, even in conjecture, than the " extraordinary

To explain, more particularly, how this transmission was effected, we must recur to the information conveyed to us in the Sacred History; and to a few facts, which occur, also, in the profane.

Moses relates, that Noah had three sons, who survived the Deluge, Sem, Cham, and Japhet. Though Japhet is the last named, yet it appears that he was the eldest of the three, in the judgment of the most judicious commentators; of whom I need name no other, than Bishop Usher, and Le Clerc.

531 years after the Deluge, a multiplicity of languages was supernaturally introduced. During the period, that intervened betwixt the Flood and this event, the posterity of Noah became very numerous. Japhet had seven sons, Gomer, Magog, Madai, Javan, (or Jon,) Thubal, Mosoch, and Thiras. Javan, in whose line the Greek tongue descended, had four sons, Elisah, Tharsis, Chittim, and Dodanim.

" extraordinary superiority of form and polish, which their speech attained, " in an age beyond tradition, and in circumstances apparently most unfa- " vourable. For it was amid continual migrations, expulsions, mixtures of " various hordes, and revolutions of every kind, the most unquestionable " circumstances of early Grecian history, that was formed that language, so " simple in its analogy; of such complex art, in its composition and in- " flection; of such clearness, force, and elegance, in its contexture; and of " such singular sweetness, variety, harmony, and majesty, in its sounds. Al- " ready, in the time of Homer and Hesiod, who lived long before writing " was common, we find it in full possession of these perfections," &c. Vol. I. p. 83 and 84.

danim. Sem and Cham had also several sons and grandsons, whose names need not be mentioned; but it may not be amiss to observe, that the languages, spoken after the confusion, by the peculiar descendants of each of the three original Patriarchs, differed more widely, from those spoken by the descendants of the other two Patriarchs, than the languages, spoken by the descendants of each, differed from each other. Thus, the languages, spoken by the descendants of Japhet, differed more, from those spoken by the descendants of Sem or Cham, than the Japhetic languages did from each other. A difference, also, with each other, but in a lesser degree, betwixt the languages, spoken by the immediate descendants of each of the sons of the same Patriarch, may be observed. Thus, a difference may be observed, betwixt the languages, spoken by the sons of Gomer, and those spoken by the sons of Javan. But the difference, betwixt the languages spoken by the descendants of each of these sons, for instance, of each of the four sons of Javan, is the smallest of all; as some communication, betwixt persons so nearly connected, would be suffered to subsist. Thus, the language of the Mantchoo Tartars, descendants from Magog, is, as we are informed by Mr. Barrow, and Monsieur l'Eveque, rich, sonorous, and energetic; and more like the Greek, than any of the Oriental languages. It is alphabetic, or, more properly speaking, syllabic; and the different parts of speech are susceptible of expressing number, case, gender, time,

modes

modes of action, passion, &c. by change of termination, preposition, or interposition.*

The posterity of Javan gradually descended from the plains of Shinaar, to the opposite coasts of Lesser Asia, on the Egean sea; and, from them, the whole country was denominated *Ionia;* as Josephus attests, Antiq. Lib. I. cap. 6. But, in process of time, they grew too numerous to remain together; and, being also pressed upon by the neighbouring barbarians, they passed into many of the islands of the Egean sea, and thence into Thrace, Macedonia, Greece, and Epire. Moses expressly tells us, that the islands of the nations were peopled by them. Genesis, x. 4. And not

* Barrow's Travels in China, 270. L'Eveque, Hist. Russ. Vol. VI. p. 282. The difference of languages consists, either in the difference of *sounds,* denoting the same object; or of constitution, or of *utterance.* The same sounds may differ in *tone,* or *duration;* or in the abundance or defect of *vowels,* their arrangement and aspiration. The difference of *constitution* consists, in the various methods by which relations are indicated; namely, by abstract signs, præfixes, interposition, alteration of termination, or the order of position. The difference of *utterance* arises, from the difference of the organs by which the sounds are principally emitted; as, the guttural, the oral, and the nasal. The *oral* is either palatal, dental, sibilant, or labial. Those, that agree in the signification of a great number of words, and have a similar fundamental constitution, or nearly so, are, more or less remote, *kindred* languages, and frequently hybrid, at least, one of them is often so; as, the English and German; the French, Spanish, and Italian: the three last are certainly mixed or hybrid languages. When the radical words agree in signification, and have the same, or nearly the same constitution, but differ only in termination or utterance, they are called *dialects* of the same common language. Thus, the affinity or discrepance of languages, even their pedigree, may often be traced, even when history is silent.

not only islands, strictly so called, are to be understood by that name, but Greece itself; for, being much intersected by the sea, it was, in a loose sense, susceptible of that appellation.* Tharsis appears to have passed into Thrace,† Chittim into Macedonia. This is solidly proved by Le Clerc.‡ The author of the book of Maccabees expressly says, Alexander came from the land of Chittim, cap. i. 1. Dodanim seems to have passed into Epire.

From the invective of Alexander against Philotas,‖ one would be apt to imagine the Macedonian language was different from the Greek; but it is evident, from Philotas's reply, that the Macedonians understood it, and that Alexander himself addressed the army in Greek. It was, certainly, the language, introduced by Ptolemy into Egypt; and exclusively spoken in the court of his successors.§ However, from a mixture of several barbarian nations, the Macedonian dialect was much debased: besides, as already noticed, some difference occurred in the languages spoken by the families descended from the different sons of Javan.

The Thracians and Epirots, being still more exposed to the inroads of the neighbouring barbarians, many of whom settled among them, difficultly retained any traces of their original language; particularly the former. However, it was long retained in some parts of Thrace; as appears

by

* Greece is expressly so called, 1 Maccab. xi. 38.

† Le Clerc on Genes. x.

‡ Ibid.

‖ Quint. Curtius, Lib. VI. cap. 28.

§ 7 L'Archer's Herodot. 72.

by the poems of Orpheus and Linus, composed in Greek. Pieria and Olympus were anciently parts of Thrace,* though they were afterwards accounted to belong to Macedonia:† from the prevailing mixture of barbarians, the Thracians were deemed to be also barbarians.‡

That Epire was also inhabited by Greeks, though intermixed with many barbarian tribes, appears by Strabo,|| who tells us, the Molossi, an Epirotic tribe, were governed by kings of the race of Æacus; as was afterwards all Epire by Pyrrhus. Besides, we find the Molossi sent a colony to Ionia: now the Ionians would certainly not have received them, if they were not of Greek origin. It is true, they also received the Pelasgic Arcadians; for this reason only, that the Pelasgi were incorporated with the Arcadians, and could not be distinguished, see Herodot. Lib. I. cap. cxlvi;§ as they were, also, with the Athenians. Plin. Lib. IV. cap. i. reckons Macedonia, Epire, and Thrace, as part of Greece; and so does Homer, Iliad II. v. 635.

The descendants of Elisah, the eldest son of Javan, passed into Greece, properly so called, extending from Macedonia, on the north, to the southern extremity of Peloponnesus; and from the Eastern to the Western sea, and the adjacent islands. Thus, we see the territories of all

* Strabo, Lib. VII. p. 471.
† Ibid.
‡ Ibid. Lib. VII. p. 321.
|| Ibid. Lib. VII. p. 324.
§ See 1 l'Archer, Herod. 119, and the notes and 7 l'Archer, 221. 231.

all the sons of Jon bordered on each other; and, I believe, it generally happened, that the progeny of *each* of the original patriarchs, Japhet, Sem, and Cham, settled at a great distance, from that of the other Patriarchs; but the progeny of *each* of the sons of the *same* Patriarch, for instance of Japhet, settled at a less considerable distance from each other; and the descendants of each of the grandsons, for instance the descendants from Javan, settled at a still less distance from each other.

Elisah, in the Samaritan copy, is written *Helas*;* and from him, after some ages, for reasons we shall presently mention, the Greeks were then called *Hellenes*. The Hellenes, then, not being permanently exposed to barbarians, as the other descendants of Jon were, preserved the Greek language unmixed. Greece, before the arrival of the Hellenes, was inhabited by various barbarian tribes; as Strabo informs us from Hecateus;† of whom the most powerful were the Pelasgi, who originally dwelled in the maritime parts, afterwards called Ionia.‡ Hence, it is plain, by the testimony of a profane historian also, that the descendants of Jon passed into Greece, from the continent of Lesser Asia, after they had expelled the Pelasgi, who inhabited the coasts afterwards called Ionia. The Pelasgi, thus expelled from Ionia, passed, probably, into the country, afterwards called Attica, as being nearest to them; but this being

* See Newcome on Ezechiel, xxvii. 8.

† Lib. VII. p. 321.

‡ Strabo, Lib. XIII. 621, and Lib. V. 220, 221.

being barren, they settled, in greater numbers, in Peloponnesus, and founded the kingdoms of Sicyon and Argos: the former, 2171 years before Christ,* and the latter 1779.† Hence Ephorus, quoted by Strabo, says, Peloponnesus was anciently called Pelasgia;‡ and Æschylus, in *Supplices*, 598, 600, (or rather 327 and 350, in my edition); and Pliny, Lib. IV.

Who these Pelasgi were, it is difficult to discover: that they were originally Arcadians, I think improbable, though affirmed by Strabo. Arcadia, being a very small territory, could scarcely contain a tribe so numerous as the Pelasgi formed in these early ages: besides, it is an inland territory, and the Pelasgi always chose to inhabit the sea coasts; and hence, the part of Peloponnesus, which they inhabited, was often called Ægialea. Strabo, Lib. VIII. p. 384. It seems more probable, that they were the descendants of Chanaan, the son of Cham; and were those, who, as Herodotus relates, after wandering to the Red sea, settled at last in Phœnicia,|| Herodot. Lib. I. p. 1; whence they sent colonies into Greece, and the adjacent islands. He also says, Lib. II. §. 51, that, from the island of Samothrace, they

* 3 Jacks. 306; or 2164, according to 7 l'Archer's Herodot.; a very near agreement.

† 3 Jacks. 310 and 313; according to l'Archer, 1986 before Christ.

‡ Lib. V. 221.

|| But the expedition, which he mentions, must have happened long after the settlement of the Pelasgi in Argos. See l'Archer's note thereon.

they pasesd into Attica. Now, Sanchoniatho informs us, that the Samothracians derived their origin from Sydoc, a Phœnician divinity:* that is, a divinised Phœnician. It is also certain, from Herodot. Lib. I. §. 57, that they spoke a barbarian language; and were barbarians, §. 58: were the most ancient inhabitants of Greece, Strabo, Lib. VII. 327: and had spread over all Greece, Ibid, Lib. V. 220. Their language, however, was not the Phœnician; else Herodotus would not have been at a loss to discover what it was; nor would Cadmus have expelled them from Bœotia. Hence, the conjecture of the very learned General Vallancey, that they were an Indo-Scythian nation, is not destitute of probability; and is supported by many respectable authorities.

The descendants of Hellas, who afterwards occupied all Greece, except Etolia and Acarnania, seem first to have landed in Attica, being the nearest part of the continent; and, from the name of their particular ancestor, they bestowed, on the interjacent rocky and deserted island, the name *Helene*. It is mentioned by Strabo, Lib. IX. 612, and Pausanias, p. 85: but the Greeks themselves could not know the reason of that appellation. On landing, they found the country inhabited, though thinly, on account of its barrenness, by two Pelasgian tribes, the Aones, and the Temnices. Many of these fled to the southern promontory of Sunium, where they are noticed by Strabo, p. 615; but

* Euseb. Prepar. Evang. Lib. I. cap. x. p. 36.

but many still remained, who submitted to the Hellenes, and were incorporated with them. The territory they thus possessed, they called *Ionia;* in memory of their primitive ancestor, and not from Jon, the son of Xuthus; as the Greeks themselves, in after ages, falsely imagined. Thus the testimonies of Herodotus and Strabo should be understood, consistently with each other, and with that of Josephus.

Herodotus, Lib. VIII. §. 44, tells us, that when the Pelasgi possessed the country, now called Greece, the Athenians (that is, the inhabitants of Attica) were Pelasgi; and were called Craneans, (from the roughness of the country); and Cecropidæ, under the reign of Cecrops; and Erechtheidæ, under that of Erechtheus; and from Jon, the general of their forces, they assumed the name of Ionians. And Strabo, Lib. IX. 608, adds, that Attica was called Mopsopia, from a great grandson of Cranaus. But these names were given only by poets; as Kuhnius has well remarked, in his notes on this passage. Thus, the Romans were called Romulidæ, by Virgil, Æneid VIII. 638: but this could not be called their general appellation. Mopsopus must have lived under Erectheus the second: he never reigned in Attica, never performed any memorable action, and was cotemporary with Jon. His name, therefore, could never be given to the country, but by poets.

Again, Herodotus, Lib. I. §. 56, says, the principal nations of Greece were, the Lacedemonians and Athenians; the one, among the Dorians, and the other, among the

 Ionians;

Ionians; the one Pelasgic, the other Hellenic: the former never quitted the country it first settled in; the latter frequently did. And, §. 57, he says, "the Pelasgi spoke a "barbarian language; and, that being so, that it follows, "that the Athenians, originally Pelasgi, forgot their own "language, when they became Hellenes, and learned that "of the Hellenes." If this account be understood of those, whom Herodotus called Hellenes, it is evidently false: those, which he called Hellenes, were inhabitants of Phthiotis, in Thessaly; as he himself declares. Now these not only never conquered, but did not even attack, nor enter into Attica How, then, in his sense, could the Pelasgi of Attica become Hellenes, and forget their own language? That the Pelasgic inhabitants of Attica did, however, become Hellenes, is true; but it was by mixing, and being incorporated with the Ionic Hellenes, as above stated. It is also plain, that these Ionic Hellenes were much more numerous than the Pelasgi, with whom they were incorporated; otherwise their language would not have prevailed: yet, both together could not amount to any considerable number; since, upwards of 180 years after the arrival of the Ionians, the joint population did not exceed 20,000.* Herodotus further adds, §. 58, that, in his opinion, the Hellenes always spoke the same language, from their very origin; and, that though they were, at first, few and weak, when considered apart from the Pelasgi,

* See the authors, quoted by Goguet, Vol. II. p. 20, English.

lasgi, they, afterwards, by incorporating several barbarian tribes, became as considerable as many other nations: and, that for this, among many other reasons, the Pelasgi, who were barbarians, never became considerable: probably, as Mr. l'Archer remarks, because they never adopted any other tribe. From this passage, I think, it may also be inferred, that the Hellenic or Greek language never received any improvement, from the time of the first Ionic descent.

A very learned and judicious translator of Herodotus thinks, that, if Attica had been originally possessed by the Pelasgi, it would have been called *Pelasgia;* as Peloponnesus had been. And, probably, it would, if the Pelasgi had been equally powerful there; and had retained the possession of it, as long as they did of Sicyon and Argos: but most of them had been expelled from Attica, in the earliest age to which history reaches. He thinks, also, that the Aones and Temnices were not Pelasgi: but, may not they have been Pelasgic tribes? Strabo tells us, there were many tribes of them, p. 921; and quotes Homer's 2d Iliad, v. 840. And, are we not bound to think them Pelasgi, by the express testimony of Herodotus, uncontradicted by any ancient historian? The learned translator thinks Ogyges to have been king of the Aones and Temnices; and to have fled with them, into Bœotia, at the time of the flood, which bears his name, 7 l'Archer, 270. If so, he must have reigned in Attica, at the time that the Aones and Temnices possessed it; and, consequently,

quently, before the arrival of the Ionians in Attica. Yet, I am rather disposed to think, that he was an Ionian king; and that this Flood happened after the Ionian descent; for the Athenians celebrated the anniversary of that inundation for many centuries; as Plutarch informs us, in his Life of Sylla.* Now, it does not appear likely, that they would commemorate an event, that happened in that country before they arrived in, and inhabited it. Nor would they claim a barbarian king, as Ogyges must have been, if he reigned only over the Aones and Temnices: for these are expressly called barbarians,† by Strabo, Lib. IX. 615. Nay, Africanus, in Euseb. Prepar. Evang. 488, expressly calls him a native Athenian, that is, Ionian.

I shall now continue to establish the Ionian origin of the Athenians particularly, and, generally, of all the Greeks; not denying, that several barbarian tribes were incorporated with them.

Strabo, Lib. VIII. 513, tells us, there were as many Grecian tribes as there were varieties of Greek dialects; and, that of these, the ancient Attic was the same as the Ionic: for, that the ancient inhabitants of Attica were called Ionians; from whom sprung the Ionians, who afterwards settled in Asia: and, that the Doric was the same as the Æolic. Now, let it not be said, the inhabitants of Attica were called Ionians, from Jon, the son of Xuthus; as

* Vol. IV. p. 148, English.

† That is, they spoke a different language from the Greek.

as Herodotus, who lived about 1000 years after this Jon, and most other subsequent heathen historians, were led to imagine; for such a compliment, as the adoption of a name, derived from that of an individual, was never paid but to kings, or the first settlers in a country. Now Jon, though general of the Athenian forces, never reigned over Attica;* nor is he mentioned in the list of Athenian kings, given by Pausanias, Attic. p. 7; nor in the more accurate series, collected by l'Archer, Vol. VII. p. 293. Foreigners seem to have been better acquainted with the origin of the Greeks. Thus, the Persian Queen, Atossa, calls all Greece, and not the Athenians in particular, Ιανων γεν, Æschylus, Persæ, v. 154. The old scholiast, on the Acarnenses of Aristophanes, says, that the Thracians, Bœotians, and Achæans, were called Ionians: and so does Hesychius, in voce Ιων. For the Thracians, also, were, prior to their mixture with a multitude of barbarians, descendants from Jon or Javan, as already seen. Hence, the Athenians boasted, that their community was the most ancient of all the Greek communities; and, that they had never abandoned the territory in which they first settled, Herod. Lib. VII. §. 161: that is, they never voluntarily quitted it, nor were expelled by force. But they sent out several colonies; and were, for some time, expelled, by a natural convulsion.

* Conon, indeed, in Photius, p. 438, says, that Jon reigned in Attica: but he is contradicted by the whole series of events of Jon's life; and, at least, by implication, by all other historians.

sion. And, Lib. I. §. 143, he calls Athens an Ionian city. He adds, indeed, that the Athenians (in after times, namely, in that of Cyrus) were ashamed of being called Ionians. If this be true, it was, evidently, on account of the weak state of the Ionian colonies, in the reign of Cyrus: but Plutarch, in his treatise on the malignity of Herodotus, §. 21, absolutely denies it. It must, also, be remembered, that Herodotus was a Dorian; a tribe always jealous of the Athenians. He owns, that several, if not most of the Ionian colonies, gloried in that name.

We may date the arrival of the Ionians in Attica, from the reign of Ogyges, who was, probably, their leader, and began his reign 1796 years before the Christian æra, see 7 l'Archer's Herodotus; that is, 848 years after the confusion of languages, and the dispersion of mankind; 374 years after the commencement of the Pelasgic kingdom of Sicyon, under Ægialeus; 176 years after the commencement of another Pelasgic kingdom, in Argos, by Inachus. Thus, we see the Pelasgi, after their expulsion from Ionia, had sufficient time to spread themselves all over Greece, before the arrival of Ogyges. About thirty-seven years after his arrival, that is, about the year 1759 before Christ, he was obliged to quit Attica, by that great inundation, which still bears his name; occasioned, most probably, by the rupture of the isthmus, which separated the Black sea from the Mediterranean; whose efflux, and reaction, were felt on the shores of Asia Minor, and Attica. He, his subjects, and his neighbours, the Aones and Temnices, fled

fled for refuge to Bœotia. This we may infer, (for I find no express proof of it,) from Bœotia having been anciently called Ogygia. And, as Ogyges had, in Attica, built the city of Eleusis, Euseb. Prepar. Evang. 489, so, in Bœotia, there were cities, called Athens, and Elusis, in the age of Cecrops, which were destroyed by a subsequent inundation, Strabo, 624, Pausan. 756: and, in Thebes, there was a gate called Ogygia, Pausan. 728. Now Philocorus, an ancient historian, who flourished in the reign of Antigonus, king of Macedonia, denies, that any king reigned in Attica, for 189 years after this deluge; and tells us, that it remained waste, until the reign of Cecrops, Euseb. Prepar. Evang. 490. Since, therefore, Ogyges survived this deluge, and did not reign after it in Attica, but left so many marks of his presence in Bœotia, it naturally follows, that he remained and reigned there, as long as he lived. That he survived the deluge, is affirmed by Eusebius, in his chronicle.

During the time that Ogyges reigned in Attica, and while he remained in Bœotia, and before the return of the greater part of his colony to the Athenian territory, that is, during 226 years, we may conclude, that many Ionian families settled in Locris and Phocis; as we find them in those regions after that interval.

Such, also, of the descendants of Jon, as settled in Epire, being pressed by the barbarians behind them, during this interval, passed into Acarnania and Etolia. Pliny expressly tells us, that Etolia was peopled by the Athamanes,

manes, Lib. IV. c. vii; and these, according to Strabo, p. 495, were Epirots. Thus, the Ionic language was introduced into the eastern and western regions of Greece without the isthmus.

Of the successors of Ogyges, in Bœotia, until the reign of Cecrops, an. 1582 before Christ,* we have no account. According to Strabo, p. 624, he reigned in Bœotia: and, as he led back the Athenians, or the greater part of them, into Attica, he is generally esteemed the first king of Athens. It has been said, indeed, that he married *Acte*, the daughter of Acteus, king of Athens, Pausan. 7; but this Philocorus affirms to be a fiction. Some say he was an Egyptian. It is highly probable, that he travelled into Egypt; but not that he was an Egyptian; for Euseb. Prepar. Evang. Lib X. c. x, expressly says, he was a native Athenian; and so does Apollodorus, Lib. III. c. xiii. He was said to be of a double nature; probably, because he spoke both the Greek and Egyptian languages.

During his reign, two remarkable events occurred; namely, the conquest of Thessaly, by Deucalion, an. 1541; and the inundation, by which it was laid waste, an. 1529, commonly called Deucalion's Flood.

Deucalion was the son of Prometheus,† who was said to have come from Mount Caucasus; but, probably, rather from

* The dates, in the sequel, are to be understood of years preceding the Christian æra; and, generally, taken from l'Archer's edition of Herodotus, Vol. VII.

† Dionys. Halicar. p. 14.

from Caucasium, in the island of Chios; a port, mentioned by Herodotus, Lib. V. §. 53, and, consequently, an Ionian: for the Chians were admitted into the Ionian assemblies, as Pausanias attests, p. 532; though he admits, that he was ignorant of the reason. But Apollodorus, Lib. III. c. xiii. §. 6, expressly says, he was a native Athenian. It is certain, the name, *Prometheus*, was well known in Athens; for Codrus had a son, called Prometheus, Pausan. 528. Hence, it follows, that Deucalion was also an Athenian. He fled to Athens, during the flood, Parian Marbles, epoch 4, and, probably, remained there; for he died, and was buried there. Pausan. 43.

Thessaly was, when invaded by Deucalion, possessed by the Pelasgi, who came from Peloponnesus, an. 1727, conducted by Acheus, Phthius, and Pelasgus; from whom three districts of Thessaly were named, Dionys. Halicar. p. 14. These Deucalion expelled, an. 1541, at the head of an army, composed of Leleges, Curetes, and a multitude of the inhabitants of the foot of Parnassus. The *Curetes* were Etolians; so called from Curium, a city of Etolia, Strabo, 657, 692. The *Leleges*, Strabo deems a collection of various tribes of Leucadians and Bœotians, who settled in Locris, and joined Deucalion, p. 495, 496, and were afterwards called Locrians, Dionys. Halicar. 14. The inhabitants of the foot of Parnassus must have been Phocians. Hence, I conclude, that both Deucalion, and his army, were Ionians, and mostly Hellenes; and thus the Hellenic language supplanted the Pelasgic, in Thessaly.

Deucalion reigned over all Thessaly, and inhabited Cyne, a city of Locris, Strabo, 660, 651: he had two sons, Amphyction, and Hellen. Amphyction reigned over that part of Thessaly, that lay near Thermopylæ, Par. Marbles, and Pausan. 815; and Hellen, over that part called Phthiotis, Strabo, 587. Amphyction is celebrated for having formed a council, consisting of deputies from all the Grecian states or communities, existing in his time; that is, according to the Parian Marbles, an. 1521. These were, the

Ionians,	Phthiotæ,	
Dolopes,	Dorians,	
*Thessalians,	Malienses,	Pausan. 815.
Ænians,	Phocians,	
Magnetes,	Locri Epicmenides,	

This account of the different states, represented in the Amphyctionic council, is of much importance to our present enquiry; for by it we find,

1st, That the tribes therein mentioned, and they alone, formed the really Greek population, at that period; to the exclusion of the Peloponnesians, who were then Pelasgi or Danai; and of the Bœotians, who were Cadmeans.

2dly, That the Athenians were then called *Ionians;* and, consequently, could not have been so called from Jon, the grandson of Hellen, (as Herodot. Lib. VIII. §. 44, and most of the Greek historians, imagined; not knowing the true reason of that denomination;) for Jon was not

then

* From Thessaliotitis, a district of Thessaly. See l'Archer, 564.

then born. Yet, to this reasoning, many would, perhaps, object, that the Dorians are here mentioned; who, according to Strabo, 587, were so called, from Dorus, a son of Hellen; who, nevertheless, was not then born. But Strabo was mistaken; for Andro, an earlier historian, whom he quotes, p. 729, says, they anciently inhabited a district of Thessaly, called *Doris;* whence they came to Parnassus, where Dorus settled, and governed them: and hence they were called Dorians; not from him, but from the territory they inhabited, afterwards called Hestiotis.

3dly. We may remark, that the Hellenes are not even mentioned, as forming a separate tribe from the rest; as Herodot. Lib. I. §. 56, asserts: for, if such a tribe then existed, it could not fail of being enumerated with the other tribes. He is, therefore, mistaken, in representing them as a distinct tribe, inhabiting Phthiotis, in the reign of Deucalion. In one sense, it is true, all the Greek tribes might, and probably were, even then, called Hellenes; as the greater part of them descended from Hellas, the son of Javan, as already mentioned. But of this Herodotus was ignorant:* as was also Thucydides, Lib. I. §. 3, who imagined the Hellenes derived their name from Hellen, the son of Deucalion: and also Pausan. 262, who thought all Greece was called *Hellas,* from an inconsiderable

* Yet, of this, the ancient Greeks seemed to have some suspicion; for, Conon informs us, some thought Hellen to be a son of Jupiter Photius, 438; that is, a person of illustrious but unknown birth.

rable district of that name; so called from Hellen, who built a city, to which it was annexed; but which was, soon after, deserted by Hellen himself, the inhabitants removing to Melitæa, Strabo, 660. Hence, no other reason, for comprehending all the Greeks, under the name of Hellenes, can be given but that which I have assigned.

Thucydides, Lib. I. §. 3, says, the Greeks were comprehended under no common denomination, even so late as the days of Homer. Yet, it is certain, that all the inhabitants of Greece, without the isthmus, were called Hellenes, before the Trojan war, or shortly after: for Homer, speaking of Ulysses, says, *whose fame was spread all over Hellas and Argos*, Odyss. Lib. I. v. 344. Here Peloponnesus, which was anciently called Argos, is distinguished from all the rest of Greece; and not merely from the inconsiderable territory of Hellas. It also appears, by the 2d Iliad, v. 683, (831, English,) that the town of Hellas was repeopled before the Trojan war: for Homer distinguishes the inhabitants of Hellas from those of Phthia,

And *Hellas, blest*
With female beauty far above the rest.

Strabo, also, p. 568, shews, that Hesiod, at least as ancient as Homer, comprehended all the Greeks, under the name Hellenes.

The Enians, Magnetes, Dolopes, and Malienses, were Thessalian tribes. See 8 l'Archer, under those names. The two first were afterwards called Eolians, Pausan. 508.

Hellen

Hellen had three sons, Eolus, his eldest, Dorus, and Xuthus; by whose migrations or conquests, or those of their posterity, the Greek language was propagated into Peloponnesus and Bœotia.

To Eolus, Hellen left that part of Thessaly, which he governed: to Dorus, he assigned a certain portion of his subjects, to form a new settlement: Xuthus, the youngest, passed into Attica, where he married Creusa, the daughter of Erectheus, king of Athens. Dorus led his people to the foot of Parnassus, and founded three cities, Conon in Photius, 438. Yet, Herodotus says, he reigned in that part of Thessaly, called Hæstiotis; but he probably meant, that Dorus reigned over the the people of that district; whom, according to Conon, he led to the foot of Parnassus. Now Parnassus is a mountain of Phocis. Thus his account may, in some measure, be reconciled with that of Conon; who expressly says, that Dorus led his colony out of the dominion of Hellen, and settled at the foot of Parnassus; and Strabo, 587, agrees with him. But both are mistaken, as I have already shewn, in thinking, that from Dorus they received the name of Dorians.

How the Greek language penetrated into Peloponnesus, and gradually supplanted the Pelasgic, I shall now shew.

Xuthus, the youngest son of Hellen, had two sons, Acheus and Jon. Acheus having committed an involuntary homicide, was obliged to fly from Attica, and took refuge in Laconia in Peloponnesus, Strabo, 588, about the year 1407. He there built four cities, Conon in Photius,

tius, 438. It is then plain, that he was accompanied or followed by a number of Athenians. The inhabitants, from him, were called Achæans; and the country, Achaia. Laconia was the most southern part of Peloponnesus; having the Laconic gulph on the south, Arcadia on the north, the Argolic gulph on the east, and Messenia on the west.

Shortly after, namely, in 1406, Attica, being over-stocked with inhabitants, Jon, the younger brother of Acheus, led a considerable colony of Athenians into that part of Peloponnesus, then called Egialea, which bordered on the Corinthian gulph; and, at that time, subject to a Pelasgic king, called Silinous. This prince, to avoid hostilities, gave him his daughter in marriage, and appointed him his heir. In effect, Jon succeeded him, established his colony, and called the country Ionia, Strabo, 588. Pausan. 522. An. 1404. Acheus, collecting his forces, from Egialea and Attica, passed into Thessaly, and recovered the share, which his father Xuthus should have possessed, Pausan. 521.

Eolus, the eldest son of Hellen, had several sons; one only of whom need here be mentioned, namely, Salmoneus, who reigned in Thessaly, Diodor. 397, Apollodorus, Lib. I. cap. vii. §. 24. Being probably disturbed, by the invasion of Acheus, he passed, with a great number of Eolians, into Elis, in Peloponnesus; and possessed himself of a considerable part of it, on the banks of the river Alpheus, and built the city Salmonea, 1 Diodor. 312. He

was

was received there the more readily, as Elis was peopled from Etolia, and its first king, Ethiolus, was a son of a daughter of Deucalion, Pausan. 375.

Sicyon was, for many ages, governed by Pelasgic kings; but, after the death of Corax, Epopeus, a Thessalian, succeeded him. His son, Laomedon, married Pheno, daughter of Clytius, an Athenian; and also assumed an Athenian, called Sicyon, a grandson of Erectheus, king of Athens, as his partner in the kingdom, gave him his daughter in marriage, and named him his successor. From him, that territory, before called Egialea, was called Sicyon. After him, Janiscus, also an Athenian, reigned: thus the Hellenic language became predominant. Pausan. 124, 125.

About the year 1374, Archander and Arciteles, sons of Acheus, passed from Phthiotis to Argos, and married two daughters of Danaus the second, who then reigned at Argos: by them, in memory of their father, both Argos and Lacedemon were called Achaia. Pausan. 522.

Not long after, that is, about the year 1362, Pelops, a native of Sipyle, a town on the confines of Phrygia and Lydia, came, with large treasures, into Peloponnesus, Thucyd, Lib. I. cap. ix. hired a body of Acheans from Phthiotis; which, at that time, was also called Achaia. Strabo, 561. By marriage with Hippodamia, the daughter of Oenomaus, he became master of Pisa, in Elis; and afterwards of Olympia. Pausan. 376. 1 Diodor. 317. His son, Atreus, obtained the kingdom of Mycenæ; and his grandson,

 Agamemnon,

Agamemnon, became still more considerable: thus the Hellenic language made a further progress.

Arcadia was originally peopled by the Pelasgi; and anciently called Pelasgia. Pausan. 598, 599. How the Hellenic language was introduced into it, does not clearly appear. It is certain, it was not by the introduction of strangers; for Pausan. 375, tells us, it was from its very origin, inhabited by the same people. It is probable then, since it certainly adopted that language, that, being a very small territory, and surrounded by people who spoke that language, its inhabitants gradually acquired it; as the people of Savoy did the French. Even if the account, given by some writers, of its conquest, by Arcas, the son of Orchomenus, were true; yet, as this event is said to have happened 1834 years before Christ; that is, forty-four years before the arrival of Ogyges, and, consequently, when the Pelasgic language was spoken all over Greece, the difficulty of explaining, how it was supplanted by the Greek, would still remain.

The Greek language was introduced into Bœotia, at a much later period than into any other part of Greece. After the return of Cecrops into Attica, the Aones, Hyantes, and other mixed barbarian tribes, remained in Bœotia, until the arrival of Cadmus, in 1549, with a Phœnician colony. After some resistance, he obtained the entire possession of that country, and called it Cadmeia. Strabo, 615. However, after the lapse of many years, the descendants of Hellen, as appears by Diodorus, obtained

a part

a part of it: for Eolus, the son of Hellen, had several sons, as already mentioned. One of them, called Mimas, remained in Eolis, and had a son, called Hippotes; whose son, Eolus the second, had a daughter, called Arne; and she had a son, called Beotus. This Beotus, with a number of Eolians, invaded Cadmeia; possessed himself of a part of it, and called it Bœotia. Diodor. 311. From these descended those Bœotians, who assisted the Greeks in the Trojan war. Diodor. 312. Thucyd. Lib. I. cap. xii. But the Phœnicians continued to occupy the greater part of Bœotia, until the war with the Epigoni, an. 1307, Strabo, 615; at the conclusion of which, Thebes was taken, the inhabitants forced to fly into Illyria, and an Argive colony settled there; who transferred the government to Thersander, the son of Polynices, by an Argive princess. Pausan. 722. At this time, and for upwards of a century after, the Ionic dialect, and no other, was spoken all over Greece. Pausan. 199, expressly tells us, that, before the return of the Heraclidæ to Peloponnesus, with an army of Dorians, the Argives spoke the same dialect as the Athenians; that is, until eighty years after the destruction of Troy. Thucyd. Lib. I. cap. xii. Now it is well known, that the ancient Attic dialect was the same as the Ionic. Strabo, 513.

Thus I have proved, that the primeval language was introduced into Greece, by the Ionians, who inhabited Attica; and shewn how, from them, it was extended to the different regions that composed it.

 It

It were difficult, however, if not impossible, to conceive how an entire language, and, particularly, one so perfect as the Greek, could subsist, among a people so rude and unsettled as the early Greeks, and who had so little peaceful intercourse with each other, if not committed to writing, and preserved in books, composed long before their lapsing into a state so unfavourable to literature. And, accordingly, we do find, that such books existed in the earliest ages. Diodorus, Lib. V. p. 376, tells us, that several literary monuments existed in Greece, which were lost by a great inundation, probably, that of Ogyges, by which Attica was laid waste; and from which he fled, with precipitation, into Bœotia.* But many may have been saved; and, certainly, some existed, in the age of Cecrops: for Tacitus, Lib. XI. Annal. c. xiv. says, that many attributed the invention of letters to him; which could not be, if books did not exist in his time.† It appears, also, from Diodorus's account, that these literary monuments existed, at the time of the inundation, in Attica only; and not in those parts inhabited by the Pelasgi: for he tells us, that the Egyptians, claiming to themselves the invention of the astronomical science, the Greeks had nothing to reply. Now, as the inundation reached no other part of Greece but Attica, they could have replied, if any astronomical books had existed in the parts inhabited by the Pelasgi. We

* Mount Helicon was a very proper place of refuge.

† If we credit Cedrenus, p. 81, Deucalion wrote a history of the flood; namely, that which happened in his time.

We have, also, strong reasons to presume, that the Ionians, on the continent, had books, previous to the arrival of Ogyges in Greece. Where else could those astronomical observations be made, or those treatises composed, which the inundation swept away? That the letters they used, were the most ancient known in Greece, appears by several testimonies. Tacitus tells us, Annal. Lib. XI. c. xiv. that the Latin letters were formed as were the most ancient letters in Greece; *formæ literis Latinis quæ veterrimis Græcorum:* and, Pliny tells us, these forms were the Ionic; *gentium consensus tacitus primus omnium conspiravit, ut Ionum literis uterentur; veteres Græcas fuisse, easdem pæne quæ nunc Latinæ.* Histor. Natur. Lib. VII. c. lvii. and lviii.

Mr. Astle, than whom no man penetrated deeper into this subject, tells us, p. 56, of his treatise on the Origin of Writing, that, " after the Romans had established the " use of the Ionic letters, they seem not to have acknow- " ledged the Pelasgic and Etruscan to have been Greek " alphabets. The most learned of them knew none older " than the Ionic; as appears, by the Greek Farnese in- " scriptions of Herodes Atticus.* This learned man, out " of a sacred regard to antiquity, caused the oldest ortho- " graphy to be observed in the writing; and the letters to " be delineated after the most antique forms that could " be found; and they are, plainly, no other than the Ionic, " or right-handed characters." But we shall presently see, that the Pelasgic and Ionic letters were nearly the same.

It

* He was prefect of Asia, A. D. 97.

It has been long and very generally held, on the authority of Herodotus, Lib. V. §. 58, that the Greeks were unacquainted with letters, before the arrival of Cadmus, an. 1549; but Mr. l'Archer has well shewn, that the text of Herodotus, on which that opinion is principally founded, has been misunderstood; and that Herodotus does not say, that *letters* were brought into Greece by Cadmus, but only *some letters*, 4 l'Archer, 254. Cadmus introduced only three letters, *Zeta*, *Theta*, and *Chi;* which, for the facility of arithmetical calculation, (best understood by the Phœnicians, a commercial people,) were generally received.

Diodorus also, Lib. V. §. 57, says, that it was believed that Cadmus first brought letters into Greece: but, §. 74, he says, that the Phœnicians were not the inventors, but barely changed their form.

Many have also supposed, that the Pelasgic letters were the first known in Greece, and more ancient than the Ionic: but this is evidently a mistake; for Pliny, Lib. VII. cap. lvi. tells us, that the Pelasgi introduced letters into Latium. And, in the two following chapters, he tells us, that the Latin letters were nearly the same as the most ancient Greek, and were the Ionic: which is confirmed by Tacitus, and Herodes Atticus.

These Pelasgi were either those, who, according to Dionys. Halicarnass. Lib. I. §. 18, being expelled from Thessaly, by Deucalion, passed soon after into Italy, an. 1539; or those that followed Evander, from Arcadia, into Italy, an. 1330; or under Œnotrus, also from Arcadia, at a much

earlier

earlier period, an. 1837. Dionys. Halicar. Lib. I. §. 11. However that may be, it is plain, the Pelasgic and Ionic were nearly the same.

Dionysius expressly says, the colony, conducted by Evander, brought letters into Italy, Lib. I. §. 31, 33; and this I think the most probable opinion.

The Pelasgi occupying, in the earliest ages, the greatest part of Greece, the letters they used, though the same as the Ionians also used, were more generally known under the name of Pelasgic. Hence it is, that Orpheus and Linus are said, by Diodorus, Lib. III. §. 66, p. 236, to have written their poems in Pelasgic letters. But he confounds the first Orpheus, who, according to Solinus, p. 718 and 719, lived eleven generations before the Trojan war; and, consequently, in the year before Christ 1633, with Orpheus, the Argonaut.

The elder Orpheus then wrote long before the arrival of Cadmus in Greece: for the proof of this I refer to Mr. Jackson, who, in the third volume of his Chronological Antiquities, p. 138, has treated this subject very fully.

Mr. l'Archer, also, in the fourth volume, p. 256, of his translation of Herodotus, has shewn, that the Pelasgic, and ancient Attic letters, were the same; though he acknowledges, that he is at a loss to account for their identity, or how they were introduced into Attica; not noticing the Ionic descent of the Athenians. Herodotus, Lib. V. §. 58, expressly tells us, that the Ionians of old had books, written on parchment, called *Dipththeræ*.

Lastly,

Lastly, the etymology of antediluvian names is as easily found in the Greek, as either in the Hebrew, Syriac, or Arabic; or even more easily. Thus, *Adam* is derived from Αττα, *pater; Eve*, (or rather Cheva, as Dathe has it,) from Εχευα, *peperi; Cain*, from Καινος, *novus*, being a new man; *Abel*, from Αβαλε, alas; *Seth*, from Ζητεω, *quæro*, being sought for, in the room of Abel; *Noah*, from Ναυς, a ship. Tubal Cain I omit; as this name was given to a remote descendant of Cain, long after his banishment; and, consequently, when the primitive tongue was probably altered. *Babel*, from Βαλβις, a starting-post; as it was from thence all mankind set out, to settle in different countries. The Hebrew, which is said to contain the roots of many languages, did nothing more, than strip some primeval words of their terminations, and thus disfigured them.

ANTIQUITIES.

ON THE

ORIGIN OF ROMANTIC FABLING IN IRELAND.

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TO trace the origin of romantic fabling, in modern Europe, would be a curious, and, perhaps, not a fruitless enquiry. In proportion as the literary treasures of the East shall be opened and displayed, the means of acquiring information, on this interesting subject, will, probably, be increased. It would seem, that the magicians, knights, and damsels, with which Fairy-land is peopled, owed their birth, to the warm fancy of the Oriental romance-writers. Through what channels, the fictions of the East found their way into Europe, may be conjectured, but cannot be positively determined. To the time of the Crusades, their introduction is generally referred. I think, however, that the commercial intercourse, which formerly subsisted, between the Levant, and some of the principal Italian states, opened a channel, equally wide, and certainly more secure. The tumultuous crowd, that rushed to the rescue of the Holy Sepulchre, had not, probably, either leisure or inclination for mental gratifications. In the acquisition of spoils, they seem to have rather exercised their prowess, than their taste. But, we will not weary ourselves with conjecture, in regard to the medium, through which those fictions flowed into Europe; it is enough, for our present purpose, that we not only find them there, during the middle ages, but can trace them, in some of the popular romances of that period. Ariosto supplies us with an instance in point. The story of Schariar and his brother, in the Arabian Nights Entertainments, evidently appears to have laid the foundation for the well-known tale of Astolpho and Jocundo, in Canto XXVIII. of the Orlando Furioso.* I am, I will confess, inclined to consider Italy, as the great emporium of the fictions under consideration. And as the monks of that delightful region, as well as those of France, occasionally relaxed from their severer studies, in excursions to Fairy-land, the Oriental fictions might, through their means, have spread to the neighbouring countries. Some of the early romances, as well as the legends of saints, were undoubtedly fabricated, in the deep silence of the cloister.† Both frequently sprung from the warmth of fancy, which religious seclusion

* Hole's Arthur, pref. p. viii.

† Vid. Ritson's Dissertation on Romance and Minstrelsy, prefixed to Ancient English Metrical Romances, Vol. I. See, also, the elegant and accurate Mr. Ellis's Historical Sketch of the Rise and Progress of the English Poetry and Language, prefixed to Specimens of the Early English Poets.

sion is so well calculated to nourish; but the former were adorned with foreign embellishments.

While the See of Rome was fostering, with anxious solicitude, the Catholic church in Ireland, missionaries were occasionally sent, from the several monastic foundations on the Continent, to regulate the ritual; and, at the same time, to invigorate superstition, by furnishing fresh supplies of holy legends. Amongst these, it may be presumed, some of the profane romances, fabricated in the Continental cloisters, were introduced (perhaps we might say smuggled) into this country. And, as the brilliant fictions of the East were the elements, of which those romances were chiefly composed, they thus obtained a footing in Ireland, and furnished materials for the metrical tales of our early bards.* To the stock of materials thus supplied, were, probably,

* Availing myself of the privilege of a note, I shall embrace this occasion, to observe, that the splendour of the provincial Irish courts, at a very remote period, which strikes and astonishes us, in some of our historians, (particularly Keating,) borrowed, in all probability, a good deal of their lustre, from the romances alluded to in the text. Wanting the assistance of authentic documents, our historians have been tempted to fill up the void, with materials, drawn from the historical tales of the bards; and have thus been unconsciously led to ascribe, to the ancient Irish, the customs and manners of the East; forgetting they were only employed by the bards as poetical embellishments. Hence, the romantic air, which our early history wears.—I hope my candour, on this occasion, will not be mistaken for retraction. Although my crude productions, on the subjects of the history and antiquities of Ireland, glow with all the warmth of youthful enthusiasm, it will not, I trust, be found, that I was led into wilful misrepresentation. I may have inadvertently erred; but my authorities are before the public.

probably, added many Moorish and Arabian fables, and Spanish Historias de Cavallerias, which might have found their way to the western coast of this island, by means of the commercial intercourse, which subsisted so early, and so long, between Spain and Galway.*

" A very gallant gentleman, of the North of Ireland," (says Sir William Temple,) " has told me, of his own ex-" perience, that, in his wolf-huntings there, when he used to " be abroad in the mountains three or four days together, " and lay very ill a-nights, so as he could not well sleep, " they would bring him one of the tale-tellers, that, when " he lay down, would begin a story of a king, or a gyant, " a dwarf, and a damsel, and such rambling stuff; and " continue it all night long, in such an even tone, that " you heard it going on whenever you awaked."† Now, as giants, dwarfs, and damsels, are topics, in which the Eastern romances are very conversant, we can be at no loss to discover the source, whence they flowed into Ireland,‡ though

* The Irish prose romances of the middle ages, seem, in general, to have been constructed, on the Spanish model: at least, such of them, as have met my observation, were interspersed with poetical pieces, like the Historia de las Civiles Guerras de Granada.

† Miscel. Essay IV.

‡ Pharroh, (or, as the name was sometimes written, Forroch or Ferragh,) a giant, evidently of Eastern extraction, was the subject of a war-song, in use amongst the Irish kerns; and a name of terror in the armies of the early Irish. Historical Memoirs of the Irish Bards, p. 96. It is a curious fact, that we find a Sir Ferragh among the knights of Ariosto; who, certainly, cannot be suspected of having borrowed, either the name or the hero, from the Irish bards.

though we cannot determine, with certainty, the medium through which they passed. But I shall now proceed to adduce a few instances, in support of my hypothesis.

The similitude, between the pathetic Irish tale of Conloch, and the story of Rustam, as related by the Persian poet, Ferdusi, in his heroic poem, entitled Shah Nameh, is almost too strong to admit of its being supposed accidental. " Ferdusi relates," (I borrow the words of the ingenious Sir William Ouseley,) " that, after a sumptuous feast, " and magnificent entertainment, given, in honour of Rus- " tam, by the king of Sitemgam, to which wine and music " contributed all their charms, a couch or bed being care- " fully prepared for the Persian hero, (Rustam,) he retired " to rest; and, after a short time, was astonished at the ap- " pearance of a lovely damsel, who advanced from behind " the curtains and hangings." After a glowing description of the personal charms of the damsel, and a relation of the particulars of her conversation, with the hero, Sir William proceeds. " Of this mysterious interview, and " the subsequent union of our hero with the princess, " the result was a son, whom the king, her father, edu- " cated, after Rustam's departure, and called by the name " of Sohraùb. The youth, having learned from his mo- " ther, the strange circumstances of his birth, and of " Rustam's fame, resolved to set out, in quest of adven- " tures, and immediately commenced a series of brave " and gallant actions. But being so unfortunate, as to " encounter his own father, each ignorant of his relation

" to

" to the other, the issue of the combat proved fatal to " Sohraùb; who did not, however, expire, until it was " discovered that he fell by a parent's hand. The circum- " stances attending this discovery, the dying words, and " filial affection, of the ill-fated youth, and the father's " vehement affliction and distress, afford the poet, Ferdusi, " a fine subject, for many interesting and beautiful pas- " sages."*

Of the Irish tale, I shall now give the outlines, illustrated with extracts, from the very elegant and spirited version of Miss Brooke.† Conloch, " haughty, bold, and " brave,"

> Came to visit Erin's coast;
> Came to prove her mighty host!

Finding the Finian chiefs assembled, on some particular occasion, he hurls defiance at them, and

> While he spoke, collecting all his might,
> Fierce he addrest his conquering arms to fight;
> No stop, no stay, his furious faulchion found,
> Till his dire hand an hundred warriors bound:
> Vanquish'd, they sunk beneath his dreadful sway,
> And low on earth their bleeding glories lay.

A messenger

* Persian Miscellanies, p. 95, 97, 115.

† Reliques of Irish Poetry, p. 9—31; a work, of which Ireland has reason to be proud.

A messenger is then dispatched for Cucullin. He arrives, and challenges Conloch to single combat; but first requests he will

> To him his purpose and his name confide,
> And what his lineage and his land declare.

To this requisition, Conloch gives an unwilling refusal. He knows he is about to raise his arm against a parent; but his honour, as a knight, will not allow him to decline the combat, or declare his name.

> Reluctant, then, the chiefs commenc'd the fight,
> Till glowing honor rous'd their slumbering might!
> Dire was the strife each valiant arm maintain'd,
> And undecided long their fates remain'd;
> For, till that hour, no eye had ever view'd
> A field so fought, a conquest so pursu'd!
> At length Cucullin's kindling soul arose;
> Indignant shame recruited fury lends;
> With fatal aim his glittering lance he throws,
> And low on earth the dying youth extends.

Conloch, feeling the approach of death, addresses Cucullin, in the following pathetic terms.

> Approach!—the wounded youth reply'd,—
> Yet,—yet more closely nigh!
> On this dear earth,—by that dear side,
> O let me die!—

Thy hand,—my father,—hapless chief!—
And you, ye warriors of our isle, draw near,
The anguish of my soul to hear,
For I must kill a father's heart with grief.*

As this passage (a passage not inferior, perhaps, to any of those passages in the Shah Nameh, alluded to by Sir William Ouseley) exhibits a fine subject for the pencil, I shall submit it to the contemplation of the Academy; while I proceed to the relation of another Irish tale, which bears evident marks of an Oriental origin. The tale in question, is entitled, Moira Borb; of which also Miss Brooke has given a translation.

While the Finian chiefs range carelessly along the banks of the fierce Mac-bovar, or river Erne, which, in its fall, near Ballyshannon, occasions the celebrated salmon-leap, they are surprised, by the appearance of a lovely damsel, in an enchanted bark. The damsel lands, and is courteously received by the chiefs; who, observing her trembling apprehensions, enquire into the cause. She relates her story.

O! I am follow'd o'er the rolling wave!
O! mighty Finn! thy trembling suppliant save!
The son of Sora's king with wrath pursues,
The chief of spears, whose arm the host subdues!

While

* After reading this passage, we cannot wonder, that Spenser should declare, that the poems of the Irish bards "savoured of sweet wit and good "invention."

While she speaks, a mighty warrior appears, riding over the waves, upon a magic steed. Reaching the shore, he rushes forward, and seizes the trembling damsel. A combat ensues, between him and the Finian chiefs, in which he falls; and, immediately after, receives sepulchral honours. The maid continues in the camp. Miss Brooke concludes, from the following passage in the poem, that the story does not end here.

> Woe to the champions of that lovely dame!
> Woe to the land, to which her beauty came!

On these lines, she observes, in a note, "It is probable, "that this passage alludes to some subsequent conse- "quences of the death of Moira-borb." It may, therefore, be presumed, that the heroine of this poem was, like the Armida of Tasso,* a deceitful damsel, whose object was, to seduce some of the Finian chiefs from their duty; and destroy or enervate them, by female wiles, and the power of enchantment. Indeed, I am inclined to think, that the Italian and the Irish bards drew the materials, of which their respective tales are composed, from the same source. The similitude is certainly striking. That Tasso never saw the Irish tale, is highly probable;† and, if he had

* Gerusal. Liberata, Canto IV.

† It cannot be safely asserted, that the metrical tales of the Irish were known on the Continent; but it is an undoubted fact, that the Irish bards not only imitated, but sometimes translated, the French and Italian romances. An Irish version of Huon de Bourdeaux still exists. It may, however, be supposed, that the translations and imitations, to which I allude, were subsequent

had seen it, he undoubtedly could not have read it: yet, it may be presumed, it was written before he was born. Miss Brooke, on the presumptive evidence of the language, refers it to the middle ages. If, therefore, it supplied Tasso with a foundation for his beautiful episode of Armida, he must have found it in some other language; and, perhaps, under some other form. Without meaning, however, to insist on the probability of my conjecture, I shall exhibit a few parallel passages, from the two poems, and leave the reader to decide.

All' apparir della beltà novella
Nasce un bisbiglio, e'l guardo ogn'un v'intende;
Siccome là, dove Cometa, o Stella
Non più vista di giorno in ciel risplende:
E traggon tutti per veder chi sia
Sì bella pellegrina, e chi l'invia.

Argo non mai, non vide Cipro, o Delo
D'abito, o di beltà forme sì care.

Her matchless charms the wond'ring bands surprize,
Provoke their whispers, and attract their eyes;
So mortals, through the midnight fields of air,
Observe the blaze of some unusual star.
Sudden they throng to view th' approaching dame,
Eager to learn her message, and her name.
Not Argos, Cyprus, or the Delian coast, &c. HOOLE.

And,

sequent to the time of Spenser; else he would not have omitted to notice them, in his very curious and interesting account of the Irish Bards; an order of men, whose " history" (as Dr. Brown justly observes) " is, perhaps, " of all others, the most extraordinary."

And, oh, to tell the charms her form array'd!
The winning sweetness that her face display'd!
On her alone we could or think or gaze,
And our rapt souls were lost in sweet amaze. MOIRA-BORB.

Stassi l'avaro sguardo in sè raccolto,
E i tesori d'Amore, e i suoi nasconde.*

Declin'd on earth, her modest look denies,
To shew the starry lustre of her eyes. HOOLE.

Deck'd by soft love, with sweet attractive grace,
And all the charms of mind-illumin'd face;
Before our host the beauteous stranger bow'd,
And, thrown to earth, her eyes their glories shroud. MOIRA-BORB.

Donna,

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.

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Che da te si ricerca? e donde viensi?
Qual tua ventura, o nostra, or qui ti mena?

Say,

* This passage is rendered less elegantly, but more faithfully, by Mr. Doyne,—

Her spareful eyes, their brightest beams retain'd;
Love's treasure, and her own, were there conceal'd.

Doyne's translation of the Gerusalemme Liberata, which was once much read and admired, at least for its fidelity, seems to be now almost totally unknown. It is very extraordinary, however, that it should have escaped the notice of Mr. Hoole. Philip Doyne was an Irish gentleman, of taste, talents, and erudition. While he was a student in the College of Dublin, he distinguished himself by some poetical exercises. He afterwards undertook, with the assistance of his Italian master, Signor Palermo, a translation of Tasso's noble poem, in blank verse, which was published by Ewing, in 1761, in two volumes octavo. He died soon after.

Say, damsel!—
What fortune bids thee to our camp repair?
What fortune sends to us a form so fair?
What art thou? HOOLE.

Soft mariner! (the son of Cumhal cry'd,)
What chance has torn thee from protection's side?
Why com'st thou here, and from what happy earth?
And whose the noble race that gave thee birth? MOIRA-BORB.

Il tuo lodar troppo alto sale;
Nè tanto insuso il merto nostro arriva.
Cosa vedi, signor, non pur mortale,
Ma già morta ai diletti, al duol sol viva.
Mia sciagura mi spinge in loco tale,
Vergine pellegrina, e fuggitiva.
Ricorro al pio Goffredo, e in lui confido:
Tal va di sua bontate intorno il grido.

Too far thy praise extends, (she made reply,)
My merits ne'er attain'd a flight so high.
Thy eyes, O chief! a mortal wretch survey,
To pleasure dead, to grief a living prey!
Unhappy fate my footsteps hither led,
A fugitive forlorn, a wand'ring maid!
Godfrey I seek, on him my hopes depend,
Oppression's scourge, and injur'd virtue's friend. HOOLE.

Truth, O great chief! my artless story frames:
A mighty king my filial duty claims.
But princely birth no safety could bestow;
And, royal as I am, I fly from woe.

Long have I look'd, that mighty arm to see,
Which is alone of force to set me free;

To

> To Erin's far fam'd chief for aid I fly,
> And on that aid my trembling hopes rely. MOIRA-BORB.

But I shall not multiply quotations. Unwilling to trespass too long on the patience of the Academy, I shall adduce but a single instance more, in support of my position. The story of the Ring, as related by Trissino, in the Italia Liberata,* and by the author of the Irish poem of the Chase, seem to bear so close an affinity to each other, that, it may be presumed, they were raised upon the same foundation. But that foundation lies, and will, probably, ever lie, "hid in night." In both tales, we may discover the colouring of magic, with which the Saracens of the middle ages, then adepts in chemistry, tinctured all the fables, which sprung from their brilliant and creative imaginations.

Belisarius, having ordered out a detachment of his army, to watch the motions of the enemy, the warriors are met, at the entrance of the camp, by

> Una donzella
> Tanto leggiadra, e graziosa in vista,
> Ch' arebbe accesa ogni gelata mente:
> Ben' era piena di fallaci inganni.

This damsel, who appears "sconcolata e mesta," says, sighing, to the admiring chiefs,

> Voi mi parete Cavalieri eccelsi,
> Di gran valore, e di pietade adorni;

Però

* Lib. IV.

Però prendo ardimento di pregarvi,
Che m' ajutate in questo mio bisogno.
Io fui figliuola già d' una gran donna,
Signora del paese di Bitonte,
Che maritommi al Duca di Crotone,
E diedemi per dote un solo anello
Di pregio estremo, e di valore immenso:
Questo avea tal virtù, che s' io il basciava,
E poi toccava ogni qualunque cosa,
Quella si convertiva in seta, o in oro,
O in tutto quel, ch' i' avea dentr' al pensiero.
Or' io tornando al dolce mio terreno,
Per rivedere i miei, con questo anello,
Ch' io nol lasciava mai da me lontano;
Passai vicina ad una bella fonte;
E veduta, ch' io l' ebbi, ivi discesi
Per bere, e l' anel presi, e lo basciai,
Volendo farmi un' ottima bevanda:
Ma mentre che volea toccar con esso
L' acqua del fonte, e trarmi ivi la sete,
Mi sopravenne un Cavalier armato
Con dui giganti; e con orribil voce
Sì mi sgridaro, ch' io lasciai l' anello
Cadermi per timor nella fontana:
Poi quei crudeli mi tiraro indietro,
Nè voller più, ch' io, m' appressasse ad essa;
Ond' io, per non lasciar sì ricca gioja,
Quì mi rimasi, e vo cercando ajuto:
E s' alcun mi sarà tanto cortese,
Ch' atterri il Cavaliere, ond' io racquisti
La mia sì cara, e prezioso gemma;
I' sarò più di lui, che di me stessa.

Yielding to her requisition, the chiefs attend her to the lake or fountain, where they find an armed knight, the son of an enchantress, ready to receive them. They engage in combat with him. They are vanquished, and led away prisoners to the palace of the enchantress, under the guard of the two giants mentioned by the artful damsel. It is not necessary, for our present purpose, to relate the adventures which followed; I shall only observe, that the waters of the fountain, into which the damsel pretended she had dropped her ring, were endued with miraculous powers.

Chiunque beve
Di sì dolce acqua, tutto si risana;
Onde è detta la fonte del Sanajo.

Let us now turn to the Irish tale.*

During a feast, given in the hall of Almhain to the Finian chiefs, Finn steals from the festive board "to breathe "the fragrant gale." An enchanted doe suddenly appears before him. He calls his dogs, and pursues her to Slieve-Guillin, where she instantly vanishes. Finn then looking around, discovers, near a small lake,

A weeping fair,
Upon a bank reclin'd,
In whose fine form, and graceful air,
Was every charm combin'd.

* Reliques of Irish Poetry, page 73.

The chief approaches the fair mourner, and addresses her,

Hast thou, sweet maid! of golden hair!
  Beheld my hounds in chase?

She replies,

Thy chase, O king, was not my care;
  I nothing of it know;
Far other thoughts my bosom share,
  The thoughts, alas, of woe!

* * *

Alas, my ring, for whose dear sake
  These ceaseless tears I shed,
Fell from my finger, in the lake,
  (The soft-hair'd virgin said.)

Let me conjure thee, generous king!
  Compassionate as brave,
Find for me now my beauteous ring,
  That fell beneath the wave.

The tale proceeds:

Scarce was the soft entreaty made,
  Her treasure to redeem,
When his fair form he disarray'd,
  And plung'd into the stream.

At the white-handed fair's request,
  Five times the lake he try'd;
On ev'ry side his search address'd,
  Till he the ring descry'd.

But when he sought the blooming maid,
  Her treasure to restore;
His powers were gone,—he scarce could wade
  To reach the distant shore!

That form, where strength and beauty met,
  To conquer or engage,
Paid, premature, its mournful debt,
  To grey and palsied age.

Finn is soon afterwards found by his chiefs, in the state described by the poet. They draw the enchantress from a cave, in which she had concealed herself, and oblige her, by threats, to disenchant their leader. She presents him with a medicated cup. He drinks, and immediately

His former grace,
  His former powers return'd;
Again with beauty glow'd his face,
  His breast with valour burn'd.

I shall now conclude. I have not the vanity to think, that I have established my hypothesis; but, I flatter myself, I have thrown out a hint, which may lead to a curious and interesting investigation by some abler hand.

POSTSCRIPT.

SINCE writing the above slight essay, it has occurred to me, that it might be observed that the story of Armida originates from that of Circe. I grant it might, with much appearance of probability, be traced to that source,—the fountain whence the Alcina of Ariosto, and the Acrasia of Spencer sprung. But circumstances may be found, in the story of Armida, and in the tale of Moira-Borb, which Homer certainly did not supply, and which may be discovered in the Oriental writers. I do not, however, insist on my hypothesis. I merely throw out a hint for investigation.—I might have urged the probability of the Irish bards being descendants of an Oriental colony; and inheriting, of course, the inventive faculties peculiar to the East: but I have studiously avoided every assertion, or conjecture, that could lead to controversy. I have no system to support.

END OF VOL. X.

[illegible] of [illegible] [illegible] abidhgida
[illegible] of Chas [illegible] much
[illegible] bility, [illegible]

than [illegible] cannot supply, [illegible] covered in the Oriental writers. I do not, [illegible] on my hypothesis, [illegible]

hands being [illegible] Oriental [illegible] writings, of course, the inventive faculties [illegible] that I have [illegible] conjecture, that would [illegible] I have no system to support.